



**RWE Renewables UK Dogger Bank  
South (West) Limited**

**RWE Renewables UK Dogger Bank  
South (East) Limited**

## **Dogger Bank South Offshore Wind Farms**

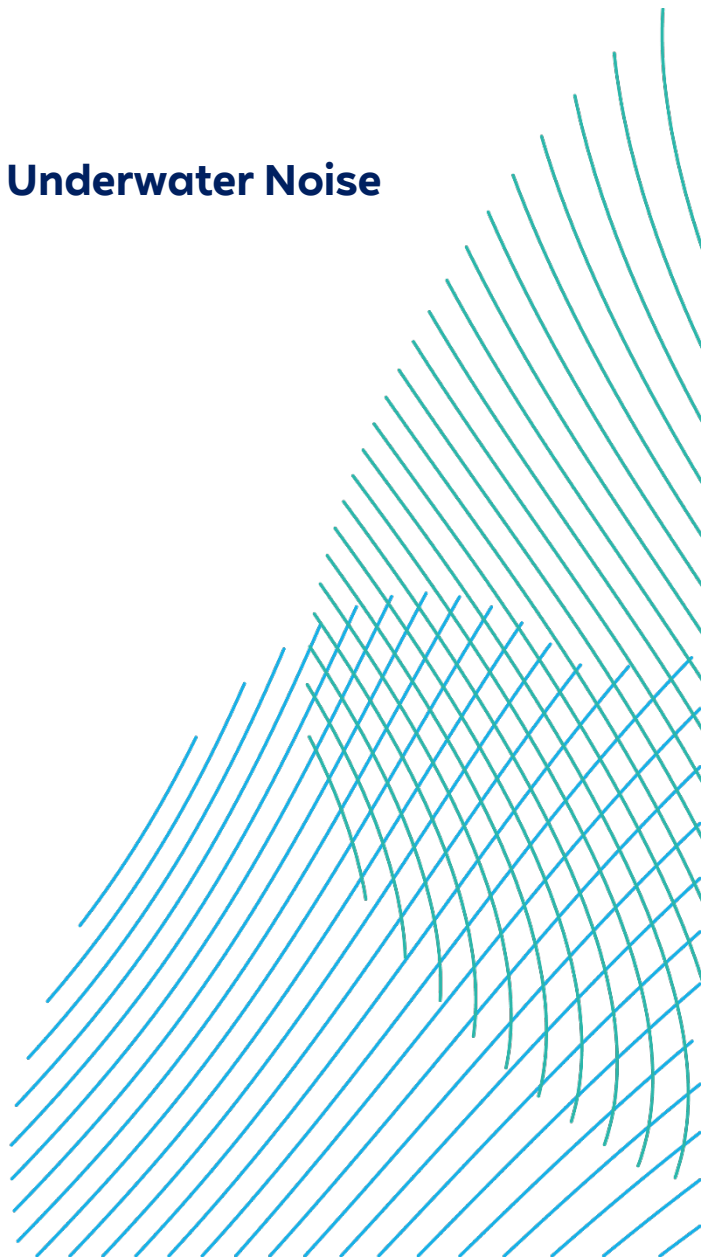
**Appendix 11.3 Marine Mammal Underwater Noise  
Impact Assessment**

**27/04/2023**

**Document Reference: 004300119**

**Revision: 04**

**Unrestricted**





|                                   |                                                                                                                                  |                                 |                                |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------------------|
| Company:                          | <b>RWE Renewables UK<br/>Dogger Bank South (West)<br/>Limited and RWE<br/>Renewables UK Dogger<br/>Bank South (East) Limited</b> | Asset:                          | <b>Development</b>             |
| Project:                          | <b>Dogger Bank South<br/>Offshore Wind Farms</b>                                                                                 | Sub<br>Project/Package:         | <b>Consents</b>                |
| Document Title or<br>Description: | Appendix 11.3 Marine Mammal Underwater Noise Impact Assessment                                                                   |                                 |                                |
| Document Number:                  | 004300119-04                                                                                                                     | Contractor<br>Reference Number: | PC2340-RHD-OF-ZZ-<br>RP-Z-0051 |

*The document Originator shall complete this Cover Sheet and may give guidance below on any actions required by the recipient(s). The document Checker and Approver must not be the same person. The Document Author and Approver must not be the same person. The Approver must not be less senior than the Author.*

*COPYRIGHT © RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited.*

*All pre-existing rights reserved.*

*This document is supplied on and subject to the terms and conditions of the Contractual Agreement relating to this work, under which this document has been supplied, in particular:*

#### **LIABILITY**

*In preparation of this document RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited has made reasonable efforts to ensure that the content is accurate, up to date and complete for the purpose for which it was contracted. RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited makes no warranty as to the accuracy or completeness of material supplied by the client or their agent.*

*Other than any liability on RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited detailed in the contracts between the parties for this work RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited shall have no liability for any loss, damage, injury, claim, expense, cost or other consequence arising as a result of use or reliance upon any information contained in or omitted from this document.*

*Any persons intending to use this document should satisfy themselves as to its applicability for their intended purpose.*

*The user of this document has the obligation to employ safe working practices for any activities referred to and to adopt specific practices appropriate to local conditions.*

| <b>Rev No.</b> | <b>Date</b> | <b>Status/Reason for<br/>Issue</b> | <b>Author</b> | <b>Checked by</b> | <b>Approved<br/>by</b> |
|----------------|-------------|------------------------------------|---------------|-------------------|------------------------|
| 01             | 15/03/2023  | First Issue                        | AS/SB         | HC                | AP                     |
| 02             | 04/04/2023  | Second Issue                       | SB            | AS                | HC                     |
| 03             | 24/04/2023  | Third Issue                        | LL            | AS                | HC                     |
| 04             | 27/04/2023  | Final Issue                        | LL            | CC                | AC                     |

**Unrestricted**

## Contents

|                                                                                                                                                                     |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 11. Marine Mammal Underwater Noise Assessment .....                                                                                                                 | 4   |
| 11.1. Introduction.....                                                                                                                                             | 4   |
| 11.2. Underwater noise modelling .....                                                                                                                              | 4   |
| 11.2.1. Methodology of underwater noise modelling .....                                                                                                             | 4   |
| 11.2.1.1. Underwater noise .....                                                                                                                                    | 5   |
| 11.2.1.2. Piling locations .....                                                                                                                                    | 5   |
| 11.2.1.3. Soft-start and hammer energy profiles.....                                                                                                                | 7   |
| 11.2.1.4. Noise source levels.....                                                                                                                                  | 8   |
| 11.2.1.5. Environmental conditions.....                                                                                                                             | 9   |
| 11.2.1.6. Sequential piling .....                                                                                                                                   | 9   |
| 11.2.1.7. Concurrent piling.....                                                                                                                                    | 9   |
| 11.2.1.8. Baseline noise levels .....                                                                                                                               | 10  |
| 11.2.1.9. Marine mammal impact thresholds .....                                                                                                                     | 10  |
| 11.2.1.10. Fleeing receptors .....                                                                                                                                  | 13  |
| 11.2.1.11. Assumptions and limitations .....                                                                                                                        | 14  |
| 11.3. Assessment of underwater noise effects from piling .....                                                                                                      | 17  |
| 11.3.1. Assessment for permanent auditory injury (PTS).....                                                                                                         | 17  |
| 11.3.1.1. Assessment of the potential for permanent auditory injury (PTS) from monopiles at a single piling location.....                                           | 17  |
| 11.3.1.1. Assessment of the potential for permanent auditory injury (PTS) from monopiles due to concurrent piling at multiple pile locations.....                   | 41  |
| 11.3.1.2. Assessment of the potential for permanent auditory injury (PTS) from pin pile jacket foundations at a single piling location.....                         | 47  |
| 11.3.1.3. Assessment of the potential for permanent auditory injury (PTS) from pin pile jacket foundations due to concurrent piling at multiple pile locations..... | 69  |
| 11.3.2. Assessment for a temporary auditory injury (Temporary Threshold Shift (TTS)).....                                                                           | 77  |
| 11.3.2.1. Assessment of the potential for temporary auditory injury (TTS) from monopiles at a single piling location.....                                           | 77  |
| 11.3.2.2. Assessment of the potential for temporary auditory injury (TTS) from monopiles due to concurrent piling at multiple pile locations.....                   | 106 |
| 11.3.2.3. Assessment of the potential for temporary auditory injury (TTS) from pin pile jacket foundations at a single piling location.....                         | 113 |

|                                                                                                                                                                     |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 11.3.2.4. Assessment of the potential for temporary auditory injury (TTS) from pin pile jacket foundations due to concurrent piling at multiple pile locations..... | 141 |
| 11.4. Assessment of underwater noise effects from other construction activities....                                                                                 | 150 |
| 11.4.1. Underwater noise modelling .....                                                                                                                            | 150 |
| 11.4.2. Assessment for auditory injury (TTS) for a single activity .....                                                                                            | 151 |
| 11.4.3. Assessment for auditory injury for multiple activities .....                                                                                                | 164 |
| 11.4.4. Assessment for disturbance by other construction activity .....                                                                                             | 173 |
| 11.5. Assessment of underwater noise effects from vessels (all phases) .....                                                                                        | 184 |
| 11.5.1. Underwater Noise Modelling .....                                                                                                                            | 184 |
| 11.5.2. Assessment for auditory injury for one vessel .....                                                                                                         | 184 |
| 11.5.1. Assessment for auditory injury (TTS) for multiple vessels .....                                                                                             | 195 |
| 11.5.2. Assessment for disturbance by vessel activity.....                                                                                                          | 227 |
| 11.6. Assessment of underwater noise effects from operational turbine noise .....                                                                                   | 270 |
| 11.6.1. Assessment for an auditory injury (TTS) from a single wind turbine .....                                                                                    | 270 |
| 11.6.2. Assessment for auditory injury for multiple wind turbines .....                                                                                             | 279 |

## Tables

|                                                                                                                                                                                                                                                                                                                                                                                                                        |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Table 11-1 Hammer energy and ramp up used for the monopile foundation modelling .....                                                                                                                                                                                                                                                                                                                                  | 7  |
| Table 11-2 Hammer energy and ramp up used for the pin pile jacket foundation modelling .....                                                                                                                                                                                                                                                                                                                           | 8  |
| Table 11-3 Unweighted $SPL_{peak}$ and $SEL_{SS}$ source levels used in underwater noise modelling for monopile and pin pile jacket foundation.....                                                                                                                                                                                                                                                                    | 8  |
| Table 11-4 Southall et al. (2019) thresholds and criteria used in the underwater noise modelling assessments .....                                                                                                                                                                                                                                                                                                     | 12 |
| Table 11-5 Underwater noise assessment for the potential of PTS onset from a single strike from the maximum hammer energy of a monopile ( $SPL_{peak}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold) ..... | 18 |
| Table 11-6 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation of one monopile in a 24 hour period ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas including all potential density estimates and reference populations .....                                                                                                    | 26 |
| Table 11-7 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation of two sequentially installed monopiles in a 24 hour period ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array including all potential density estimates and reference populations (density estimates and reference                                                       |    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 33 |
| Table 11-8 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation from a single strike from the maximum hammer energy of two sequentially installed piles at DBS East (South location), DBS West (West location) and a single pile at DBS East/West (Centre location) ( $SEL_{cum}$ ), including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold) | 43 |
| Table 11-9 Underwater noise assessment for the potential of PTS onset from a single strike from the maximum hammer energy of a pin pile jacket foundation ( $SPL_{peak}$ ) at the worst case modelling location for the DBS array areas including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                                                                       | 48 |
| Table 11-10 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation of a single pile of a pin pile jacket foundation ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                                                      | 55 |
| Table 11-11 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation of four sequentially installed piles of a pin pile jacket foundation ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                                  | 62 |
| Table 11-12 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation from a single strike from the maximum hammer energy of two sequentially installed piles at DBS East (South location), DBS West (West location) and a single pile at Centre location ( $SEL_{cum}$ ), including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                | 71 |
| Table 11-13 Underwater noise assessment for the potential of TTS onset from a single strike from the maximum hammer energy of a monopile ( $SPL_{peak}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                                                                                       | 78 |
| Table 11-14 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation of one monopile in a 24 hour period ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference                                                                                                                                                                                                                                     | 88 |
| Table 11-15 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation of two sequentially installed monopiles in a 24 hour period ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference                                                                                                                                                                |    |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 97  |
| Table 11-16 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation from a single strike from the maximum hammer energy of two sequentially installed piles at DBS East (South location), DBS West (West location) and a single pile at DBS East/West (Centre location) ( $SEL_{cum}$ ), including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                    | 107 |
| *Table 11-17 Underwater noise assessment, based on the results of the modelling at the three locations, added together: potential of TTS onset from the cumulative exposure of sequential piling of two sequentially installed piles at DBS East (South location), DBS West (West location) and a single pile at DBS East/West (Centre location) ( $SEL_{cum}$ ) including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                  | 110 |
| Table 11-18 Underwater noise assessment for the potential of TTS onset from a single strike from the maximum hammer energy of a pin pile jacket foundation ( $SPL_{peak}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                                                                                                                         | 114 |
| Table 11-19 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation of a single pile of a pin pile jacket foundation ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array, including all potential density estimates and reference populations                                                                                                                                                                                                                                                                      | 125 |
| Table 11-20 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation of four sequentially installed piles of a pin pile jacket foundation ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                                                                                            | 133 |
| Table 11-21 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation from a single strike from the maximum hammer energy of four sequentially installed piles at each of the locations: DBS East (South location), DBS West (West location) and the Centre location ( $SEL_{cum}$ ), including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)                                                         | 142 |
| Table 11-22 Underwater noise assessment for the potential of TTS onset due to cable laying, suction dredging, trenching and rock placement ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area for bottlenose dolphin, common dolphin, white-beaked dolphin, minke whale, grey seal, and harbour seal, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold) | 152 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Table 11-23 Underwater noise assessment for the potential of TTS onset due to cable laying, suction dredging, trenching and rock placement ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area harbour porpoise including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                                                                                                          | 159 |
| Table 11-24 Underwater noise assessment for the potential of TTS onset due to cable laying, suction dredging, trenching and rock placement undertaken at the same time ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                                                                                          | 165 |
| Table 11-25 Assessment for disturbance due to cable laying, suction dredging, trenching and rock placement undertaken at the same time ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area for harbour porpoise, bottlenose dolphin, common dolphin, white-beaked dolphin, minke whale, grey seal, and harbour seal, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)..... | 174 |
| Table 11-26 Underwater noise assessment for the potential of TTS onset due to the presence of one construction vessel ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                                                                                                                                                 | 185 |
| Table 11-27 Underwater noise assessment for the potential of TTS onset due to the presence of 66 construction vessels ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                                                                                                                                            | 196 |
| Table 11-28 Underwater noise assessment for the potential of TTS onset due to the presence of 132 construction vessels ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                                                                                                                                           | 204 |
| Table 11-29 Underwater noise assessment for the potential of TTS onset due to the presence of 11 Operation & Maintenance vessels ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                                                                                                                                 | 211 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Table 11-30 Underwater noise assessment for the potential of TTS onset due to the presence of 21 Operation & Maintenance vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....         | 219 |
| Table 11-31 Assessment for disturbance by the potential disturbance due to the presence of one construction vessel ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                  | 228 |
| Table 11-32 Assessment for disturbance by the potential disturbance due to the presence of 66 construction vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                  | 236 |
| Table 11-33 Assessment for disturbance by the potential disturbance due to the presence of 132 construction vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                 | 244 |
| Table 11-34 Underwater noise assessment for the potential disturbance due to the presence of 11 Operation & Maintenance vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area for harbour porpoise, bottlenose dolphin, common dolphin, white-beaked dolphin, minke whale, grey seal, and harbour seal, including all potential density estimates and reference populations..... | 253 |
| Table 11-35 Underwater noise assessment for the potential disturbance due to the presence of 21 operation & maintenance vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference.....                                                                                                                                       | 261 |
| Table 11-36 Underwater noise assessment for the potential of TTS onset from the operation of one wind turbine ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridors and the Offshore Development Area including all potential density estimates and reference populations.....                                                                                                                                        | 271 |
| Table 11-37 Underwater noise assessment for the potential of TTS onset from the operation of 100 wind turbines ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold).....                 | 280 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Table 11-38 Assessment for disturbance through the operation of 200 wind turbines (SEL <sub>cum</sub> ) at the worst case modelling location for the DBS array areas, export cable corridors and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold) ..... | 288 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|

### Plates

|                                                                                                                                                                                                                                    |    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Plate 11-1 Approximate positions of the modelling locations at DBS.....                                                                                                                                                            | 6  |
| Plate 11-2 Example of the effect of a fleeing animal on the exposure to cumulative underwater noise ( <b>Appendix 11-2</b> ).....                                                                                                  | 14 |
| Plate 11-3 Contour plots for PTS (shown in red) and TTS onset (shown in yellow) due to the simultaneous installation of monopiles at the North and South modelling locations ( <b>Appendix 11-2</b> ).....                         | 42 |
| Plate 11-4 Contour plots for PTS (shown in red) and TTS onset (shown in yellow) due to the concurrent installation of pin pile jacket foundations at three locations across DBS modelling locations ( <b>Appendix 11-2</b> ) ..... | 70 |

## Glossary

| Term                            | Definition                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Array Areas                     | The DBS East and DBS West offshore array areas, where the wind turbines and array cables will be located. The array areas do not include the offshore export cable corridor.                                                                                                                                                                                                   |
| Array Cables                    | Cables which link the wind turbine generators to the offshore substation/converter/collector platform(s).                                                                                                                                                                                                                                                                      |
| Offshore Development Area       | The Offshore Development Area encompasses the wind farm site and the options for the offshore transmission works.                                                                                                                                                                                                                                                              |
| Offshore Export Cable Corridor  | This is the area which will contain the offshore export cables (and potentially the ESP and / or RCP) between the offshore substation/converter platforms and Transition Joint Bays at the landfall.                                                                                                                                                                           |
| Offshore Export Cables          | The cables which would bring electricity from the offshore substation platform(s) to the landfall.                                                                                                                                                                                                                                                                             |
| Offshore Substation Platform(s) | Offshore Substation Platforms (OSPs) will be required for the HVAC option. These are fixed structures located within the array areas that contain electrical equipment to aggregate the power from the wind turbines, followed by conversion into a more suitable voltage for transmission through the offshore export cables to the Project's onshore grid connection points. |
| Permanent Threshold Shift (PTS) | A permanent total or partial loss of hearing 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.                                                                                                                                                                             |
| Root Mean Square (RMS)          | The square root of the arithmetic average of a set of squared instantaneous values. Used for presentation of an average sound pressure level.                                                                                                                                                                                                                                  |

| Term                                                     | Definition                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sound Exposure Level (SEL)                               | The constant sound level acting for one second, which has the same amount of acoustic energy, as indicated by the square of the sound pressure, as the original sound. It is the time-integrated, sound-pressure-squared level. SEL is typically used to compare transient sound events having different time durations, pressure levels, and temporal characteristics. |
| Sound Exposure Level, cumulative (SEL <sub>cum</sub> )   | Single value for the collected, combined total of sound exposure over a specified time or multiple instances of a noise source.                                                                                                                                                                                                                                         |
| Sound Exposure Level, single strike (SEL <sub>ss</sub> ) | Calculation of the sound exposure level representative of a single noise impulse, typically a pile strike.                                                                                                                                                                                                                                                              |
| Sound Pressure Level (SPL)                               | The sound pressure level is an expression of sound pressure using the decibel (dB) scale; the standard frequency pressures of which are 1 µPa for water and 20 µPa for air.                                                                                                                                                                                             |
| Sound Pressure Level Peak (SPL <sub>peak</sub> )         | The highest (zero-peak) positive or negative sound pressure, in decibels.                                                                                                                                                                                                                                                                                               |
| The Projects                                             | DBS East and DBS West (collectively referred to as the Dogger Bank South offshore wind farms).                                                                                                                                                                                                                                                                          |
| Transition Joint Bay                                     | The Transition Joint Bay (TJB) is an underground structure at the landfall that houses the joints between the offshore export cables and the onshore export cables.                                                                                                                                                                                                     |

## Acronyms

| Term    | Definition                                   |
|---------|----------------------------------------------|
| ADD     | Acoustic Deterrent Device                    |
| dB      | Decibel                                      |
| EMODnet | European Marine Observation and Data Network |
| HF      | High-frequency                               |
| Hz      | Hertz                                        |
| kJ      | kilojoule                                    |
| LF      | Low-frequency                                |
| m       | metre                                        |
| m/s     | Metres per second                            |
| NMFS    | National Marine and Fisheries Service        |
| OSP     | Offshore Substation Platform                 |
| PCW     | Phocid carnivores in water                   |
| PTS     | Permanent Threshold Shift                    |
| RMS     | Root mean square                             |
| SEL     | Sound exposure level                         |
| SPL     | Sound pressure level                         |
| TTS     | Temporary Threshold Shift                    |
| UXO     | Unexploded Ordinance                         |
| VHF     | Very high-frequency                          |

## 11. Marine Mammal Underwater Noise Assessment

### 11.1. Introduction

1. This Appendix details the underwater noise modelling that has been undertaken for Dogger Bank South (DBS) East and DBS West offshore wind farms, collectively known as DBS offshore wind farms, and the resultant assessment of effect to each of the marine mammal populations assessed.

### 11.2. Underwater noise modelling

2. Underwater noise modelling was carried out by Subacoustech Environmental Ltd to estimate the noise levels likely to arise during noisy activities and determine the potential impacts on marine mammals using the INSPIRE v5.1 (Impulsive Noise Propagation and Impact Estimator) subsea noise propagation model (**Appendix 12.2**). The INSPIRE model is a semi-empirical noise propagation model based on the use of a combination of numerical modelling and actual measured underwater noise data. It was designed to calculate the propagation of noise in shallow, mixed water, typical of both conditions around the UK. The INSPIRE model has been validated against over 80 datasets of underwater noise propagation from the monitoring of underwater noise at offshore piling activities. See **section 4-1** of **Appendix 11-2** for more information on the validation process.
3. The modelling for piling considers a wide array of input parameters, including variations in bathymetry and source frequency content to ensure accurate results for the DBS sites. It should also be noted that the results presented in this assessment are precautionary, as the worst case parameters have been selected for all relevant parameters, including;
  - Piling hammer energies;
  - Soft-start, ramp-up profiles, and strike rate;
  - The duration of piling; and
  - Receptor swim speeds.
4. The modelling for other noisy activities (including other construction activities, operation and maintenance activities, Unexploded Ordinance (UXO) clearance, and vessels) uses a simple modelling approach.

#### 11.2.1. Methodology of underwater noise modelling

5. The key parameters used within the underwater noise modelling are described in detail below. More information can be found within **Appendix 11-2**.

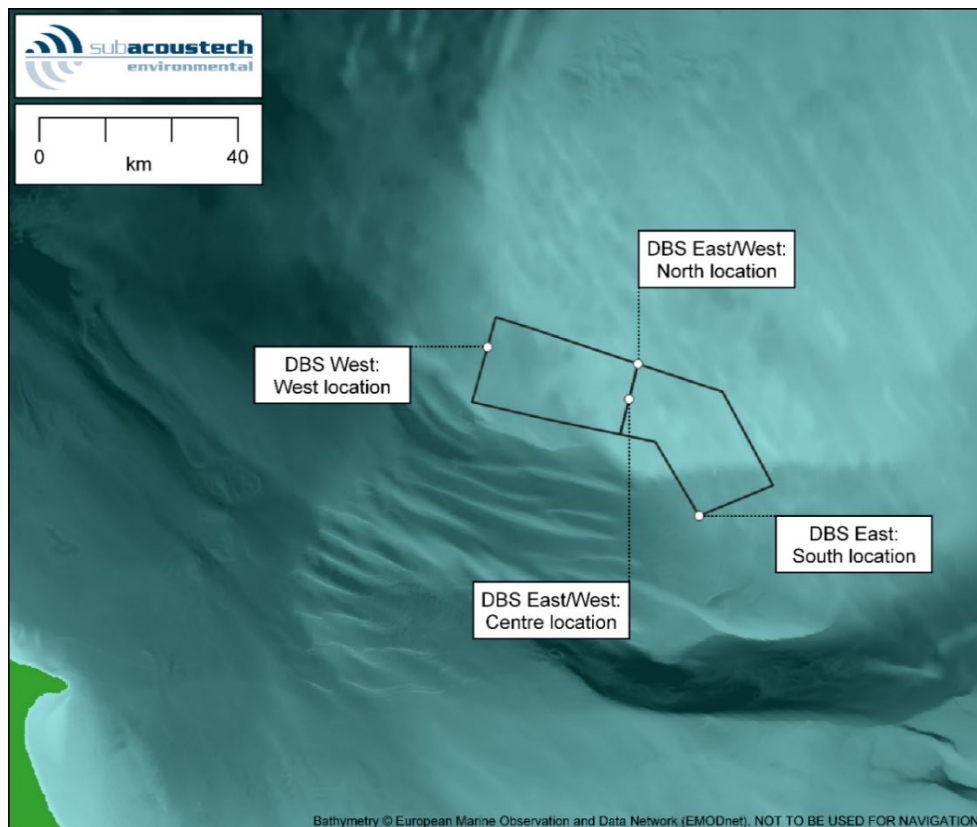
## 11.2.1.1. Underwater noise

6. Sound measurements underwater are usually expressed using the decibel (dB) scale, which is a logarithmic measure of sound.
7. The sound pressure level (SPL) is normally used to characterise noise and vibration of a continuous nature. The variation in sound pressure can be measured over a specific time period to determine the root mean square (RMS) level of the time varying acoustic pressure, therefore SPL (i.e.  $SPL_{RMS}$ ) can be considered as a measure of the average unweighted level of the sound over the measurement period. Peak SPLs ( $SPL_{peak}$ ) are often used to characterise sound transients from impulsive sources, such as percussive impact piling. A peak SPL is calculated using the maximum variation of the pressure from positive to zero within the wave. This represents the maximum change in positive pressure (differential pressure from positive to zero) as the transient pressure wave propagates.
8. The sound exposure level (SEL) sums the acoustic energy over a measurement period, and effectively takes account of both the SPL of the sound source and the duration the sound is present in the acoustic environment (further details are provided in **Appendix 11-2**).  $SEL_{ss}$  is the potential sound exposure level from a single strike of the hammer, e.g. one hammer strike at the starting hammer energy or maximum hammer energy applied.  $SEL_{cum}$  is the cumulative sound exposure level during the total duration of piling, including the soft-start, and time required to complete the installation of the pile.

## 11.2.1.2. Piling locations

9. Modelling has been undertaken at four representative locations, covering the extent of the Dogger Bank South array areas, with two positions modelled within both the DBS East and DBS West array area. These modelling locations include the deepest point of the sites (typically the worst case location; i.e. the deepest location where piling can take place, which tends to give the greatest noise propagation) (**Plate 11-1; Appendix 11-2**):
  - South location;
    - located at the southernmost extent of the DBS East site, the closest point to the deep water Outer Silver Pit to the south;
    - Water depth of 33.0m;
  - West location;
    - located along the eastern edge of the DBS West site, closest to the deep water to the west of the DBS site;
    - Water depth of 34.7m;

- North location;
  - a shared second location at the northern corner of the two DBS sites' shared boundary; the northwest corner of DBS East and the northeast corner of DBS West;
  - Water depth of 16.1m;
- Centre location;
  - a shared location at the centre of the two DBS sites' shared boundary; the western edge corner of DBS East and the eastern edge of DBS West, used for the concurrent piling scenarios (see section 11.2.1.8) and represents a position for an offshore platform.
  - Water depth of 14.3m.



*Plate 11-1 Approximate positions of the modelling locations at DBS*

10. The assessments are based on the largest impact ranges modelled at any of these four locations (for DBS East this was the south location and for DBS West this was the west location in all modelling results) and was used to inform the assessment of the maximum potential impacts on receptor groups, in order to provide a conservative assessment.

## 11.2.1.3. Soft-start and hammer energy profiles

11. The underwater noise modelling was based on the following worst case scenarios for monopiles and pin pile jacket foundations;
  - A monopile foundation scenario, installing a 17m diameter pile with a maximum blow energy of 7,000kJ; and
  - A pin pile jacket foundation scenario, installing a 4.2m diameter pile with a maximum blow energy of 3,000kJ.
12. To determine the potential for permanent auditory injury (Permanent Threshold Shift (PTS)) or temporary auditory injury (Temporary Threshold Shift (TTS)) from  $SEL_{cum}$ , the soft-start, hammer energy profile, total active piling duration, and strike rate are taken into account. The soft-start takes place over the first 30 minutes of piling, which includes low-energy blows (at the starting hammer energy) for 10 minutes, followed by a gradual increase (ramp-up) to the maximum hammer energy required to safely install the pile.
13. As a worst case scenario, it is assumed that all piles installed will require 100% of the maximum hammer energy, however, maximum hammer energy is only likely to be required at a few of the piling installation locations, and for shorter periods of time.
14. The low-energy blows, ramp-up, and piling duration used to assess  $SEL_{cum}$  for both monopiles and pin-piles are summarised in **Table 11-1** and **Table 11-2**.

Table 11-1 Hammer energy and ramp up used for the monopile foundation modelling

| Hammer energy / piling parameters                                                              | 1,050kJ   | 1,750kJ   | 3,500kJ | 5,250kJ | 7,000kJ          |
|------------------------------------------------------------------------------------------------|-----------|-----------|---------|---------|------------------|
| No. of strikes                                                                                 | 100       | 800       | 800     | 800     | 5,000            |
| Duration                                                                                       | 10 mins   | 20 mins   | 20 mins | 20 mins | 4 hours, 10 mins |
| Strike rate                                                                                    | 10 bl/min | 40 bl/min |         |         | 20 bl/min        |
| 7,500 strikes over 5 hours 20 mins per pile / 15,000 strikes over 10 hours 40 mins for 2 piles |           |           |         |         |                  |

Table 11-2 Hammer energy and ramp up used for the pin pile jacket foundation modelling

| Hammer energy / piling parameters                                                              | 450kJ     | 750kJ     | 1,500kJ | 2,250kJ | 3,000kJ   |
|------------------------------------------------------------------------------------------------|-----------|-----------|---------|---------|-----------|
| No. of strikes                                                                                 | 100       | 800       | 800     | 800     | 2,400     |
| Duration                                                                                       | 10 mins   | 20 mins   | 20 mins | 20 mins | 2 hours   |
| Strike rate                                                                                    | 10 bl/min | 40 bl/min |         |         | 20 bl/min |
| 4,900 strikes over 3 hours 10 mins per pile / 19,600 strikes over 12 hours 40 mins for 4 piles |           |           |         |         |           |

#### 11.2.1.4. Noise source levels

15. Underwater noise modelling requires knowledge of the source level, which is the theoretical noise level at 1m from the noise source. The INSPIRE noise propagation model assumes that the noise acts as a single point source. The source level is estimated based on the pile diameter and the hammer energy imparted on the pile by the hammer. This is then adjusted depending on the water depth at the modelling location to allow for the length of pile in contact with the water, which can affect the amount of noise that is transmitted from the pile into its surroundings; therefore, there are small differences in the source levels at each of the four modelling locations (further information is provided in **Appendix 11-2**).
16. The unweighted  $SPL_{peak}$  and  $SEL_{ss}$  source levels estimated for this assessment are summarised in **Table 11-3**.

Table 11-3 Unweighted  $SPL_{peak}$  and  $SEL_{ss}$  source levels used in underwater noise modelling for monopile and pin pile jacket foundation

| Source levels      | Location | Monopile foundation<br>17m / 7,000 kJ      | Pin pile jacket foundation<br>4.2m / 3,000 kJ |
|--------------------|----------|--------------------------------------------|-----------------------------------------------|
| Unwtd $SPL_{peak}$ | South    | 243.2 dB re 1 $\mu$ Pa @ 1m                | 241.7 dB re 1 $\mu$ Pa @ 1m                   |
|                    | West     |                                            | 241.5 dB re 1 $\mu$ Pa @ 1m                   |
|                    | North    |                                            |                                               |
|                    | Centre   |                                            |                                               |
| Unwtd $SEL_{ss}$   | South    | 224.4 dB re 1 $\mu$ Pa <sup>2</sup> s @ 1m | 222.2 dB re 1 $\mu$ Pa <sup>2</sup> s @ 1m    |
|                    | West     |                                            |                                               |
|                    | North    |                                            |                                               |
|                    | Centre   |                                            |                                               |

## 11.2.1.5. Environmental conditions

17. The inclusion of measured data for similar offshore piling operations in UK waters allows the INSPIRE model to intrinsically account for various environmental conditions. This includes the differences that can occur with the temperature and salinity of water as well as the sediment type surrounding the site. Data from the European Marine Observation and Data Network (EMODnet) geology study show that the seabed surrounding the Projects is generally made up of sandy gravel.
18. Digital bathymetry, also from the EMODnet, has been used for this modelling, and mean tidal depth has been used throughout (**Appendix 11-2**).

## 11.2.1.6. Sequential piling

19. Underwater noise modelling has been undertaken to cover the possible option for more than one pile to be installed, one after the other, in the same 24-hour period. The modelling was based on the worst case for two monopiles installed sequentially, or four pin-piles installed sequentially at each modelling location.
20. Due to the uncertainty of what a receptor will do between piling operations it has been assumed that any additional piling will occur immediately after the previous installation, with no pause.
21. A fleeing receptor, such as marine mammals, will have travelled away from the noise source by the time the second pile installation starts, and as such increases in noise level compared to a single installation are not as pronounced when compared to simultaneous piling (see **Appendix 11-2** for further information).

## 11.2.1.7. Concurrent piling

22. Underwater noise modelling has been carried out to investigate the potential impacts of three piling installations occurring simultaneously at separated foundation locations across DBS East and DBS West, based on the following worst case scenarios:
  - Installation of two sequentially installed monopiles at the DBS East: South location and DBS West: West location with a single pile installed at the DBS East/West: Central location for an offshore platform; and
  - Installation of four sequentially installed piles at the DBS East: South location and DBS West: West location with four piles installed at the DBS East/West: Central location for an offshore platform.

23. The simultaneous piling modelling uses the three locations as the piling locations as they are the furthest apart, and would represent the worst case in terms of potential cumulative exposure effect areas.
24. All simultaneous modelling assumes that the three piling operations start at the same time.
25. When considering  $SEL_{cum}$  modelling, piling from multiple sources has the ability to increase impact ranges and areas significantly, as it triples the number of pile strikes (see **Appendix 11-2** for further information).

### 11.2.1.8. Baseline noise levels

26. Ambient noise measurements for UK coastal waters indicates that noise levels are generally 95 to 120 dB re 1  $\mu$ Pa (maximum third-octave band), with the peak noise levels occurring in the tens of Hz, to 100s of Hz (Nedwell *et al.* 2007; Theobald *et al.* 2010; Robinson *et al.* 2011).
27. There is minimal available background noise information for the Dogger Bank area of the North Sea. At the Hornsea development areas, ambient noise levels were, with isolated exceptions, recorded between 114 dB and 134 dB re 1  $\mu$ Pa  $SPL_{RMS}$ . This survey was undertaken in 2020 and represents the best estimate of subsea noise levels in this region prior to installation.
28. Two primary sources influence the noise levels: flow-related noise associated with tides moving material on the seabed and vessel noise. The highest noise levels above are produced at times of greatest currents and the passing of vessels, whereas the quietest noise levels are at slack water with no significant anthropogenic influence.

### 11.2.1.9. Marine mammal impact thresholds

29. The metrics and criteria that have been used to assess the potential impact of underwater noise on marine mammals are based on the most up to date publications and recommended guidance, at the time of writing.
30. Southall *et al.* (2019) present unweighted peak criteria ( $SPL_{peak}$ ) for single strike, weighted sound exposure criteria for single strike ( $SEL_{ss}$ ) and cumulative (i.e. more than a single sound impulse) weighted sound exposure criteria ( $SEL_{cum}$ ) for both permanent auditory injury (PTS), where unrecoverable reduction in hearing sensitivity may occur, and for temporary auditory injury (TTS), where a temporary reduction in hearing sensitivity may occur.

31. Southall *et al.* (2019) categorises marine mammal species into hearing groups and applies filters to the unweighted noise to approximate the hearing sensitivities of the species to approximate for the specific hearing abilities and sensitivities of each group. This provided the weighted SEL criteria, which corrects the sound level based on the sensitivity of the receiver, for example, harbour porpoise *Phocoena phocoena* are less sensitive to low frequency sound than minke whales *Balaenoptera acutorostrata*.
32. Southall *et al.* (2019) also includes criteria based on  $SPL_{peak}$ , which are unweighted and do not take species sensitivity into account. It is important to note that they are different criteria and as such they should not be compared directly. All decibel SPL values are referenced to  $1\mu Pa$  and all SEL values are referenced to  $1\mu Pa^2s$ . Assessments have been based on the criteria with the greatest predicted impact ranges.
33. Note that the Southall *et al.* (2019) Marine Mammal Noise Exposure Criteria are the same as the National Marine and Fisheries Service (NMFS) (2018) criteria, although the names of the species groupings are different. The species groupings used in Southall *et al.* (2019), and therefore referred to in the underwater noise modelling report (See **Appendix 11-2**) are;
  - LF = low-frequency cetaceans;
    - Including all baleen whales (such as minke whale).
  - HF = high-frequency cetaceans;
    - Including all dolphin species, toothed whales, beaked whales, and bottlenose whales.
  - VHF = very high-frequency cetaceans; and
    - Including porpoise species (such as harbour porpoise).
  - PCW = phocid carnivores in water;
    - Including all true seals (such as grey seal *Halichoerus grypus* and harbour seal *Phoca vitulina*).
34. The Southall *et al.* (2019) thresholds and criteria used in the assessments are summarised in **Table 11-4**.

Table 11-4 Southall *et al.* (2019) thresholds and criteria used in the underwater noise modelling assessments

| Marine mammal species group                              | Impulsive thresholds |     | Non-impulsive thresholds |     |
|----------------------------------------------------------|----------------------|-----|--------------------------|-----|
|                                                          | PTS                  | TTS | PTS                      | TTS |
| Unweighted SPL <sub>peak</sub> (dB re 1 µPa)             |                      |     |                          |     |
| <b>LF</b>                                                | 219                  | 213 | -                        | -   |
| <b>HF</b>                                                | 230                  | 224 | -                        | -   |
| <b>VHF</b>                                               | 202                  | 196 | -                        | -   |
| <b>PCW</b>                                               | 218                  | 212 | -                        | -   |
| Weighted SEL <sub>cum</sub> (dB re 1 µPa <sup>2</sup> s) |                      |     |                          |     |
| <b>LF</b>                                                | 183                  | 168 | 199                      | 179 |
| <b>HF</b>                                                | 185                  | 170 | 198                      | 178 |
| <b>VHF</b>                                               | 155                  | 140 | 173                      | 153 |
| <b>PCW</b>                                               | 185                  | 170 | 201                      | 181 |

35. The Southall *et al.* (2019) criterion are based on whether the noise source is considered to be impulsive or non-impulsive. Impulsive noises are defined as having high peak sound pressure, a short duration, fast rise-time and broad frequency content at source, and non-impulsive sources as steady-state noise. Explosives, impact piling and seismic airguns are considered impulsive noise sources, while sonars, vibro-piling, drilling and other low-level continuous noises are considered non-impulsive. However, a non-impulsive noise does not necessarily have to have a long duration.
36. As sound pulses propagate through the environment and dissipate, they lose their most injurious characteristics (e.g. rapid pulse rise time and high peak sound pressure) and become more like a “non-pulse” at greater distances. Active research is currently underway into the identification of the distance at which the pulse can be considered effectively non-impulsive (see **Appendix 11-2**), with one study finding that most impulsive noise signals analysed were considered to be impulsive at 3.5km from the source (Hastie *et al.* 2019). Both impulsive and non-impulsive criteria from Southall *et al.* (2019) have been included in the underwater noise modelling, however assessments have been based on the criteria with the greatest predicted impact ranges. While work in this field is ongoing, when reviewing the results of this underwater noise modelling, it should be considered that where impulsive noise ranges are considerably higher than 3.5km, the non-impulsive impact range is likely to be more appropriate.

## 11.2.1.10. Fleeing receptors

37. To determine  $SEL_{cum}$  ranges for marine mammals, a fleeing animal model has been used. This assumes that the animal exposed to high noise levels will swim away from the noise source.
38. For this, a constant swimming speed of 3.25m/s has been assumed for minke whale (Blix and Folkow 1995), and as a precautionary approach for all other species a constant swimming speed of 1.5 m/s has been used, based on the average swimming speed for harbour porpoise mother calf pairs (Otani *et al.* 2000). This is considered a 'worst case' scenario as marine mammals are expected to be able to swim faster. Further details on how  $SEL_{cum}$  is modelled is provided in **Appendix 11-2**.
39. For the results of the  $SEL_{cum}$  modelling, the impact ranges presented can be considered to be a starting position that the animal would have to be (at the onset of piling) to not be exposed to the relevant impact. For example, if the animal began to flee in a straight line (and at the fleeing speeds as outlined above) from the noise source, the impact range would represent the range at which that animal would need to be exposed to noise levels to induce the relevant impact as per the thresholds as outlined in section 11.2.1.9. Further explanation is provided in **Appendix 11-2**, and **Plate 11-2** illustrates this effect.

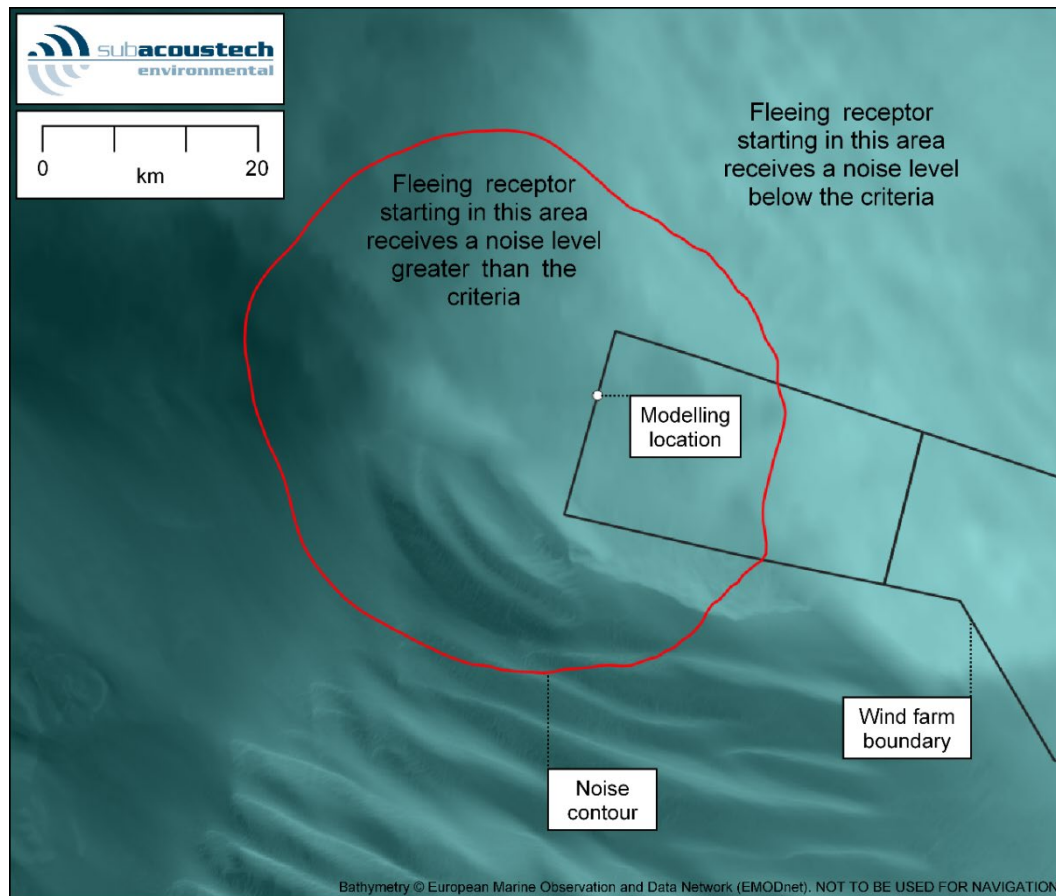


Plate 11-2 Example of the effect of a fleeing animal on the exposure to cumulative underwater noise (**Appendix 11-2**)

## 11.2.1.11. Assumptions and limitations

40. It should be noted and taken into account that the underwater noise modelling and assessment is based on 'worst case' scenarios and precautionary approaches, this includes, but is not limited to:
- The maximum hammer energy to be applied and maximum piling duration is assumed for all piling locations; however, it is unlikely that maximum hammer energy applied and duration will be required at the majority of piling locations.
  - The maximum predicted impact ranges are based on the location with the greatest potential noise propagation range and this was assumed as the worst case for each piling location.

- Impact ranges modelled for a single strike are from the piling location and do not take into account (i) the distance marine mammals could move away from the piling location during mitigation measures, such as the use of Acoustic Deterrent Devices (ADDs) to move marine mammals out of the area where there could be a risk of physical or auditory injury; or (ii) the potential disturbance and movement of marine mammals away from the site as a result of the vessels and set-up prior to mitigation.
  - The assumption that fleeing animals (harbour porpoise, dolphin species, grey seal and harbour seal) are swimming at a constant speed of 1.5m/s (based on swimming speed of harbour porpoise mother calf pairs; Otani *et al.* 2000), however, marine mammals are expected to swim much faster.
    - For example, harbour porpoise have been recorded swimming at speeds of up to 4.3m/s (Otani *et al.* 2000), and the swimming speed of a harbour porpoise during playbacks of pile driving sounds (SPL of 154 dB re 1µPa) was 1.97m/s (7.1km/h), and during quiet baseline periods the mean swimming speed was 1.2m/s (4.3km/h; Kastelein *et al.* 2018).
  - The assumption that animals are submerged 100% of the time, which does not account for any time that an individual may spend at the surface or the reduced SELs near the surface where the animal would not be exposed to such high levels, or for seals having their head out of the water.
41. Underwater noise modelling assumes that marine mammals will travel in the mid-water column where sound pressure levels are greatest. However, in reality animals would not be subjected to these high sound pressure levels at all times since they are likely to move up and down through the water column, and surface to breathe, where the sound pressure would drop to zero. A study by Teilmann *et al.* (2007) on diving behaviour of harbour porpoise in Danish waters suggests that animals spent 55% of their time in the upper 2m of the water column from April to August, and over the whole year they spent 68% of their time in less than 5m depth. However, it should be noted that this study was conducted for “undisturbed” animals, which could show a different behaviour.

42. The swimming patterns of harbour porpoise undertaking direct travel are typically characterised by short submergence periods, compared to feeding animals (Watson and Gaskin 1983). These short duration dives with horizontal travel suggest that travelling animals, such as harbour porpoise moving away from pile driving noise, would swim in the upper part of the water column. It would be anticipated, that during a fleeing response, from a loud underwater noise, such as piling, that their swimming behaviour may change with a reduction in deep dives. For example, during pile driving playback sounds to examine TTS, harbour porpoise showed behaviour response during the exposure periods, which included increased swimming speeds and jumping out of the water more (Kastelein *et al.* 2016).
43. Noise impact assessments assume that all animals within the noise contour may be affected to the same degree for the maximum worst case scenario. For example, that all animals exposed to noise levels that induce behavioural avoidance will be displaced, or all animals exposed to noise levels that are predicted as inducing PTS or TTS will suffer permanent or temporary auditory injury, respectively. However, a study looking at the proportion of trials at different SELs that result in TTS in exposed bottlenose dolphins suggests that to induce TTS in 50% of animals, it would be necessary to extrapolate well beyond the range of measured SEL levels (Finneran *et al.* 2005). This suggests that for a given species, the potential effects follow a dose-response curve such that the probability of inducing TTS will decrease moving further away from the SEL threshold required to induce TTS. Further work by Thompson *et al.* (2013) has adopted this dose-response curve to produce a theoretical dose-response for PTS in harbour seal by scaling up Finneran *et al.* (2005) dose response curve for changes in levels of TTS at different SEL, where the probability of seals experiencing PTS increases from an SEL of 186 up to 240 dB re 1  $\mu\text{Pa}^2\text{s}$ ; the point at which all animals are predicted to have PTS.

44. The soft-start and ramp-up is included as embedded mitigation. The soft-start begins with a lower hammer energy before reaching maximum hammer energy, with the assumption that marine mammals will move out of the area as the hammer energy is increased, and before there is the increased risk of PTS from the maximum hammer energy. However, research around the installation of jacket foundations in the Moray Firth found that received levels at any given distance were highest at low hammer energies (Thompson *et al.* 2020). Modelling highlighted that this was because noise from pin-pile installations was dominated by the strong negative relationship with pile penetration depth, with only a weak positive relationship with hammer energy (Thompson *et al.* 2020). Although the responses to ADD play-back indicated that disturbance was beyond that required to mitigate injury (Thompson *et al.* 2020).

### 11.3. Assessment of underwater noise effects from piling

45. The following sections provide the results of the underwater noise modelling (**Appendix 11-2**), and the subsequent assessment for each marine mammal species. All assessments are undertaken based on the area of effect for permanent auditory injury (PTS) and temporary auditory injury (TTS), the density of each species (as outlined in **Appendix 11.1** and **section 11.5 of Chapter 11 Marine Mammals**), and the percentage of the reference populations with the potential to be affected. The potential magnitudes of effect (as outlined in **section 11.4 of Chapter 11 Marine Mammals**) are then applied, to produce the overall magnitude of effect for each underwater noise impact and receptor.
46. The following sections include the assessments for all species densities estimates.

#### 11.3.1. Assessment for permanent auditory injury (PTS)

##### 11.3.1.1. Assessment of the potential for permanent auditory injury (PTS) from monopiles at a single piling location

47. **Table 11-5** to **Table 11-7** below provide the assessments for the potential of PTS onset due to monopile installation.
48. **Table 11-5** includes the assessment of the potential for PTS onset of a single monopile strike at the maximum hammer energy of 7,000kJ.
49. **Table 11-6** includes an assessment of the potential for PTS onset due to the cumulative exposure of one monopile installation, and **Table 11-7** includes the assessment for the potential for PTS onset due to the cumulative exposure of two monopile installations in one 24-hour period.

Table 11-5 Underwater noise assessment for the potential of PTS onset from a single strike from the maximum hammer energy of a monopile ( $SPL_{peak}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                          | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------------|---------------------|
| DBS East (South location)                                                         |                             |                      |                   |                                |                                                                               |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                  | 0.275                       | 346,601              | 0.76              | 1.8                            | 0.5 harbour porpoise (0.00014% of the NS MU reference population)             | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | <b>0.888</b>                | <b>346,601</b>       | 0.76              | 1.8                            | 1.61 harbour porpoise (0.00046% of the NS MU reference population)            | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.00011                     | 2,022                | < 0.05            | < 0.01                         | 0.0000009 bottlenose dolphin (0.00000004% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.00014</b>              | <b>2,022</b>         | < 0.05            | < 0.01                         | 0.000001 bottlenose dolphin (0.00000005% of the GNS MU reference population)  | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)              | 0.029                       | 102,656              | < 0.05            | < 0.01                         | 0.0002 common dolphin (0.00000002% of the CGNS MU reference population)        | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>       | <b>0.037</b>                | <b>102,656</b>       | < 0.05            | < 0.01                         | 0.0003 common dolphin (0.00000003% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.0052                      | 43,951               | < 0.05            | < 0.01                         | 0.00004 white-beaked dolphin (0.00000009% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.0055</b>               | <b>43,951</b>        | < 0.05            | < 0.01                         | 0.00004 white-beaked dolphin (0.00000001% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | 0.05              | 0.01                           | 0.00008 minke whale (0.00000004% of the CGNS MU reference population)          | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array)                    | 0.0018                      | 20,118               | 0.05              | 0.01                           | 0.00001 minke whale (0.00000007% of the CGNS MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b>         | <b>0.181</b>                | <b>34,461</b>        | 0.6               | 0.01                           | 0.002 grey seal (0.000006% of the SE England MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | <b>0.181</b>                | <b>60,310</b>        | 0.6               | 0.01                           | 0.002 grey seal (0.000003% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 0.6               | 0.01                           | 0.004 grey seal (0.00001% of the SE England MU reference population)  | Negligible          |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)          | 0.386                       | 60,310               | 0.6               | 0.01                           | 0.004 grey seal (0.000007% of the Wider reference population)                | Negligible          |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | <b>0.0017</b>               | <b>4,853</b>         | 0.6               | 0.01                           | 0.000019 harbour seal (0.0000004% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)                | 0.0015                      | 4,853                | 0.6               | 0.01                           | 0.000017 harbour seal (0.0000003% of the SE England MU reference population) | Negligible          |
| <b>DBS West (West location)</b>                                                                   |                             |                      |                   |                                |                                                                              |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                                  | 0.427                       | 346,601              | 0.77              | 1.8                            | 0.77 harbour porpoise (0.0002% of the NS MU reference population)            | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | <b>0.888</b>                | <b>346,601</b>       | <0.05             | 1.8                            | 1.6 harbour porpoise (0.0005% of the NS MU reference population)             | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.00023                     | 2,022                | <0.05             | < 0.01                         | 0.000002 bottlenose dolphin (0.00000009% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | <b>0.00025</b>              | <b>2,022</b>         | <0.05             | < 0.01                         | 0.000002 bottlenose dolphin (0.0000001% of the GNS MU reference population)  | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)            | 0.032                       | 102,656              | <0.05             | < 0.01                         | 0.0003 common dolphin (0.0000002% of the CGNS MU reference population)       | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>     | <b>0.041</b>                | <b>102,656</b>       | <0.05             | < 0.01                         | 0.0003 common dolphin (0.0000003% of the CGNS MU reference population)       | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.011                       | 43,951               | <0.05             | < 0.01                         | 0.00009 white-beaked dolphin (0.0000002% of the CGNS MU reference population)  | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | <b>0.012</b>                | <b>43,951</b>        | <0.05             | < 0.01                         | 0.00009 white-beaked dolphin (0.00000021% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | 0.05              | 0.01                           | 0.00008 minke whale (0.0000004% of the CGNS MU reference population)           | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array) | 0.0025                      | 20,118               | 0.05              | 0.01                           | 0.00002 minke whale (0.0000001% of the CGNS MU reference population)           | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 0.06              | 0.01                           | 0.003 grey seal (0.000009% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 0.06              | 0.01                           | 0.003 grey seal (0.000005% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | 0.06              | 0.01                           | 0.004 grey seal (0.00001% of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)        | 0.386                       | 60,310               | 0.06              | 0.01                           | 0.004 grey seal (0.000007% of the Wider reference population)         | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 0.06              | 0.01                           | 0.000011 harbour seal (0.0000002% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)             | 0.0015                      | 4,853                | 0.06              | 0.01                           | 0.000017 harbour seal (0.0000003% of the SE England MU reference population) | Negligible          |

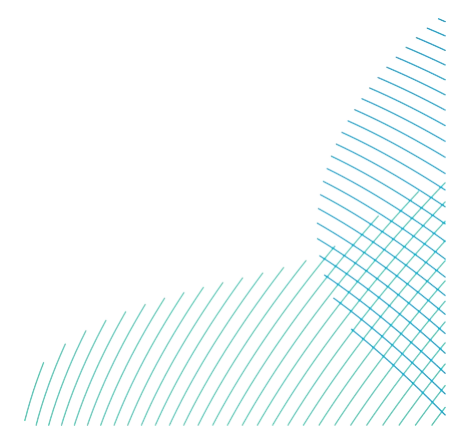


Table 11-6 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation of one monopile in a 24 hour period ( $SE_{Lcum}$ ) at the worst case modelling location for the DBS array areas including all potential density estimates and reference populations

| Species scenario                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|----------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| <b>DBS East (South location)</b>                                           |                             |                      |                   |                                |                                                                             |                     |
| Harbour porpoise (site-specific aerial summer density estimates)           | 0.275                       | 346,601              | 11                | 270                            | 74.25 harbour porpoise (0.02% of the NS MU reference population)            | Medium              |
| Harbour porpoise (SCANS-III density estimate)                              | 0.888                       | 346,601              | 11                | 270                            | 239.76 harbour porpoise (0.07% of the NS MU reference population)           | Medium              |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave) | 0.00011                     | 2,022                | < 0.1             | < 0.01                         | 0.000011 bottlenose dolphin (0.0000005% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave) | 0.00014                     | 2,022                | < 0.1             | < 0.01                         | 0.00001 bottlenose dolphin (0.0000007% of the GNS MU reference population)  | Negligible          |

| Species scenario                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)       | 0.029                       | 102,656              | < 0.1             | < 0.01                         | 0.0029 common dolphin (0.000003% of the CGNS MU reference population)        | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)       | 0.037                       | 102,656              | < 0.1             | < 0.01                         | 0.0037 common dolphin (0.000004% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave) | 0.0052                      | 43,951               | < 0.1             | < 0.01                         | 0.00052 white-beaked dolphin (0.000001% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave) | 0.0055                      | 43,951               | < 0.1             | < 0.01                         | 0.00055 white-beaked dolphin (0.000001% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate)                                     | 0.01                        | 20,118               | 19                | 610                            | 6.1 minke whale (0.031% of the CGNS MU reference population)                 | Medium              |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Minke whale (Wag-gitt <i>et al.</i> 2019 annual density estimate for DBS East array)            | 0.0018                      | 20,118               | 19                | 610                            | 1.1 minke whale (0.0055% of the CGNS MU reference population)      | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 1.7               | 7.2                            | 1.3 grey seal (0.0038% of the SE England MU reference population)  | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 1.7               | 7.2                            | 1.3 grey seal (0.0022% of the Wider reference population)          | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | 1.7               | 7.2                            | 2.78 grey seal (0.0081% of the SE England MU reference population) | Low                 |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)   | 0.386                       | 60,310               | 1.7               | 7.2                            | 2.78 grey seal (0.0046% of the Wider reference population)              | Low                 |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 1.7               | 7.2                            | 0.013 harbour seal (0.00025% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 1.7               | 7.2                            | 0.012 harbour seal (0.00003% of the SE England MU reference population) | Negligible          |
| <b>DBS West (West location)</b>                                                            |                             |                      |                   |                                |                                                                         |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                           | 0.427                       | 346,601              | 11                | 270                            | 115.29 harbour porpoise (0.03% of the NS MU reference population)       | Medium              |

| Species scenario                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| Harbour porpoise (SCANS-III density estimate)                                | 0.888                       | 346,601              | 11                | 270                            | 239.76 harbour porpoise (0.07% of the NS MU reference population)           | Medium              |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)   | 0.00023                     | 2,022                | < 0.1             | < 0.1                          | 0.00002 bottlenose dolphin (0.000001% of the GNS MU reference population)   | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)   | 0.00025                     | 2,022                | < 0.1             | < 0.1                          | 0.000001 bottlenose dolphin (0.0000012% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)       | 0.032                       | 102,656              | < 0.1             | < 0.1                          | 0.003 common dolphin (0.0000031% of the CGNS MU reference population)       | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)       | 0.041                       | 102,656              | < 0.1             | < 0.1                          | 0.004 common dolphin (0.000004% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave) | 0.011                       | 43,951               | < 0.1             | < 0.1                          | 0.0011 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                    | 0.012                       | 43,951               | < 0.1             | < 0.1                          | 0.0012 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate)                                                        | 0.01                        | 20,118               | 19                | 690                            | 6.9 minke whale (0.034% of the CGNS MU reference population)                | Medium              |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array)             | 0.0025                      | 20,118               | 19                | 690                            | 1.73 minke whale (0.009% of the CGNS MU reference population)               | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 1.8               | 8.6                            | 2.24 grey seal (0.006% of the SE England MU reference population)           | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 1.8               | 8.6                            | 2.24 grey seal (0.004% of the Wider reference population)                   | Low                 |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                | 0.386                       | 34,461               | 1.8               | 8.6                            | 3.17 grey seal (0.009% of the SE England MU reference population)      | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)   | 0.386                       | 60,310               | 1.8               | 8.6                            | 3.17 grey seal (0.005% of the Wider reference population)              | Low                 |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 1.8               | 8.6                            | 0.009 harbour seal (0.0002% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)             | 0.0015                      | 4,853                | 1.8               | 8.6                            | 0.0082 harbour seal (0.00002% of the Wider reference population)       | Negligible          |

Table 11-7 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation of two sequentially installed monopiles in a 24 hour period ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| <b>DBS East (South location)</b>                                                  |                             |                      |                   |                                |                                                                             |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                  | 0.275                       | 346,601              | 11                | 270                            | 74.25 harbour porpoise (0.02% of the NS MU reference population)            | Medium              |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | <b>0.888</b>                | <b>346,601</b>       | 11                | 270                            | 239.76 harbour porpoise (0.07% of the NS MU reference population)           | Medium              |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.00011                     | 2,022                | < 0.1             | < 0.1                          | 0.00001 bottlenose dolphin (0.000005% of the GNS MU reference population)   | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.00014</b>              | <b>2,022</b>         | < 0.1             | < 0.1                          | 0.000014 bottlenose dolphin (0.0000007% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)              | 0.029                       | 102,656              | < 0.1             | < 0.1                          | 0.003 common dolphin (0.000003% of the CGNS MU reference population)       | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>       | <b>0.037</b>                | <b>102,656</b>       | < 0.1             | < 0.1                          | 0.004 common dolphin (0.000004% of the CGNS MU reference population)       | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.0052                      | 43,951               | < 0.1             | < 0.1                          | 0.001 white-beaked dolphin (0.000001% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.0055</b>               | <b>43,951</b>        | < 0.1             | < 0.1                          | 0.001 white-beaked dolphin (0.000001% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | 19                | 620                            | 6.2 minke whale (0.03% of the CGNS MU reference population)                | Medium              |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array)                    | 0.0018                      | 20,118               | 19                | 620                            | 1.116 minke whale (0.01% of the CGNS MU reference population)         | Low                 |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b>         | <b>0.181</b>                | <b>34,461</b>        | 1.8               | 7.6                            | 1.376 grey seal (0.00399% of the SE England MU reference population)  | Low                 |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | <b>0.181</b>                | <b>60,310</b>        | 1.8               | 7.6                            | 1.376 grey seal (0.00228% of the Wider reference population)          | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 1.8               | 7.6                            | 2.9336 grey seal (0.00851% of the SE England MU reference population) | Low                 |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)          | 0.386                       | 60,310               | 1.8               | 7.6                            | 2.9336 grey seal (0.00486% of the Wider reference population)          | Low                 |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | <b>0.0017</b>               | <b>4,853</b>         | 1.8               | 7.6                            | 0.013 harbour seal (0.0003% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)                | 0.0015                      | 4,853                | 1.8               | 7.6                            | 0.013 harbour seal (0.00003% of the Wider reference population)        | Negligible          |
| <b>DBS West (West location)</b>                                                                   |                             |                      |                   |                                |                                                                        |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                                  | 0.427                       | 346,601              | 11                | 280                            | 115.29 harbour porpoise (0.03% of the NS MU reference population)      | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | <b>0.888</b>                | <b>346,601</b>       | 11                | 280                            | 248.64 harbour porpoise (0.07% of the NS MU reference population)          | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.00023                     | 2,022                | < 0.1             | < 0.1                          | 0.000032 bottlenose dolphin (0.000001% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | <b>0.00025</b>              | <b>2,022</b>         | < 0.1             | < 0.1                          | 0.00003 bottlenose dolphin (0.0000012% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)            | 0.032                       | 102,656              | < 0.1             | < 0.1                          | 0.003 common dolphin (0.000003% of the CGNS MU reference population)       | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>     | <b>0.041</b>                | <b>102,656</b>       | < 0.1             | < 0.1                          | 0.004 common dolphin (0.000004% of the CGNS MU reference population)       | Negligible          |

| Species scenario                                                                               | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)                   | 0.011                       | 43,951               | < 0.1             | < 0.1                          | 0.001 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>            | <b>0.012</b>                | <b>43,951</b>        | < 0.1             | < 0.1                          | 0.001 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                                | <b>0.01</b>                 | <b>20,118</b>        | 20                | 700                            | 7.0 minke whale (0.035% of the CGNS MU reference population)               | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array)            | 0.0025                      | 20,118               | 20                | 700                            | 1.75 minke whale (0.01% of the CGNS MU reference population)               | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b> | <b>0.26</b>                 | <b>34,461</b>        | 1.8               | 8.6                            | 2.24 grey seal (0.006% of the SE England MU reference population)          | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)</b> | <b>0.26</b>                 | <b>60,310</b>        | 1.8               | 8.6                            | 2.24 grey seal (0.004% of the Wider reference population)              | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 1.8               | 8.6                            | 3.32 grey seal (0.01% of the SE England MU reference population)       | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)               | 0.386                       | 60,310               | 1.8               | 8.6                            | 3.32 grey seal (0.006% of the Wider reference population)              | Negligible          |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b>      | <b>0.001</b>                | <b>4,853</b>         | 1.8               | 8.6                            | 0.009 harbour seal (0.0002% of the SE England MU reference population) | Negligible          |

# RWE

Dogger Bank South Offshore Wind Farms

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Harbour seal<br>(Carter <i>et al.</i><br>2022 average<br>density for ODA<br>and the SE MU) | 0.0015                      | 4,853                | 1.8               | 8.6                            | 0.013 harbour seal (0.0003% of the SE<br>England MU reference population) | Negligible          |

## 11.3.1.1. Assessment of the potential for permanent auditory injury (PTS) from monopiles due to concurrent piling at multiple pile locations

50. This section outlines the effect of simultaneous monopile installations at the East, West and Centre modelling locations. **Plate 11-3** shows the results of the modelling, and **Table 11-8** provides the assessment of the potential for PTS onset due to the cumulative exposure of two sequentially installed piles at DBS East (South location), DBS West (West location) and a single pile at the Centre location.
51. The simultaneous piling scenario assumes that animals that are within potential effect ranges for a much longer period (i.e. they would be travelling from one pile location to another), and therefore cumulative effect ranges are much larger than for the cumulative exposure ranges of one monopile at a time.
52. The potential effect ranges are not possible to model under this scenario, as there are two starting points for receptors, and it is not possible to determine the potential range at which they need to be in order to not be at risk of effect. Therefore, the following assessment is based on the potential areas of effect.
53. Where the potential effect areas are not large enough to interact with each other, they have not been included in the results of the modelling (as the results for the respective locations and scenarios can be used).
54. The potential for PTS onset due to simultaneous monopile installations did not interact for seals and high frequency cetaceans (**Plate 11-3**). For harbour porpoise and minke whale, the results of the modelling for simultaneous piling for monopiles are used in the assessments, whilst for both dolphin and seal species, the assessments for sequential piling are based on the results of the modelling at the three locations, summed together and are included in **Table 11-8**.

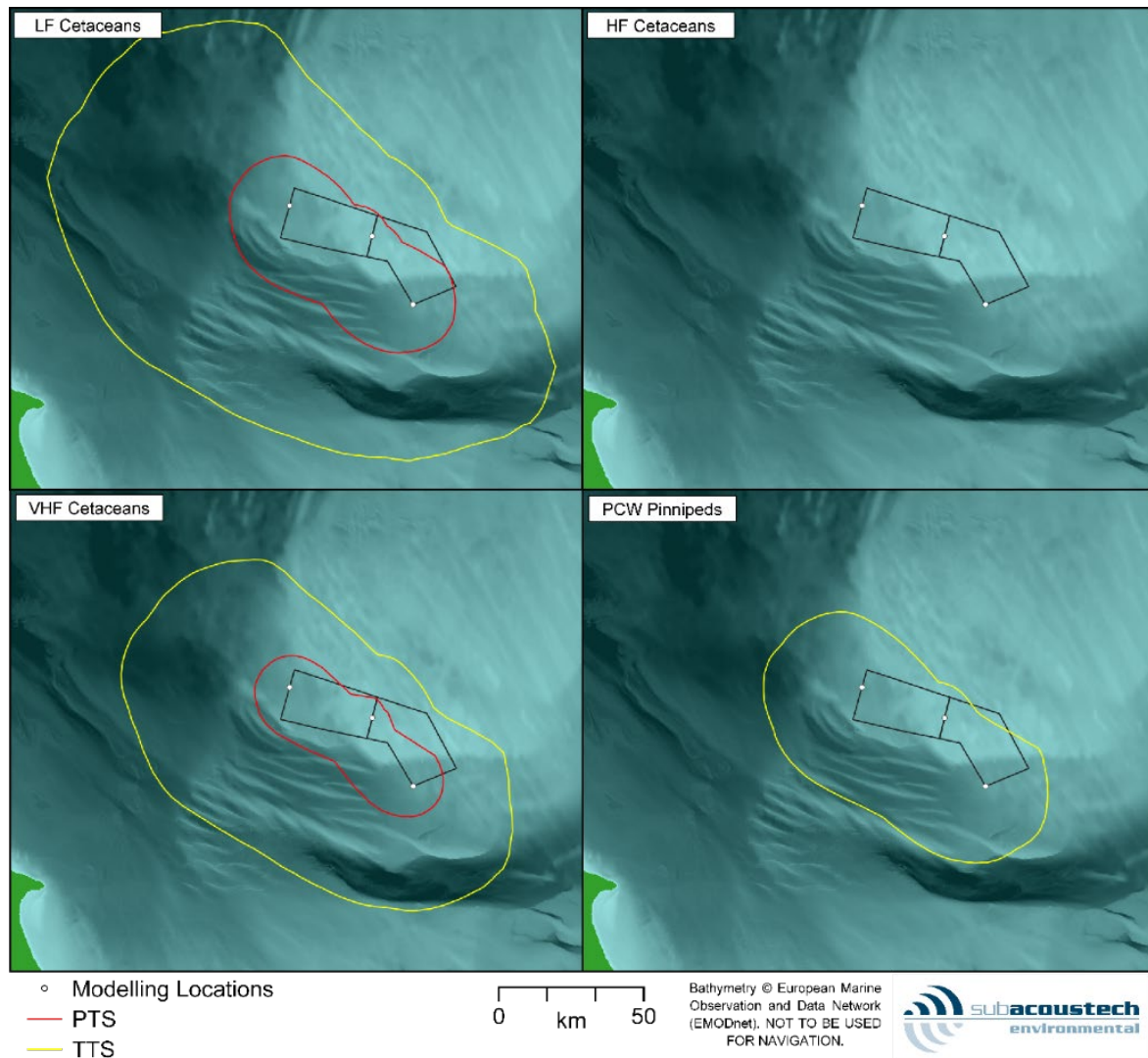


Plate 11-3 Contour plots for PTS (shown in red) and TTS onset (shown in yellow) due to the simultaneous installation of monopiles at the North and South modelling locations (**Appendix 11-2**)

Table 11-8 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation from a single strike from the maximum hammer energy of two sequentially installed piles at DBS East (South location), DBS West (West location) and a single pile at DBS East/West (Centre location) ( $SEL_{cum}$ ), including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| <b>Harbour porpoise (SCANS-III density estimate)</b>                                       | 0.888                       | 346,601              | 1,800                          | 1598.4 harbour porpoise (0.46% of the NS MU reference population)            | High                |
| Harbour porpoise (site-specific aerial summer density estimate to DBS East)                | 0.275                       | 346,601              | 1,800                          | 495 harbour porpoise (0.14% of the NS MU reference population)               | High                |
| Harbour porpoise (site-specific aerial summer density estimates at DBS West)               | 0.427                       | 346,601              | 1,800                          | 768.6 harbour porpoise (0.22% of the NS MU reference population)             | High                |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                 | 0.00025                     | 2,022                | 0.3                            | 0.000075 bottlenose dolphin (0.00000002% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | 0.0016                      | 2,022                | 0.3                            | 0.00048 bottlenose dolphin (0.000024% of the GNS MU reference population)    | Negligible          |

| Species scenario                                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|----------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                       | 0.037                       | 102,656              | 0.3                            | 0.0111 common dolphin (0.0000001% of the CGNS MU reference population)         | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>                | 0.041                       | 102,656              | 0.3                            | 0.0123 common dolphin (0.00000012% of the CGNS MU reference population)        | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)              | 0.038                       | 102,656              | 0.3                            | 0.0114 common dolphin (0.0000001% of the CGNS MU reference population)         | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                 | 0.0055                      | 43,951               | 0.3                            | 0.00165 white-beaked dolphin (0.00000004% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                 | 0.012                       | 43,951               | 0.3                            | 0.0036 white-beaked dolphin (0.00000008% of the CGNS MU reference population)  | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | 0.017                       | 43,951               | 0.3                            | 0.0051 white-beaked dolphin (0.00000012% of the CGNS MU reference population)  | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| <b>Minke whale (SCANS-III density estimate)</b>                                                 | 0.01                        | 20,118               | 3,000                          | 30 minke whale (0.15% of the CGNS MU reference population)          | High                |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)                    | 0.0075                      | 20,118               | 3,000                          | 22.5 minke whale (0.11184% of the CGNS MU reference population)     | High                |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 16.3                           | 2.95 grey seal (0.00009% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 16.3                           | 2.95 (0.00005% of the Wider reference population)                   | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)</b>              | 0.386                       | 34,461               | 16.3                           | 6.29 grey seal (0.018% of the SE England MU reference population)   | Medium              |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)</b> | 0.386                       | 60,310               | 16.3                           | 6.29 (0.01% of the Wider reference population)                      | Medium              |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)           | 0.26                        | 34,461               | 16.3                           | 4.24 grey seal (0.012% of the SE England MU reference population)     | Medium              |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)   | 0.26                        | 60,310               | 16.3                           | 4.24 (0.007% of the Wider reference population)                       | Low                 |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | 0.0017                      | 4,853                | 16.3                           | 0.03 harbour seal (0.0006% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)        | 0.001                       | 4,853                | 16.3                           | 0.02 harbour seal (0.0003% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)                | 0.0015                      | 4,853                | 16.3                           | 0.02 harbour seal (0.0005% of the SE England MU reference population) | Negligible          |

11.3.1.2. Assessment of the potential for permanent auditory injury (PTS) from pin pile jacket foundations at a single piling location

- 55. **Table 11-9** to **Table 11-12** below provide the assessments for the potential of PTS onset due to pin pile jacket foundation installation.
- 56. **Table 11-9** includes the assessment of the potential for PTS onset of a strike for a pin pile jacket foundation at the maximum hammer energy of 3,000kJ.
- 57. **Table 11-10** includes an assessment of the potential for PTS onset due to the cumulative exposure of a single pile installation, and **Table 11-11** includes the assessment for the potential for PTS onset due to the cumulative exposure of four sequentially installed piles in one 24 hour period.

Table 11-9 Underwater noise assessment for the potential of PTS onset from a single strike from the maximum hammer energy of a pin pile jacket foundation ( $SPL_{peak}$ ) at the worst case modelling location for the DBS array areas including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                          | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------------|---------------------|
| <b>DBS East (South location)</b>                                                  |                             |                      |                   |                                |                                                                               |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                  | 0.275                       | 346,601              | 0.6               | 1.1                            | 0.31 harbour porpoise (0.0001% of the NS MU reference population)             | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | <b>0.888</b>                | <b>346,601</b>       | 0.6               | 1.1                            | 1.0 harbour porpoise (0.0003% of the NS MU reference population)              | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.00011                     | 2,022                | < 0.05            | < 0.01                         | 0.0000009 bottlenose dolphin (0.00000004% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.00014</b>              | <b>2,022</b>         | < 0.05            | < 0.01                         | 0.0000011 bottlenose dolphin (0.00000005% of the GNS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)              | 0.029                       | 102,656              | < 0.05            | < 0.01                         | 0.0002 common dolphin (0.00000002% of the CGNS MU reference population)        | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>       | <b>0.037</b>                | <b>102,656</b>       | < 0.05            | < 0.01                         | 0.0003 common dolphin (0.00000029% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.0052                      | 43,951               | < 0.05            | < 0.01                         | 0.00004 white-beaked dolphin (0.00000009% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.0055</b>               | <b>43,951</b>        | < 0.05            | < 0.01                         | 0.00004 white-beaked dolphin (0.0000001% of the CGNS MU reference population)  | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | < 0.05            | 0.01                           | 0.00008 minke whale (0.0000004% of the CGNS MU reference population)           | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array) | 0.0018                      | 20,118               | < 0.05            | 0.01                           | 0.00001 minke whale (0.00000007% of the CGNS MU reference population)          | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | < 0.05            | 0.01                           | 0.001 grey seal (0.000004% of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | < 0.05            | 0.01                           | 0.001 grey seal (0.000002% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | < 0.05            | 0.01                           | 0.003 grey seal (0.0000088% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)        | 0.386                       | 60,310               | < 0.05            | 0.01                           | 0.003 grey seal (0.000005% of the Wider reference population)          | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                          | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------------|---------------------|
| <b>Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU)</b> | <b>0.0017</b>               | <b>4,853</b>         | < 0.05            | 0.01                           | 0.000013 harbour seal (0.00000003% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)                | 0.0015                      | 4,853                | < 0.05            | 0.01                           | 0.000012 harbour seal (0.00000002% of the SE England MU reference population) | Negligible          |
| <b>DBS West (West location)</b>                                                            |                             |                      |                   |                                |                                                                               |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                           | 0.427                       | 346,601              | 0.61              | 1.2                            | 0.5 harbour porpoise (0.0001% of the NS MU reference population)              | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                                       | <b>0.888</b>                | <b>346,601</b>       | 0.61              | 1.2                            | 1.0 harbour porpoise (0.0003% of the NS MU reference population)              | Negligible          |
| Bottlenose dolphin (Waggitt et al. 2019, DBS West array annual Ave)                        | 0.00023                     | 2,022                | < 0.05            | < 0.01                         | 0.000002 bottlenose dolphin (0.000000009% of the GNS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>   | <b>0.00025</b>              | <b>2,022</b>         | < 0.05            | < 0.01                         | 0.000002 bottlenose dolphin (0.0000001% of the GNS MU reference population)    | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)              | 0.032                       | 102,656              | < 0.05            | < 0.01                         | 0.0003 common dolphin (0.0000002% of the CGNS MU reference population)         | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>       | <b>0.041</b>                | <b>102,656</b>       | < 0.05            | < 0.01                         | 0.0003 common dolphin (0.00000031% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.011                       | 43,951               | < 0.05            | < 0.01                         | 0.00009 white-beaked dolphin (0.0000002% of the CGNS MU reference population)  | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | <b>0.012</b>                | <b>43,951</b>        | < 0.05            | <0.01                          | 0.00009 white-beaked dolphin (0.00000021% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | < 0.05            | 0.01                           | 0.00008 minke whale (0.0000004% of the CGNS MU reference population)           | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array)                    | 0.0025                      | 20,118               | < 0.05            | 0.01                           | 0.00002 minke whale (0.0000001% of the CGNS MU reference population)  | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b>         | <b>0.26</b>                 | <b>34,461</b>        | < 0.05            | 0.01                           | 0.002 grey seal (0.000006% of the SE England MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)</b> | <b>0.26</b>                 | <b>60,310</b>        | < 0.05            | 0.01                           | 0.002 grey seal (0.000003% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | < 0.05            | 0.01                           | 0.003 grey seal (0.00001% of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)               | 0.386                       | 60,310               | < 0.05            | 0.01                           | 0.003 grey seal (0.000005% of the Wider reference population)         | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | < 0.05            | 0.01                           | 0.000008 harbour seal (0.0000002% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)             | 0.0015                      | 4,853                | < 0.05            | 0.01                           | 0.000012 harbour seal (0.0000002% of the SE England MU reference population) | Negligible          |

Table 11-10 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation of a single pile of a pin pile jacket foundation ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| <b>DBS East (South location)</b>                                                  |                             |                      |                   |                                |                                                                            |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                  | 0.275                       | 346,601              | 0.75              | 130                            | 35.75 harbour porpoise (0.01% of the NS MU reference population)           | Medium              |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | <b>0.888</b>                | <b>346,601</b>       | 0.75              | 130                            | 115.44 harbour porpoise (0.03% of the NS MU reference population)          | Medium              |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.00011                     | 2,022                | < 0.1             | < 0.1                          | 0.00001 bottlenose dolphin (0.0000005% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.00014</b>              | <b>2,022</b>         | < 0.1             | < 0.1                          | 0.000011 bottlenose dolphin (0.000001% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)              | 0.029                       | 102,656              | < 0.1             | < 0.1                          | 0.0029 common dolphin (0.000003% of the CGNS MU reference population)        | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>       | <b>0.037</b>                | <b>102,656</b>       | < 0.1             | < 0.1                          | 0.0037 common dolphin (0.000004% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.0052                      | 43,951               | < 0.1             | < 0.1                          | 0.00052 white-beaked dolphin (0.000001% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.0055</b>               | <b>43,951</b>        | < 0.1             | < 0.1                          | 0.00055 white-beaked dolphin (0.000001% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | 13                | 290                            | 2.9 minke whale (0.01% of the CGNS MU reference population)                  | Medium              |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array) | 0.0018                      | 20,118               | 13                | 290                            | 0.52 minke whale (0.0026% of the CGNS MU reference population)               | Low                 |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 0.75              | 1.4                            | 0.25 grey seal (0.0007% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 0.75              | 1.4                            | 0.253 grey seal (0.00042% of the Wider reference population)       | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | 0.75              | 1.4                            | 0.54 grey seal (0.0016% of the SE England MU reference population) | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)        | 0.386                       | 60,310               | 0.75              | 1.4                            | 0.54 grey seal (0.0009% of the Wider reference population)         | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| <b>Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU)</b> | <b>0.0017</b>               | <b>4,853</b>         | 0.75              | 1.4                            | 0.002 harbour seal (0.00005% of the SE England MU reference population)     | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)                | 0.0015                      | 4,853                | 0.75              | 1.4                            | 0.002 harbour seal (0.00004% of the SE England MU reference population)     | Negligible          |
| <b>DBS West (West location)</b>                                                            |                             |                      |                   |                                |                                                                             |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                           | 0.427                       | 346,601              | 7.1               | 130                            | 55.51 harbour porpoise (0.02% of the NS MU reference population)            | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                                       | <b>0.888</b>                | <b>346,601</b>       | 7.1               | 130                            | 115.44 harbour porpoise (0.03% of the NS MU reference population)           | Negligible          |
| Bottlenose dolphin (Waggitt et al. 2019, DBS West array annual Ave)                        | 0.00023                     | 2,022                | < 0.1             | < 0.1                          | 0.00002 bottlenose dolphin (0.00000001% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>   | <b>0.00025</b>              | <b>2,022</b>         | < 0.1             | < 0.1                          | 0.00002 bottlenose dolphin (0.000001% of the GNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)              | 0.032                       | 102,656              | < 0.1             | < 0.1                          | 0.003 common dolphin (0.0000031% of the CGNS MU reference population)       | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>       | <b>0.041</b>                | <b>102,656</b>       | < 0.1             | < 0.1                          | 0.004 common dolphin (0.000004% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.011                       | 43,951               | < 0.1             | < 0.1                          | 0.0011 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | <b>0.012</b>                | <b>43,951</b>        | < 0.1             | < 0.1                          | 0.0012 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | 13                | 310                            | 3.1 minke whale (0.015% of the CGNS MU reference population)                | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array)                    | 0.0025                      | 20,118               | 13                | 310                            | 0.78 minke whale (0.004% of the CGNS MU reference population)     | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b>         | <b>0.26</b>                 | <b>34,461</b>        | 0.8               | 1.7                            | 0.44 grey seal (0.001% of the SE England MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)</b> | <b>0.26</b>                 | <b>60,310</b>        | 0.8               | 1.7                            | 0.44 grey seal (0.0007% of the Wider reference population)        | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 0.8               | 1.7                            | 0.66 grey seal (0.001% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)               | 0.386                       | 60,310               | 0.8               | 1.7                            | 0.66 grey seal (0.001% of the Wider reference population)         | Negligible          |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b> | <b>0.001</b>                | <b>4,853</b>         | 0.8               | 1.7                            | 0.0017 harbour seal (0.00004% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                    | 0.0015                      | 4,853                | 0.8               | 1.7                            | 0.003 harbour seal (0.0001% of the SE England MU reference population)   | Negligible          |

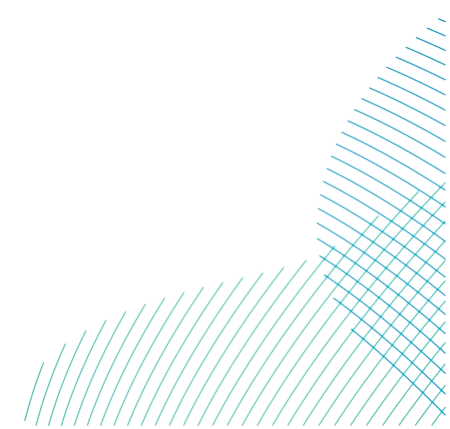


Table 11-11 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation of four sequentially installed piles of a pin pile jacket foundation ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| <b>DBS East (South location)</b>                                                  |                             |                      |                   |                                |                                                                            |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                  | 0.275                       | 346,601              | 7.9               | 140                            | 38.5 harbour porpoise (0.01% of the NS MU reference population)            | Medium              |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | <b>0.888</b>                | <b>346,601</b>       | 7.9               | 140                            | 124.32 harbour porpoise (0.04% of the NS MU reference population)          | Medium              |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.00011                     | 2,022                | < 0.1             | < 0.1                          | 0.00001 bottlenose dolphin (0.000001% of the GNS MU reference population)  | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.00014</b>              | <b>2,022</b>         | < 0.1             | < 0.1                          | 0.00001 bottlenose dolphin (0.0000007% of the GNS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)              | 0.029                       | 102,656              | < 0.1             | < 0.1                          | 0.0029 common dolphin (0.000003% of the CGNS MU reference population)        | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>       | <b>0.037</b>                | <b>102,656</b>       | < 0.1             | < 0.1                          | 0.004 common dolphin (0.000004% of the CGNS MU reference population)         | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.0052                      | 43,951               | < 0.1             | < 0.1                          | 0.001 white-beaked dolphin (0.000001% of the CGNS MU reference population)   | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | <b>0.0055</b>               | <b>43,951</b>        | < 0.1             | < 0.1                          | 0.00055 white-beaked dolphin (0.000001% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | 13                | 310                            | 3.1 minke whale (0.02% of the CGNS MU reference population)                  | Medium              |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array) | 0.0018                      | 20,118               | 13                | 310                            | 0.56 minke whale (0.003% of the CGNS MU reference population)                | Low                 |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 0.88              | 1.7                            | 0.31 grey seal (0.001% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 0.88              | 1.7                            | 0.31 grey seal (0.0005% of the Wider reference population)        | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | 0.88              | 1.7                            | 0.66 grey seal (0.002% of the SE England MU reference population) | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)        | 0.386                       | 60,310               | 0.88              | 1.7                            | 0.66 grey seal (0.001% of the Wider reference population)         | Low                 |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| <b>Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU)</b> | <b>0.0017</b>               | <b>4,853</b>         | 0.88              | 1.7                            | 0.003 harbour seal (0.0001% of the SE England MU reference population)    | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)                | 0.0015                      | 4,853                | 0.88              | 1.7                            | 0.0026 harbour seal (0.0001% of the SE England MU reference population)   | Negligible          |
| <b>DBS West (West location)</b>                                                            |                             |                      |                   |                                |                                                                           |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                           | 0.427                       | 346,601              | 8                 | 150                            | 64.1 harbour porpoise (0.02% of the NS MU reference population)           | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                                       | <b>0.888</b>                | <b>346,601</b>       | 8                 | 150                            | 133.2 harbour porpoise (0.038% of the NS MU reference population)         | Negligible          |
| Bottlenose dolphin (Waggitt et al. 2019, DBS West array annual Ave)                        | 0.00023                     | 2,022                | < 0.1             | < 0.1                          | 0.00002 bottlenose dolphin (0.000001% of the GNS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>   | <b>0.00025</b>              | <b>2,022</b>         | < 0.1             | < 0.1                          | 0.00003 bottlenose dolphin (0.0000012% of the GNS MU reference population)     | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)              | 0.032                       | 102,656              | < 0.1             | < 0.1                          | 0.003 common dolphin (0.0000031% of the CGNS MU reference population)          | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>       | <b>0.041</b>                | <b>102,656</b>       | < 0.1             | < 0.1                          | 0.0036 common dolphin (0.000004% of the CGNS MU reference population)          | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.011                       | 43,951               | < 0.1             | < 0.1                          | 0.0011 white-beaked dolphin (0.00000003 % of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | <b>0.012</b>                | <b>43,951</b>        | < 0.1             | < 0.1                          | 0.0012 white-beaked dolphin (0.00000003 % of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | 14                | 330                            | 3.3 minke whale (0.02% of the CGNS MU reference population)                    | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Minke whale (Waggett <i>et al.</i> 2019 annual density estimate for DBS West array)                    | 0.0025                      | 20,118               | 14                | 330                            | 0.83 minke whale (0.004% of the CGNS MU reference population)         | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b>         | <b>0.26</b>                 | <b>34,461</b>        | 0.95              | 2.1                            | 0.55 grey seal (0.002% of the SE England MU reference population)     | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)</b> | <b>0.26</b>                 | <b>60,310</b>        | 0.95              | 2.1                            | 0.546 grey seal (0.00091% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 0.95              | 2.1                            | 0.8106 grey seal (0.00235% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)          | 0.386                       | 60,310               | 0.95              | 2.1                            | 0.81 grey seal (0.001% of the Wider reference population)                | Negligible          |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b> | <b>0.001</b>                | <b>4,853</b>         | 0.95              | 2.1                            | 0.002 harbour seal (0.000043% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                    | 0.0015                      | 4,853                | 0.95              | 2.1                            | 0.003 harbour seal (0.0001% of the SE England MU reference population)   | Negligible          |

## 11.3.1.3. Assessment of the potential for permanent auditory injury (PTS) from pin pile jacket foundations due to concurrent piling at multiple pile locations

58. This section outlines the effect of concurrent installation of pin pile jacket foundations at three locations across the DBS modelling locations. **Plate 11-4** shows the results of the modelling for pin-piles, and **Table 11-12** provides the assessment of the potential for PTS onset due to the cumulative exposure of four sequentially installed piles at DBS East Array (South location), four sequentially installed piles at DBS West Array (West location) and four sequentially installed piles at Centre location.
59. The potential for PTS onset due to concurrent pin pile jacket foundation installation did not interact for seals and high frequency cetaceans (**Plate 11-4**). For harbour porpoise and minke whale, the results of the modelling for simultaneous piling for jacket pin piles are used in the assessments, whilst for both dolphin and seal species, the assessments for sequential piling are based on the results of the modelling at the three locations, summed together and are included in **Table 11-12**

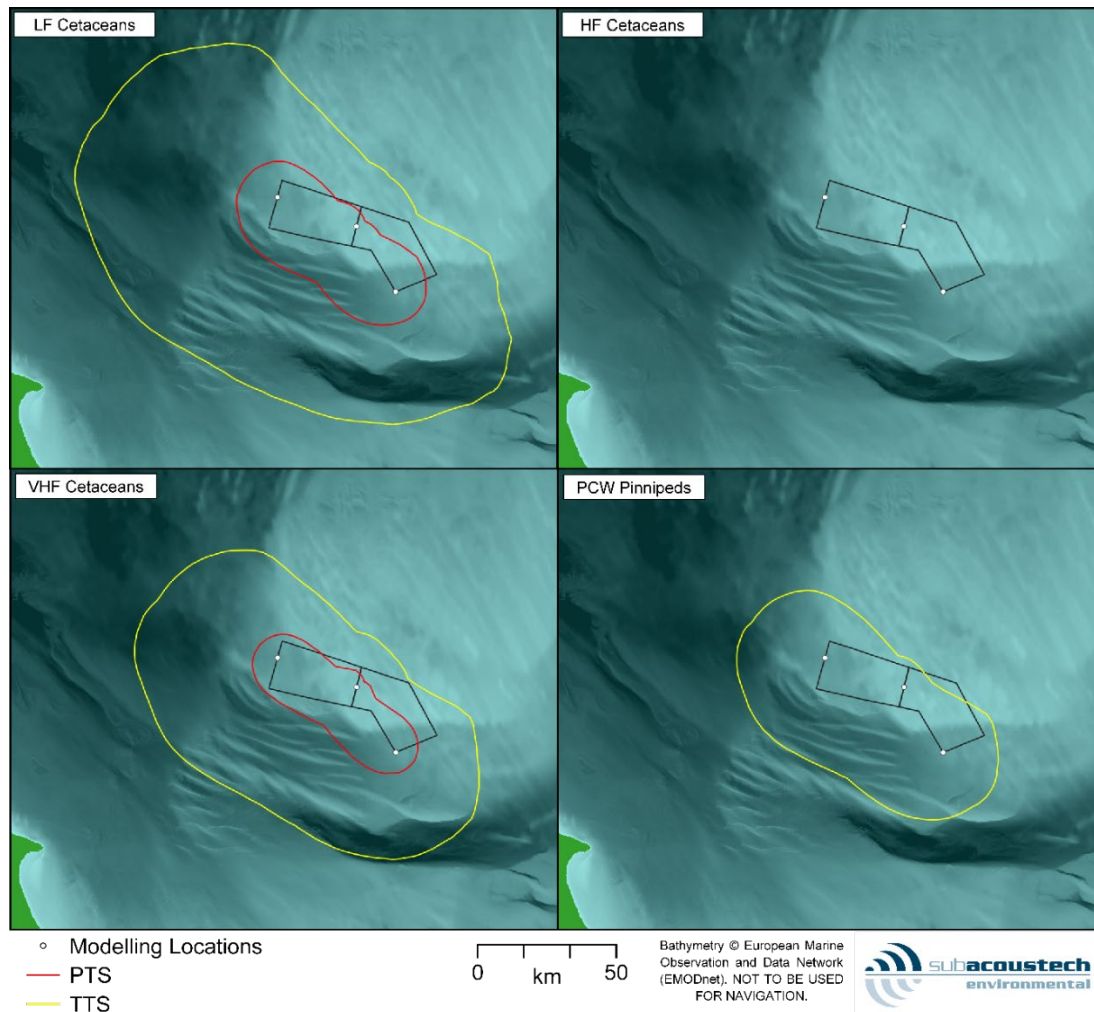


Plate 11-4 Contour plots for PTS (shown in red) and TTS onset (shown in yellow) due to the concurrent installation of pin pile jacket foundations at three locations across DBS modelling locations (**Appendix 11-2**)

Table 11-12 Underwater noise assessment for the potential of PTS onset from the cumulative exposure from the installation from a single strike from the maximum hammer energy of two sequentially installed piles at DBS East (South location), DBS West (West location) and a single pile at Centre location ( $SEL_{cum}$ ), including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| <b>Harbour porpoise (SCANS-III density estimate)</b>                         | 0.888                       | 346,601              | 1400                           | 1243.2 harbour porpoise (0.36% of the NS MU reference population)            | High                |
| Harbour porpoise (site-specific aerial summer density estimate to DBS East)  | 0.275                       | 346,601              | 1400                           | 385 harbour porpoise (0.11% of the NS MU reference population)               | High                |
| Harbour porpoise (site-specific aerial summer density estimates at DBS West) | 0.427                       | 346,601              | 1400                           | 597.8 harbour porpoise (0.17% of the NS MU reference population)             | High                |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)   | 0.00025                     | 2,022                | 0.3                            | 0.000075 bottlenose dolphin (0.00000002% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                 | 0.00014                     | 2,022                | 0.3                            | 0.000042 bottlenose dolphin (0.00000002% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | 0.0016                      | 2,022                | 0.3                            | 0.00048 bottlenose dolphin (0.000024% of the GNS MU reference population)    | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                     | 0.037                       | 102,656              | 0.3                            | 0.0111 common dolphin (0.0000001% of the CGNS MU reference population)       | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>              | 0.041                       | 102,656              | 0.3                            | 0.0123 common dolphin (0.00000012% of the CGNS MU reference population)      | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)            | 0.038                       | 102,656              | 0.3                            | 0.0114 common dolphin (0.0000001% of the CGNS MU reference population)       | Negligible          |

| Species scenario                                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|----------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                 | 0.0055                      | 43,951               | 0.3                            | 0.00165 white-beaked dolphin (0.00000004% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                 | 0.012                       | 43,951               | 0.3                            | 0.0036 white-beaked dolphin (0.00000008% of the CGNS MU reference population)  | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | 0.017                       | 43,951               | 0.3                            | 0.0051 white-beaked dolphin (0.0000001% of the CGNS MU reference population)   | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                              | 0.01                        | 20,118               | 2200                           | 22 minke whale (0.11% of the CGNS MU reference population)                     | High                |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)                 | 0.0075                      | 20,118               | 2200                           | 16.5 minke whale (0.08% of the CGNS MU reference population)                   | Medium              |

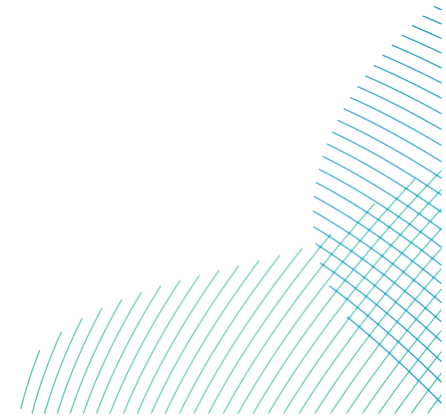
| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 3.9                            | 0.71 grey seal (0.00002% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 3.9                            | 0.71 (0.00001% of the Wider reference population)                   | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)</b>              | 0.386                       | 34,461               | 3.9                            | 1.51 grey seal (0.0044% of the SE England MU reference population)  | Low                 |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)</b> | 0.386                       | 60,310               | 3.9                            | 1.51 (0.0025% of the Wider reference population)                    | Low                 |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)           | 0.26                        | 34,461               | 3.9                            | 1.01 grey seal (0.003% of the SE England MU reference population)        | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)   | 0.26                        | 60,310               | 3.9                            | 1.01 (0.002% of the Wider reference population)                          | Low                 |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | 0.0017                      | 4,853                | 3.9                            | 0.0066 harbour seal (0.00014% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)        | 0.001                       | 4,853                | 3.9                            | 0.004 harbour seal (0.0001% of the SE England MU reference population)   | Negligible          |

# RWE

Dogger Bank South Offshore Wind Farms

| Species scenario                                                                   | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU) | 0.0015                      | 4,853                | 3.9                            | 0.01 harbour seal (0.0001% of the SE England MU reference population) | Negligible          |



## 11.3.2. Assessment for a temporary auditory injury (Temporary Threshold Shift (TTS))

11.3.2.1. Assessment of the potential for temporary auditory injury (TTS) from monopiles at a single piling location

- 60. **Table 11-13** to **Table 11-15** below provide the assessments for the potential of TTS onset due to monopile installation.
- 61. **Table 11-13** includes the assessment of the potential for TTS onset of a single monopile strike at the maximum hammer energy of 7,000kJ.
- 62. **Table 11-14** includes an assessment of the potential for TTS onset due to the cumulative exposure of one monopile installation, and **Table 11-15** includes the assessment for the potential for TTS onset due to the cumulative exposure of two monopile installations in one 24-hour period.

Table 11-13 Underwater noise assessment for the potential of TTS onset from a single strike from the maximum hammer energy of a monopile (SPL<sub>peak</sub>) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                          | Magnitude of effect |
|----------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------------|---------------------|
| DBS East (South location)                                                  |                             |                      |                   |                                |                                                                               |                     |
| Harbour porpoise (site-specific aerial summer density estimates)           | 0.275                       | 346,601              | 1.9               | 11                             | 3.12 harbour porpoise (0.001% of the NS MU reference population)              | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                       | 0.888                       | 346,601              | 1.9               | 11                             | 10.07 harbour porpoise (0.003% of the NS MU reference population)             | Negligible          |
| Bottlenose dolphin (Waggett <i>et al.</i> 2019, DBS East array annual Ave) | 0.00011                     | 2,022                | 0.05              | < 0.01                         | 0.0000009 bottlenose dolphin (0.00000004% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | 0.00014                     | 2,022                | < 0.05            | < 0.01                         | 0.000001 bottlenose dolphin (0.00000005% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)            | 0.029                       | 102,656              | < 0.05            | < 0.01                         | 0.0002 common dolphin (0.0000002% of the CGNS MU reference population)       | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>     | 0.037                       | 102,656              | < 0.05            | < 0.01                         | 0.0003 common dolphin (0.0000003% of the CGNS MU reference population)       | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.0052                      | 43,951               | < 0.05            | < 0.01                         | 0.00004 white-beaked dolphin (0.00000009% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | 0.0055                      | 43,951               | < 0.05            | < 0.01                         | 0.00004 white-beaked dolphin (0.0000001% of the CGNS MU reference population)  | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | 0.01                        | 20,118               | 0.13              | 0.05                           | 0.0005 minke whale (0.0000026% of the CGNS MU reference population)            | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array) | 0.0018                      | 20,118               | 0.13              | 0.05                           | 0.0001 minke whale (0.0000005% of the CGNS MU reference population)            | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b>         | 0.181                       | 34,461               | 0.16              | 0.07                           | 0.01 grey seal (0.000037% of the SE England MU reference population)  | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | 0.181                       | 60,310               | 0.16              | 0.07                           | 0.01 grey seal (0.000021% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 0.16              | 0.07                           | 0.027 grey seal (0.000078% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Grey seal<br>(Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)       | 0.386                       | 60,310               | 0.16              | 0.07                           | 0.027 grey seal (0.000045% of the Wider reference population)             | Negligible          |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | 0.0017                      | 4,853                | 0.16              | 0.07                           | 0.0001 harbour seal (0.000002% of the SE England MU reference population) | Negligible          |
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)             | 0.0015                      | 4,853                | 0.16              | 0.07                           | 0.0001 harbour seal (0.000002% of the SE England MU reference population) | Negligible          |

| Species scenario                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|----------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| DBS West (West location)                                                   |                             |                      |                   |                                |                                                                             |                     |
| Harbour porpoise (site-specific aerial summer density estimates)           | 0.427                       | 346,601              | 19                | 12                             | 5.12 harbour porpoise (0.001% of the NS MU reference population)            | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                       | 0.888                       | 346,601              | 19                | 12                             | 10.66 harbour porpoise (0.003% of the NS MU reference population)           | Negligible          |
| Bottlenose dolphin (Waggett <i>et al.</i> 2019, DBS West array annual Ave) | 0.00023                     | 2,022                | 0.05              | 0.01                           | 0.000002 bottlenose dolphin (0.0000001% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | 0.00025                     | 2,022                | 0.05              | 0.01                           | 0.000002 bottlenose dolphin (0.0000001% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)            | 0.032                       | 102,656              | 0.05              | 0.01                           | 0.00025 common dolphin (0.0000002% of the CGNS MU reference population)     | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>     | 0.041                       | 102,656              | 0.05              | 0.01                           | 0.0003 common dolphin (0.0000003% of the CGNS MU reference population)      | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.011                       | 43,951               | 0.05              | 0.01                           | 0.000086 white-beaked dolphin (0.0000002% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | 0.012                       | 43,951               | 0.05              | 0.01                           | 0.00009 white-beaked dolphin (0.0000002% of the CGNS MU reference population)  | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | 0.01                        | 20,118               | 0.13              | 0.06                           | 0.0006 minke whale (0.000003% of the CGNS MU reference population)             |                     |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array) | 0.0025                      | 20,118               | 0.13              | 0.06                           | 0.0002 minke whale (0.0000007% of the CGNS MU reference population)            | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b>         | 0.26                        | 34,461               | 0.16              | 0.08                           | 0.02 grey seal (0.00006% of the SE England MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)</b> | 0.26                        | 60,310               | 0.16              | 0.08                           | 0.02 grey seal (0.00003% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 0.16              | 0.08                           | 0.03 grey seal (0.00009% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| Grey seal<br>(Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)       | 0.386                       | 60,310               | 0.16              | 0.08                           | 0.03 grey seal (0.00005% of the Wider reference population)                | Negligible          |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b> | 0.001                       | 4,853                | 0.16              | 0.08                           | 0.00008 harbour seal (0.000002% of the SE England MU reference population) | Negligible          |
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                 | 0.0015                      | 4,853                | 0.16              | 0.08                           | 0.00012 harbour seal (0.000002% of the SE England MU reference population) | Negligible          |

Table 11-14 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation of one monopile in a 24 hour period ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference

| Species scenario                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|----------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| DBS East (South location)                                                  |                             |                      |                   |                                |                                                                         |                     |
| Harbour porpoise (site-specific aerial summer density estimates)           | 0.275                       | 346,601              | 48                | 3,800                          | 1045 harbour porpoise (0.3% of the NS MU reference population)          | Negligible          |
| Harbour porpoise (SCANS-III density estimate)                              | 0.888                       | 346,601              | 48                | 3,800                          | 3374.4 harbour porpoise (0.974% of the NS MU reference population)      | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave) | 0.00011                     | 2,022                | 28                | 4.3                            | 0.0006 bottlenose dolphin (0.00003% of the GNS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)   | 0.00014                     | 2,022                | 28                | 4.3                            | 0.0005bottlenose dolphin (0.000023%of the GNS MU reference population)    | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)       | 0.029                       | 102,656              | 28                | 4.3                            | 0.13 common dolphin (0.00012% of the CGNS MU reference population)        | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)       | 0.037                       | 102,656              | 28                | 4.3                            | 0.16 common dolphin (0.00015% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave) | 0.0052                      | 43,951               | 28                | 4.3                            | 0.02 white-beaked dolphin (0.000051% of the CGNS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)            | 0.0055                      | 43,951               | 28                | 4.3                            | 0.02 white-beaked dolphin (0.000054% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate)                                                | 0.01                        | 20,118               | 68                | 6,700                          | 67 minke whale (0.33% of the CGNS MU reference population)                | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array)     | 0.0018                      | 20,118               | 68                | 6,700                          | 12.06 minke whale (0.06% of the CGNS MU reference population)             | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.181                       | 34,461               | 28                | 1,400                          | 253.4 grey seal (0.74% of the SE England MU reference population)         | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 28                | 1,400                          | 253.4 grey seal (0.42% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | 28                | 1,400                          | 540.4 grey seal (1.57% of the SE England MU reference population) | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)        | 0.386                       | 60,310               | 28                | 1,400                          | 540.4 grey seal (0.9% of the Wider reference population)          | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 28                | 1,400                          | 2.4 harbour seal (0.05% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)  | 0.0015                      | 4,853                | 28                | 1,400                          | 2.1 harbour seal (0.04% of the SE England MU reference population) | Negligible          |
| DBS West (West location)                                                            |                             |                      |                   |                                |                                                                    |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                    | 0.427                       | 346,601              | 51                | 4800                           | 2049.6 harbour porpoise (0.591% of the NS MU reference population) | Negligible          |
| Harbour porpoise (SCANS-III density estimate)                                       | 0.888                       | 346,601              | 51                | 4800                           | 4262.4 harbour porpoise (1.23% of the NS MU reference population)  | Low                 |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|----------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave) | 0.00023                     | 2,022                | 1.4               | 4.8                            | 0.001 bottlenose dolphin (0.00005% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave) | 0.00025                     | 2,022                | 1.4               | 4.8                            | 0.001 bottlenose dolphin (0.00005% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)     | 0.032                       | 102,656              | 1.4               | 4.8                            | 0.15 common dolphin (0.00015% of the CGNS MU reference population)     | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)     | 0.041                       | 102,656              | 1.4               | 4.8                            | 0.2 common dolphin (0.00019% of the CGNS MU reference population)      | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.011                       | 43,951               | 1.4               | 4.8                            | 0.053 white-beaked dolphin (0.00012% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)        | 0.012                       | 43,951               | 1.4               | 4.8                            | 0.058 white-beaked dolphin (0.00013% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate)                                            | 0.01                        | 20,118               | 81                | 9800                           | 98 minke whale (0.49% of the CGNS MU reference population)                | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array) | 0.0025                      | 20,118               | 81                | 9800                           | 24.5 minke whale (0.12% of the CGNS MU reference population)              | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                             | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 30                | 1700                           | 442 grey seal (1.28% of the SE England MU reference population)  | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 30                | 1700                           | 442 grey seal (0.73% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | 30                | 1700                           | 656.2 grey seal (1.9% of the SE England MU reference population) | Low                 |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                              | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|-----------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Grey seal<br>(Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)   | 0.386                       | 60,310               | 30                | 1700                           | 656.2 grey seal (1.09% of the Wider reference population)           | Low                 |
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 30                | 1700                           | 1.7 harbour seal (0.04% of the SE England MU reference population)  | Negligible          |
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for ODA and the SE MU)             | 0.0015                      | 4,853                | 30                | 1700                           | 2.55 harbour seal (0.05% of the SE England MU reference population) | Negligible          |

Table 11-15 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation of two sequentially installed monopiles in a 24 hour period ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|----------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| DBS East (South location)                                                  |                             |                      |                   |                                |                                                                           |                     |
| Harbour porpoise (site-specific aerial summer density estimates)           | 0.275                       | 346,601              | 50                | 4,000                          | 1,100 harbour porpoise (0.32% of the NS MU reference population)          | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                       | 0.888                       | 346,601              | 50                | 4,000                          | 3,552 harbour porpoise (1.02% of the NS MU reference population)          | Low                 |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave) | 0.00011                     | 2,022                | 1.3               | 4.4                            | 0.00048 bottlenose dolphin (0.000024% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | 0.00014                     | 2,022                | 1.3               | 4.4                            | 0.0006 bottlenose dolphin (0.00003% of the GNS MU reference population)    | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)            | 0.029                       | 102,656              | 1.3               | 4.4                            | 0.13 common dolphin (0.00012% of the CGNS MU reference population)         | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>     | 0.037                       | 102,656              | 1.3               | 4.4                            | 0.16 common dolphin (0.00016% of the CGNS MU reference population)         | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)      | 0.0052                      | 43,951               | 1.3               | 4.4                            | 0.023 white-beaked dolphin (0.000052% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                               | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>            | 0.0055                      | 43,951               | 1.3               | 4.4                            | 0.024 white-beaked dolphin (0.000055% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                                | 0.01                        | 20,118               | 69                | 6,800                          | 68 minke whale (0.34% of the CGNS MU reference population)                 | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array)            | 0.0018                      | 20,118               | 69                | 6,800                          | 12.24 minke whale (0.06% of the CGNS MU reference population)              | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | 0.181                       | 34,461               | 30                | 1,500                          | 2,71.5 grey seal (0.79% of the SE England MU reference population)         | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | 0.181                       | 60,310               | 30                | 1,500                          | 2,71.5 grey seal (0.45% of the Wider reference population)           | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 30                | 1,500                          | 579 grey seal (1.68% of the SE England MU reference population)      | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)               | 0.386                       | 60,310               | 30                | 1,500                          | 579 grey seal (0.96% of the Wider reference population)              | Negligible          |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b>      | 0.0017                      | 4,853                | 30                | 1,500                          | 2. 6 harbour seal (0.053% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                   | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU) | 0.0015                      | 4,853                | 30                | 1,500                          | 2.25 harbour seal (0.046% of the SE England MU reference population)     | Negligible          |
| DBS West (West location)                                                           |                             |                      |                   |                                |                                                                          |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                   | 0.427                       | 346,601              | 57                | 5,200                          | 2,220.4 harbour porpoise (0.64% of the NS MU reference population)       | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                               | 0.888                       | 346,601              | 57                | 5,200                          | 4,617.6 harbour porpoise (1.33% of the NS MU reference population)       | Low                 |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)         | 0.00023                     | 2,022                | 1.4               | 4.9                            | 0.0011 bottlenose dolphin (0.000055% of the GNS MU reference population) | Negligible          |

# RWE

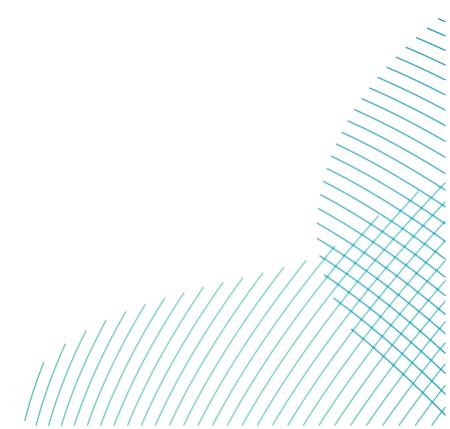
## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | 0.00025                     | 2,022                | 1.4               | 4.9                            | 0.001 bottlenose dolphin (0.0006% of the GNS MU reference population)      | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)            | 0.032                       | 102,656              | 1.4               | 4.9                            | 0.16 common dolphin (0.00015% of the CGNS MU reference population)         | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>     | 0.041                       | 102,656              | 1.4               | 4.9                            | 0.2 common dolphin (0.0002% of the CGNS MU reference population)           | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)      | 0.011                       | 43,951               | 1.4               | 4.9                            | 0.054 white-beaked dolphin (0.000123% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                               | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>            | 0.012                       | 43,951               | 1.4               | 4.9                            | 0.059 white-beaked dolphin (0.00013% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                                | 0.01                        | 20,118               | 82                | 10,000                         | 100 minke whale (0.5% of the CGNS MU reference population)                | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array)            | 0.0025                      | 20,118               | 82                | 10,000                         | 25 minke whale (0.12% of the CGNS MU reference population)                | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b> | 0.26                        | 34,461               | 33                | 1,900                          | 494 grey seal (1.43% of the SE England MU reference population)           | Low                 |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)</b> | 0.26                        | 60,310               | 33                | 1,900                          | 494 grey seal (0.82% of the Wider reference population)             | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 33                | 1,900                          | 733.4 grey seal (2.13% of the SE England MU reference population)   | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)               | 0.386                       | 60,310               | 33                | 1,900                          | 733.4 grey seal (1.22% of the Wider reference population)           | Low                 |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b>      | 0.001                       | 4,853                | 33                | 1,900                          | 1.9 harbour seal (0.039% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for ODA and the SE MU) | 0.0015                      | 4,853                | 33                | 1,900                          | 2.85 harbour seal (0.059% of the SE England MU reference population) | Negligible          |



## 11.3.2.2. Assessment of the potential for temporary auditory injury (TTS) from monopiles due to concurrent piling at multiple pile locations

63. This section outlines the effect of simultaneous monopile installations at DBS East, DBS West and the Centre location. **Plate 11-3** shows the results of the modelling for monopiles, and **Table 11-16** provides the assessment of the potential for TTS onset due to the cumulative exposure of two sequentially installed piles at both DBS East (South location) and DBS West (West location) as well as a single pile at the Centre location for harbour porpoise, minke whale and seal species. For dolphin species, the potential TTS ranges are significantly smaller, and do not interact with each other where there are simultaneous piling events at the same time.
64. **Table 11-17** presents the assessment of the potential effects for harbour porpoise, dolphin species and minke whale, where the areas at the combined modelling locations, for the cumulative exposure of multiple monopiles have been added together. Seal species have been excluded in this table as their worst case scenario has been assessed in **Table 11-16**.

Table 11-16 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation from a single strike from the maximum hammer energy of two sequentially installed piles at DBS East (South location), DBS West (West location) and a single pile at DBS East/West (Centre location) ( $SEL_{cum}$ ), including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                            | Magnitude of effect |
|------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-----------------------------------------------------------------|---------------------|
| Harbour porpoise (SCANS-III density estimate)                                | 0.888                       | 346,601              | 10,000                         | 8880 harbour porpoise (2.56% of the NS MU reference population) | Negligible          |
| Harbour porpoise (site-specific aerial summer density estimate to DBS East)  | 0.275                       | 346,601              | 10,000                         | 2750 harbour porpoise (0.79% of the NS MU reference population) | Low                 |
| Harbour porpoise (site-specific aerial summer density estimates at DBS West) | 0.427                       | 346,601              | 10,000                         | 4270 harbour porpoise (1.23% of the NS MU reference population) | Low                 |
| Minke whale (SCANS-III density estimate)                                     | 0.01                        | 20,118               | 17,000                         | 170 minke whale (0.85% of the CGNS MU reference population)     | Negligible          |
| Minke whale (Waggett <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0075                      | 20,118               | 17,000                         | 127.5 minke whale (0.63% of the CGNS MU reference population)   | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 5,100                          | 923.1 grey seal (2.68% of the SE England MU reference population)  | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 5,100                          | 923.1 grey seal (0.96% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 5,100                          | 1326 grey seal (3.85% of the SE England MU reference population)   | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 5,100                          | 1326 grey seal (1.38% of the Wider reference population)           | Low                 |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)</b>          | 0.386                       | 34,461               | 5,100                          | 1968.6 grey seal (5.71% of the SE England MU reference population) | Medium              |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)</b>   | 0.386                       | 60,310               | 5,100                          | 1968.6 grey seal (2.05% of the Wider reference population)         | Low                 |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | 0.0017                      | 4,853                | 5,100                          | 8.7 harbour seal (0.18% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)        | 0.001                       | 4,853                | 5,100                          | 5.1 harbour seal (0.11% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)                | 0.0015                      | 4,853                | 5,100                          | 7.7 harbour seal (0.16% of the SE England MU reference population) | Negligible          |

Table 11-17 Underwater noise assessment, based on the results of the modelling at the three locations, added together: potential of TTS onset from the cumulative exposure of sequential piling of two sequentially installed piles at DBS East (South location), DBS West (West location) and a single pile at DBS East/West (Centre location) ( $SEL_{cum}$ ) including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| <b>Harbour porpoise (SCANS-III density estimate)</b>                         | 0.888                       | 346,601              | 10,120                         | 8,986.56 harbour porpoise (2.59% of the NS MU reference population)     | Low                 |
| Harbour porpoise (site-specific aerial summer density estimate to DBS East)  | 0.275                       | 346,601              | 10,120                         | 2,783 harbour porpoise (0.8% of the NS MU reference population)         | Negligible          |
| Harbour porpoise (site-specific aerial summer density estimates at DBS West) | 0.427                       | 346,601              | 10,120                         | 4,321.24 harbour porpoise (1.25% of the NS MU reference population)     | Low                 |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)   | 0.00025                     | 2,022                | 9.4                            | 0.013 bottlenose dolphin (0.000007% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)   | 0.00014                     | 2,022                | 9.4                            | 0.001 bottlenose dolphin (0.000001% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | 0.0016                      | 2,022                | 9.4                            | 0.015 bottlenose dolphin (0.0007% of the GNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                     | 0.037                       | 102,656              | 9.4                            | 0.3 common dolphin (0.0003% of the CGNS MU reference population)        | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>              | 0.041                       | 102,656              | 9.4                            | 0.39 common dolphin (0.0004% of the CGNS MU reference population)       | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)            | 0.038                       | 102,656              | 9.4                            | 0.4 common dolphin (0.0004% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)               | 0.0055                      | 43,951               | 9.4                            | 0.05 white-beaked dolphin (0.0001% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|----------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                 | 0.012                       | 43,951               | 9.4                            | 0.11 white-beaked dolphin (0.0003% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | 0.017                       | 43,951               | 9.4                            | 0.16 white-beaked dolphin (0.0004% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                              | 0.01                        | 20,118               | 18,400                         | 184 minke whale (0.91% of the CGNS MU reference population)             | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)                 | 0.0075                      | 20,118               | 18,400                         | 138 minke whale (0.69% of the CGNS MU reference population)             | Negligible          |

11.3.2.3. Assessment of the potential for temporary auditory injury (TTS) from pin pile jacket foundations at a single piling location

- 65. **Table 11-18** to **Table 11-20** below provide the assessments for the potential of TTS onset due to pin-pile installation.
- 66. **Table 11-18** includes the assessment of the potential for TTS onset of a single pin-pile strike at the maximum hammer energy of 7,000kJ.
- 67. **Table 11-19** includes an assessment of the potential for TTS onset due to the cumulative exposure of one pin-pile installation, and **Table 11-20** includes the assessment for the potential for TTS onset due to the cumulative exposure of four sequentially installed pin-pile installations in one 24 hour period.

Table 11-18 Underwater noise assessment for the potential of TTS onset from a single strike from the maximum hammer energy of a pin pile jacket foundation ( $SPL_{peak}$ ) at the worst case modelling location for the DBS array areas, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                             | Magnitude of effect |
|------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------|---------------------|
| DBS East (South location)                                        |                             |                      |                   |                                |                                                                  |                     |
| Harbour porpoise (site-specific aerial summer density estimates) | 0.275                       | 346,601              | 1.5               | 7.1                            | 1.95 harbour porpoise (0.001% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>             | 0.888                       | 346,601              | 1.5               | 7.1                            | 6.3 harbour porpoise (0.002% of the NS MU reference population)  | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                          | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.00011                     | 2,022                | 0.05              | 0.01                           | 0.000001 bottlenose dolphin (0.00000005% of the GNS MU reference population)  | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | 0.00014                     | 2,022                | 0.05              | 0.01                           | 0.0000014 bottlenose dolphin (0.00000007% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)            | 0.029                       | 102,656              | 0.05              | 0.01                           | 0.0003 common dolphin (0.0000003% of the CGNS MU reference population)        | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>       | 0.037                       | 102,656              | 0.05              | 0.01                           | 0.0004 common dolphin (0.0000004% of the CGNS MU reference population)         | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.0052                      | 43,951               | 0.05              | 0.01                           | 0.00005 white-beaked dolphin (0.00000012% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | 0.0055                      | 43,951               | 0.05              | 0.01                           | 0.00006 white-beaked dolphin (0.00000013% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                               | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| <b>Minke whale (SCANS-III density estimate)</b>                                                | 0.01                        | 20,118               | 0.1               | 0.03                           | 0.0003 minke whale (0.0000015% of the CGNS MU reference population)  | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array)            | 0.0018                      | 20,118               | 0.1               | 0.03                           | 0.00005 minke whale (0.0000003% of the CGNS MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | 0.181                       | 34,461               | 0.12              | 0.05                           | 0.01 grey seal (0.000026% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | 0.181                       | 60,310               | 0.12              | 0.05                           | 0.01 grey seal (0.000015% of the Wider reference population)       | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 0.12              | 0.05                           | 0.02 grey seal (0.0001% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)               | 0.386                       | 60,310               | 0.12              | 0.05                           | 0.02 grey seal (0.00003% of the Wider reference population)        | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 0.12              | 0.05                           | 0.00009 harbour seal (0.000002% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 0.12              | 0.05                           | 0.0001 harbour seal (0.000002% of the SE England MU reference population)  | Negligible          |
| DBS West (West location)                                                            |                             |                      |                   |                                |                                                                            |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                    | 0.427                       | 346,601              | 1.6               | 7.5                            | 3.2 harbour porpoise (0.001% of the NS MU reference population)            | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | 0.888                       | 346,601              | 1.6               | 7.5                            | 6.7 harbour porpoise (0.002% of the NS MU reference population)              | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.00023                     | 2,022                | 0.05              | 0.01                           | 0.000002 bottlenose dolphin (0.00000009% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | 0.00025                     | 2,022                | 0.05              | 0.01                           | 0.000002 bottlenose dolphin (0.0000001% of the GNS MU reference population)  | Negligible          |

| Species scenario                                                              | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|-------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.032                       | 102,656              | 0.05              | 0.01                           | 0.00025 common dolphin (0.0000002% of the CGNS MU reference population)        | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | 0.041                       | 102,656              | 0.05              | 0.01                           | 0.0003 common dolphin (0.0000003% of the CGNS MU reference population)         | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)  | 0.011                       | 43,951               | 0.05              | 0.01                           | 0.000086 white-beaked dolphin (0.0000002% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                          | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)        | 0.012                       | 43,951               | 0.05              | 0.01                           | 0.00009 white-beaked dolphin (0.0000002% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate)                                            | 0.01                        | 20,118               | 0.11              | 0.03                           | 0.0003 minke whale (0.0000015% of the CGNS MU reference population)           | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array) | 0.0025                      | 20,118               | 0.11              | 0.03                           | 0.0001 minke whale (0.0000004% of the CGNS MU reference population)           | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 0.12              | 0.05                           | 0.012 grey seal (0.00003% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 0.12              | 0.05                           | 0.01 grey seal (0.00002% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | 0.12              | 0.05                           | 0.02 grey seal (0.00005% of the SE England MU reference population)  | Negligible          |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| Grey seal<br>(Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)       | 0.386                       | 60,310               | 0.12              | 0.05                           | 0.02 grey seal (0.00003% of the Wider reference population)                 | Negligible          |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b> | 0.001                       | 4,853                | 0.12              | 0.05                           | 0.00005 harbour seal (0.0000009% of the SE England MU reference population) | Negligible          |
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                 | 0.0015                      | 4,853                | 0.12              | 0.05                           | 0.00007 harbour seal (0.000001% of the SE England MU reference population)  | Negligible          |

Table 11-19 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation of a single pile of a pin pile jacket foundation ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array, including all potential density estimates and reference populations

| Species scenario                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|----------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| DBS East (South location)                                                  |                             |                      |                   |                                |                                                                           |                     |
| Harbour porpoise (site-specific aerial summer density estimates)           | 0.275                       | 346,601              | 39                | 2700                           | 742.5 harbour porpoise (0.21% of the NS MU reference population)          | Negligible          |
| Harbour porpoise (SCANS-III density estimate)                              | 0.888                       | 346,601              | 39                | 2700                           | 2397.6 harbour porpoise (0.69% of the NS MU reference population)         | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave) | 0.00011                     | 2,022                | 0.28              | 0.2                            | 0.00003 bottlenose dolphin (0.000001% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave) | 0.00014                     | 2,022                | 0.28              | 0.2                            | 0.00003 bottlenose dolphin (0.000002% of the GNS MU reference population) | Negligible          |

| Species scenario                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)       | 0.029                       | 102,656              | 0.28              | 0.2                            | 0.01 common dolphin (0.00001% of the CGNS MU reference population)         | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)       | 0.037                       | 102,656              | 0.28              | 0.2                            | 0.01 common dolphin (0.00001% of the CGNS MU reference population)         | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave) | 0.0052                      | 43,951               | 0.28              | 0.2                            | 0.001 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave) | 0.0055                      | 43,951               | 0.28              | 0.2                            | 0.001 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate)                                     | 0.01                        | 20,118               | 58                | 5000                           | 50 minke whale (0.25% of the CGNS MU reference population)                 | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                            | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------|---------------------|
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array)             | 0.0018                      | 20,118               | 58                | 5000                           | 9 minke whale (0.04% of the CGNS MU reference population)       | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 24                | 1000                           | 181 grey seal (0.53% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 24                | 1000                           | 181 grey seal (0.3% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | 24                | 1000                           | 386 grey seal (1.12% of the SE England MU reference population) | Low                 |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)   | 0.386                       | 60,310               | 24                | 1000                           | 386 grey seal (0.64% of the Wider reference population)            | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 24                | 1000                           | 1.7 harbour seal (0.04% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 24                | 1000                           | 1.5 harbour seal (0.03% of the SE England MU reference population) | Negligible          |
| DBS West (West location)                                                                   |                             |                      |                   |                                |                                                                    |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                           | 0.427                       | 346,601              | 43                | 3200                           | 2841.6 harbour porpoise (0.82% of the NS MU reference population)  | Negligible          |

| Species scenario                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|----------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Harbour porpoise (SCANS-III density estimate)                              | 0.888                       | 346,601              | 43                | 3200                           | 1366.4 harbour porpoise (0.394% of the NS MU reference population)        | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave) | 0.00023                     | 2,022                | 0.33              | 0.2                            | 0.0001 bottlenose dolphin (0.000002% of the GNS MU reference population)  | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave) | 0.00025                     | 2,022                | 0.33              | 0.2                            | 0.00005 bottlenose dolphin (0.000002% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)     | 0.032                       | 102,656              | 0.33              | 0.2                            | 0.01 common dolphin (0.00001% of the CGNS MU reference population)        | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)     | 0.041                       | 102,656              | 0.33              | 0.2                            | 0.01 common dolphin (0.00001% of the CGNS MU reference population)        | Negligible          |

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)            | 0.011                       | 43,951               | 0.33              | 0.2                            | 0.002 white-beaked dolphin (0.000005% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)            | 0.012                       | 43,951               | 0.33              | 0.2                            | 0.002 white-beaked dolphin (0.000005% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate)                                                | 0.01                        | 20,118               | 68                | 7000                           | 70 minke whale (0.35% of the CGNS MU reference population)                 | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array)     | 0.0025                      | 20,118               | 68                | 7000                           | 17.5 minke whale (0.09% of the CGNS MU reference population)               | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.26                        | 34,461               | 24                | 1100                           | 286 grey seal (0.83% of the SE England MU reference population)            | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 24                | 1100                           | 286 grey seal (0.3% of the Wider reference population)             | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                     | 0.386                       | 34,461               | 24                | 1100                           | 424.6 grey seal (1.23% of the SE England MU reference population)  | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)        | 0.386                       | 60,310               | 24                | 1100                           | 424.6 grey seal (0.44% of the Wider reference population)          | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)      | 0.001                       | 4,853                | 24                | 1100                           | 1.1 harbour seal (0.02% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                     | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|--------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Harbour seal<br>(Carter <i>et al.</i><br>2022 average density for ODA and the SE MU) | 0.0015                      | 4,853                | 24                | 1100                           | 1.65 harbour seal (0.03% of the SE England MU reference population) | Negligible          |

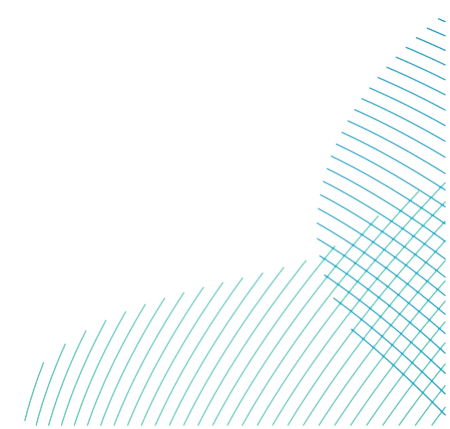


Table 11-20 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation of four sequentially installed piles of a pin pile jacket foundation ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| DBS East (South location)                                                         |                             |                      |                   |                                |                                                                             |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                  | 0.275                       | 346,601              | 44                | 3100                           | 852.5 harbour porpoise (0.25% of the NS MU reference population)            | Negligible          |
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | 0.888                       | 346,601              | 44                | 3100                           | 2752.8 harbour porpoise (0.79% of the NS MU reference population)           | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.00011                     | 2,022                | 0.33              | 0.2                            | 0.00002 bottlenose dolphin (0.000001% of the GNS MU reference population)   | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | 0.00014                     | 2,022                | 0.33              | 0.2                            | 0.00003 bottlenose dolphin (0.00000001% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)              | 0.029                       | 102,656              | 0.33              | 0.2                            | 0.007 common dolphin (0.000007% of the CGNS MU reference population)       | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>       | 0.037                       | 102,656              | 0.33              | 0.2                            | 0.009 common dolphin (0.000009% of the CGNS MU reference population)       | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)        | 0.0052                      | 43,951               | 0.33              | 0.2                            | 0.001 white-beaked dolphin (0.000002% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b> | 0.0055                      | 43,951               | 0.33              | 0.2                            | 0.001 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                     | 0.01                        | 20,118               | 60                | 5200                           | 52 minke whale (0.26% of the CGNS MU reference population)                 | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array)                    | 0.0018                      | 20,118               | 60                | 5200                           | 9.36 minke whale (0.05% of the CGNS MU reference population)      | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b>         | 0.181                       | 34,461               | 28                | 1300                           | 235.3 grey seal (0.68% of the SE England MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | 0.181                       | 60,310               | 28                | 1300                           | 235.3 grey seal (0.39% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 28                | 1300                           | 501.8 grey seal (1.46% of the SE England MU reference population) | Low                 |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)          | 0.386                       | 60,310               | 28                | 1300                           | 501.8 grey seal (0.83% of the Wider reference population)           | Negligible          |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | 0.0017                      | 4,853                | 28                | 1300                           | 2.2 harbour seal (0.046% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)                | 0.0015                      | 4,853                | 28                | 1300                           | 1.95 harbour seal (0.04% of the SE England MU reference population) | Negligible          |
| DBS West (West location)                                                                          |                             |                      |                   |                                |                                                                     |                     |
| Harbour porpoise (site-specific aerial summer density estimates)                                  | 0.427                       | 346,601              | 50                | 4000                           | 1708 harbour porpoise (0.49% of the NS MU reference population)     | Low                 |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| <b>Harbour porpoise (SCANS-III density estimate)</b>                              | 0.888                       | 346,601              | 50                | 4000                           | 3552 harbour porpoise (1.02% of the NS MU reference population)           | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.00023                     | 2,022                | 0.35              | 0.3                            | 0.0001 bottlenose dolphin (0.000003% of the GNS MU reference population)  | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b> | 0.00025                     | 2,022                | 0.35              | 0.3                            | 0.00008 bottlenose dolphin (0.000004% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)            | 0.032                       | 102,656              | 0.35              | 0.3                            | 0.01 common dolphin (0.00001% of the CGNS MU reference population)        | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>     | 0.041                       | 102,656              | 0.35              | 0.3                            | 0.01 common dolphin (0.00001% of the CGNS MU reference population)        | Negligible          |

| Species scenario                                                                               | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)                   | 0.011                       | 43,951               | 0.35              | 0.3                            | 0.003 white-beaked dolphin (0.000008% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>            | 0.012                       | 43,951               | 0.35              | 0.3                            | 0.004 white-beaked dolphin (0.000008% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate)</b>                                                | 0.01                        | 20,118               | 72                | 7500                           | 75 minke whale (0.37% of the CGNS MU reference population)                 | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array)            | 0.0025                      | 20,118               | 72                | 7500                           | 18.75 minke whale (0.09% of the CGNS MU reference population)              | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b> | 0.26                        | 34,461               | 31                | 1600                           | 416 grey seal (1.21% of the SE England MU reference population)            | Low                 |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)</b> | 0.26                        | 60,310               | 31                | 1600                           | 416 grey seal (0.69% of the Wider reference population)             | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                            | 0.386                       | 34,461               | 31                | 1600                           | 617.6 grey seal (1.79% of the SE England MU reference population)   | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)               | 0.386                       | 60,310               | 31                | 1600                           | 617.6 grey seal (1.02% of the Wider reference population)           | Low                 |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b>      | 0.001                       | 4,853                | 31                | 1600                           | 1.6 harbour seal (0.033% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for ODA and the SE MU) | 0.0015                      | 4,853                | 31                | 1600                           | 2.4 harbour seal (0.049% of the SE England MU reference population) | Negligible          |

## 11.3.2.4. Assessment of the potential for temporary auditory injury (TTS) from pin pile jacket foundations due to concurrent piling at multiple pile locations

68. This section outlines the effect of simultaneous monopile installations at DBS East, DBS West and the Centre location. **Plate 11-4** shows the results of the modelling for pin-piles, and **Table 11-21** provides the assessment of the potential for TTS onset due to the cumulative exposure of four sequentially installed piles at each of the locations: DBS East (South location), DBS West (West location) and the Centre location.
69. The potential for TTS onset due to concurrent pin pile jacket foundation installation did not interact for high frequency cetaceans (dolphins) (**Plate 11-4**). The assessments for dolphins during sequential piling are based on the results of the modelling at the three locations, summed together and are included in **Table 11-21**.
70. The potential for PTS onset due to concurrent pin pile jacket foundation installation did not interact for seals and high frequency cetaceans (**Plate 11-4**). For harbour porpoise, minke whale and seals species, the results of the modelling for simultaneous piling for jacket pin piles are used in the assessments, whilst for dolphin species, the assessments for sequential piling are based on the results of the modelling at the three locations, summed together and are included in **Table 11-21**.

Table 11-21 Underwater noise assessment for the potential of TTS onset from the cumulative exposure from the installation from a single strike from the maximum hammer energy of four sequentially installed piles at each of the locations: DBS East (South location), DBS West (West location) and the Centre location ( $SEL_{cum}$ ), including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| <b>Harbour porpoise (SCANS-III density estimate)</b>                         | 0.888                       | 346,601              | 8,800                          | 7814.4 harbour porpoise (2.25% of the NS MU reference population) | Low                 |
| Harbour porpoise (site-specific aerial summer density estimate to DBS East)  | 0.275                       | 346,601              | 8,800                          | 2420 harbour porpoise (0.7% of the NS MU reference population)    | Negligible          |
| Harbour porpoise (site-specific aerial summer density estimates at DBS West) | 0.427                       | 346,601              | 8,800                          | 3757.6 harbour porpoise (1.08% of the NS MU reference population) | Low                 |

| Species scenario                                                                         | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                            | Magnitude of effect |
|------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-----------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA)         | 0.415                       | 346,601              | 8,800                          | 3652 harbour porpoise (1.05% of the NS MU reference population) | Low                 |
| <b>Minke whale (SCANS-III density estimate)</b>                                          | 0.01                        | 20,118               | 14,000                         | 140 minke whale (0.7% of the CGNS MU reference population)      | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS East array area) | 0.0018                      | 20,118               | 14,000                         | 25.2 minke whale (0.13% of the CGNS MU reference population)    | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for DBS West array area) | 0.0025                      | 20,118               | 14,000                         | 140 minke whale (0.7% of the CGNS MU reference population)      | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)                    | 0.0075                      | 20,118               | 14,000                         | 105 minke whale (0.52% of the CGNS MU reference population)       | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 4,700                          | 850.7 grey seal (2.47% of the SE England MU reference population) | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 4,700                          | 850.7 grey seal (1.41% of the Wider reference population)         | Low                 |

| Species scenario                                                                                   | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|----------------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal<br>(Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 4,700                          | 1222 grey seal (3.55% of the SE England MU reference population)   | Low                 |
| Grey seal<br>(Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 4,700                          | 1222 grey seal (2.03% of the Wider reference population)           | Low                 |
| <b>Grey seal<br/>(Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)</b>         | 0.386                       | 34,461               | 4,700                          | 1814.2 grey seal (5.26% of the SE England MU reference population) | Medium              |

| Species scenario                                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|---------------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)</b>   | 0.386                       | 60,310               | 4,700                          | 1814.2 grey seal (3.01% of the Wider reference population)          | Low                 |
| <b>Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | 0.0017                      | 4,853                | 4,700                          | 7.99 harbour seal (0.16% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)        | 0.001                       | 4,853                | 4,700                          | 4.7 harbour seal (0.1% of the SE England MU reference population)   | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 4,700                          | 7.05 harbour seal (0.15% of the SE England MU reference population)       | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                 | 0.00025                     | 2,022                | 0.6                            | 0.0002 bottlenose dolphin (0.0000001% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                 | 0.00014                     | 2,022                | 0.6                            | 0.0001 bottlenose dolphin (0.0000004% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | 0.0016                      | 2,022                | 0.6                            | 0.001 bottlenose dolphin (0.00005% of the GNS MU reference population)    | Negligible          |

| Species scenario                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|---------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.037                       | 102,656              | 0.6                            | 0.022 common dolphin (0.0000002% of the CGNS MU reference population)       | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>   | 0.041                       | 102,656              | 0.6                            | 0.02 common dolphin (0.0000002% of the CGNS MU reference population)        | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.038                       | 102,656              | 0.6                            | 0.023 common dolphin (0.0000002% of the CGNS MU reference population)       | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)    | 0.0055                      | 43,951               | 0.6                            | 0.003 white-beaked dolphin (0.0000001% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                              | Density (/km <sup>2</sup> ) | Reference population | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|-----------------------------------------------------------------------------------------------|-----------------------------|----------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Wag-gitt <i>et al.</i> 2019, DBS West array summer Ave)                 | 0.012                       | 43,951               | 0.6                            | 0.007 white-beaked dolphin (0.0000002% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Wag-gitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | 0.017                       | 43,951               | 0.6                            | 0.01 white-beaked dolphin (0.0000002% of the CGNS MU reference population)  | Negligible          |

## 11.4. Assessment of underwater noise effects from other construction activities

### 11.4.1. Underwater noise modelling

71. Subacoustech Environmental Ltd undertook underwater noise modelling for other sources of underwater noise associated with the Projects. The other sources of noise include;
- Cable laying;
    - Underwater noise associated with the cable laying vessel and activities during offshore cable installation.
  - Dredging;
    - Dredging as required for seabed preparation works, and for the export, array, and interconnector cable installation activities. Suction dredging has been modelled as represents the worst case in terms of underwater noise.
  - Trenching;
    - Plough trenching may be required during offshore construction works.
  - Rock placement;
    - Rock placement is potentially required for cable and/or scour protections.
72. Underwater noise from vessels, and operational turbine noise were also modelled, and are assessed in sections 11.5 and 11.6 respectively.
73. A simple modelling approach has been used to determine the potential effect ranges associated with these activities. More detail on the approach used can be found in **Appendix 11-2**. This modelling approach does not take into account the site-specific bathymetry or any other environmental conditions.
74. The predicted source levels of each of these activities has been derived based on Subacoustech Environmental Ltd's own underwater noise measurement database.
- Cable laying;
    - Underwater source level of 171 dB re 1  $\mu$ Pa @ 1m (RMS), based on 11 datasets of a pipe laying vessel of 300m in length.
  - Suction dredging;

- Underwater source level of 186 dB re 1  $\mu$ Pa @ 1m (RMS), based on five datasets of suction and cutter suction dredgers.
  - Trenching;
    - Underwater source level of 172 dB re 1  $\mu$ Pa @ 1m (RMS), based on three datasets of a trenching vessel of more than 100m in length.
  - Rock placement;
    - Underwater source level of 172 dB re 1  $\mu$ Pa @ 1m (RMS), based on four datasets from a rock placement vessel.
75. To account for the frequency weightings within the Southall *et al.* (2019) thresholds, reductions in the source levels have been applied for each species grouping. See **Appendix 11-2** for further detail, and for the corrected source noise levels for the above listed sound sources.
76. The results of the underwater noise modelling using this simple modelling approach does not define effect ranges of less than 100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably less than this).
77. For the cumulative exposure ranges for these noise sources it has been assumed that the noise will be present for 12 hours within a 24 hour period.

#### 11.4.2. Assessment for auditory injury (TTS) for a single activity

78. Table 11-22 (all species but harbour porpoise) and Table 11-23. (harbour porpoise assessed separately) includes the assessment of the potential for TTS onset due to the cable laying, suction dredging, trenching, and rock placement activities that may occur in either the construction or operation and maintenance phases. The cumulative exposures are based on the noise source being present for 12 hours in any 24-hour period.

Table 11-22 Underwater noise assessment for the potential of TTS onset due to cable laying, suction dredging, trenching and rock placement ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area for bottlenose dolphin, common dolphin, white-beaked dolphin, minke whale, grey seal, and harbour seal, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| <b>Bottlenose dolphin (Waggitt et al. 2019, DBS West array summer Ave)</b>          | <b>0.00025</b>              | <b>2,022</b>         | 0.1               | 0.03                           | 0.000008 bottlenose dolphin (0.0000003% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt et al. 2019, DBS East array summer Ave)</b>          | <b>0.00014</b>              | <b>2,022</b>         | 0.1               | 0.03                           | 0.000004 bottlenose dolphin (0.0000002% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt et al. 2019 annual density estimate for the ODA)        | 0.0016                      | 2,022                | 0.1               | 0.03                           | 0.00005 bottlenose dolphin (0.0000025% of the GNS MU reference population)  | Negligible          |
| <b>Bottlenose dolphin (Waggitt et al. 2019 annual density estimate for the ECC)</b> | <b>0.0013</b>               | <b>2,022</b>         | 0.1               | 0.03                           | 0.00004 bottlenose dolphin (0.000002% of the GNS MU reference population)   | Negligible          |

| Species scenario                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                          | Magnitude of effect |
|----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------------|---------------------|
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>          | <b>0.041</b>                | <b>102,656</b>       | 0.1               | 0.03                           | 0.0013 common dolphin (0.0000013% of the CGNS MU reference population)        | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>          | <b>0.037</b>                | <b>102,656</b>       | 0.1               | 0.03                           | 0.0012 common dolphin (0.0000011% of the CGNS MU reference population)        | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)        | 0.038                       | 102,656              | 0.1               | 0.03                           | 0.0015 common dolphin (0.0000015% of the CGNS MU reference population)        | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.073</b>                | <b>102,656</b>       | 0.1               | 0.03                           | 0.002 common dolphin (0.0000022% of the CGNS MU reference population)         | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>    | <b>0.011</b>                | <b>43,951</b>        | 0.1               | 0.03                           | 0.00038 white-beaked dolphin (0.0000009% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                          | Magnitude of effect |
|----------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------------|---------------------|
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>          | <b>0.0052</b>               | <b>43,951</b>        | 0.1               | 0.03                           | 0.00017 white-beaked dolphin (0.0000004% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)        | 0.017                       | 43,951               | 0.1               | 0.03                           | 0.00053 white-beaked dolphin (0.0000012% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.046</b>                | <b>43,951</b>        | 0.1               | 0.03                           | 0.001 white-beaked dolphin (0.000003% of the CGNS MU reference population)    | Negligible          |
| <b>Minke whale (SCANS-III density estimate) DBS East</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | 0.1               | 0.03                           | 0.00031 minke whale (0.0000016% of the CGNS MU reference population)          | Negligible          |
| <b>Minke whale (SCANS-III density estimate) DBS West</b>                                     | <b>0.01</b>                 | <b>20,118</b>        | 0.1               | 0.03                           | 0.00031 minke whale (0.0000016% of the CGNS MU reference population)          | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Minke whale (Wag-gitt <i>et al.</i> 2019 annual density estimate for the ODA)                          | 0.01                        | 20,118               | 0.1               | 0.03                           | 0.00024 minke whale (0.000001% of the CGNS MU reference population)    | Negligible          |
| Minke whale (Wag-gitt <i>et al.</i> 2019 annual density estimate for the ECC)                          | 0.01                        | 20,118               | 0.1               | 0.03                           | 0.00031 minke whale (0.000002% of the CGNS MU reference population)    | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b>         | <b>0.181</b>                | <b>34,461</b>        | 0.1               | 0.03                           | 0.0057 grey seal (0.000017% of the SE England MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | <b>0.181</b>                | <b>60,310</b>        | 0.1               | 0.03                           | 0.0057 grey seal (0.0000038% of the Wider reference population)        | Negligible          |

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)                 | 0.26                        | 34,461               | 0.1               | 0.03                           | 0.0082 grey seal (0.000024% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)         | 0.26                        | 60,310               | 0.1               | 0.03                           | 0.0082 grey seal (0.000014% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 0.1               | 0.03                           | 0.012 grey seal (0.00004% of the SE England MU reference population)   | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 0.1               | 0.03                           | 0.012 grey seal (0.00002% of the Wider reference population)           | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                | 0.531                       | 34,461               | 0.1               | 0.03                           | 0.017 grey seal (0.00005% of the SE England MU reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)       | 0.531                       | 60,310               | 0.1               | 0.03                           | 0.017 grey seal (0.00003% of the Wider reference population)                 | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 0.1               | 0.03                           | 0.00005 harbour seal (0.0000011% of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 0.1               | 0.03                           | 0.000031 harbour seal (0.0000006% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                          | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|-------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)     | 0.0015                      | 4,853                | 0.1               | 0.03                           | 0.000047 harbour seal (0.000001% of the SE England MU reference population) | Negligible          |
| <b>Harbour seal<br/>(Carter <i>et al.</i> 2022 average density for ECC and the SE MU)</b> | <b>0.0017</b>               | <b>4,853</b>         | 0.1               | 0.03                           | 0.00005 harbour seal (0.0000011% of the SE England MU reference population) | Negligible          |

Table 11-23 Underwater noise assessment for the potential of TTS onset due to cable laying, suction dredging, trenching and rock placement ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area harbour porpoise including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Cable laying                                                                     |                             |                      |                   |                                |                                                                      |                     |
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)         | 0.275                       | 346,601              | 0.11              | 0.04                           | 0.011 harbour porpoise (0.000003% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Wag-gitt <i>et al.</i> 2019, DBS West array summer Ave)        | 0.427                       | 346601               | 0.11              | 0.04                           | 0.017 harbour porpoise (0.000005% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA) | 0.415                       | 346,601              | 0.11              | 0.04                           | 0.017 harbour porpoise (0.000005% of the NS MU reference population) | Negligible          |

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC) | 0.888                       | 346,601              | 0.11              | 0.04                           | 0.036 harbour porpoise (0.00001% of the NS MU reference population)  | Negligible          |
| <b>Suction dredging</b>                                                          |                             |                      |                   |                                |                                                                      |                     |
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)         | 0.275                       | 346,601              | 0.23              | 0.17                           | 0.047 harbour porpoise (0.000013% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Wag-gitt <i>et al.</i> 2019, DBS West array summer Ave)        | 0.427                       | 346601               | 0.23              | 0.17                           | 0.073 harbour porpoise (0.000021% of the NS MU reference population) | Negligible          |

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA)        | 0.415                       | 346,601              | 0.23              | 0.17                           | 0.071 harbour porpoise (0.00002% of the NS MU reference population)  | Negligible          |
| <b>Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)</b> | <b>0.888</b>                | <b>346,601</b>       | 0.23              | 0.17                           | 0.151 harbour porpoise (0.000043% of the NS MU reference population) | Negligible          |
| <b>Trenching</b>                                                                        |                             |                      |                   |                                |                                                                      |                     |
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                | 0.275                       | 346,601              | 0.1               | 0.03                           | 0.009 harbour porpoise (0.000002% of the NS MU reference population) | Negligible          |

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Wag-gitt et al. 2019, DBS West array summer Ave)               | 0.427                       | 346601               | 0.1               | 0.03                           | 0.013 harbour porpoise (0.000004% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt et al. 2019 annual density estimate of the ODA)        | 0.415                       | 346,601              | 0.1               | 0.03                           | 0.013 harbour porpoise (0.000004% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (Waggitt et al. 2019 annual density estimate of the ECC)</b> | <b>0.888</b>                | <b>346,601</b>       | 0.1               | 0.03                           | 0.028 harbour porpoise (0.000008% of the NS MU reference population) | Negligible          |
| <b>Rock placement</b>                                                            |                             |                      |                   |                                |                                                                      |                     |

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                | 0.275                       | 346,601              | 0.23              | 0.17                           | 0.847 harbour porpoise (0.00024% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                | 0.427                       | 346601               | 0.23              | 0.17                           | 1.32 harbour porpoise (0.00038% of the NS MU reference population)  | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA)        | 0.415                       | 346,601              | 0.23              | 0.17                           | 1.278 harbour porpoise (0.00037% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)</b> | <b>0.888</b>                | <b>346,601</b>       | 0.23              | 0.17                           | 2.74 harbour porpoise (0.00079% of the NS MU reference population)  | Negligible          |

### 11.4.3. Assessment for auditory injury for multiple activities

79. There is the potential that more than one of these other construction activities could be underway at either array area, or within the export cable corridors, at the same time. As a worst case and unlikely scenario, an assessment for all four activities being undertaken simultaneously has also been undertaken.
80. **Table 11-24** includes the assessment of the potential for TTS onset due to the cable laying, suction dredging, trenching, and rock placement activities could occur at the same time. The cumulative exposures are based on the noise source being present for 12 hours in any 24-hour period.

Table 11-24 Underwater noise assessment for the potential of TTS onset due to cable laying, suction dredging, trenching and rock placement undertaken at the same time ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)         | 0.275                       | 346,601              | 1.43              | 3.32                           | 0.91 harbour porpoise (0.0003% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Wag-gitt <i>et al.</i> 2019, DBS West array summer Ave)        | 0.427                       | 346601               | 1.43              | 3.32                           | 1.42 harbour porpoise (0.0004% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA) | 0.415                       | 346,601              | 1.43              | 3.32                           | 1.38 harbour porpoise (0.0004% of the NS MU reference population) | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| <b>Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)</b>    | <b>0.888</b>                | <b>346,601</b>       | 1.43              | 3.32                           | 2.95 harbour porpoise (0.0009% of the NS MU reference population)           | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                 | 0.00025                     | 2,022                | 0.4               | 0.12                           | 0.000031 bottlenose dolphin (0.0000016% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                 | 0.00014                     | 2,022                | 0.4               | 0.12                           | 0.000018 bottlenose dolphin (0.0000009% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | <b>0.0016</b>               | <b>2,022</b>         | 0.4               | 0.12                           | 0.0002 bottlenose dolphin (0.00001% of the GNS MU reference population)     | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 0.4               | 0.12                           | 0.009 common dolphin (0.000009% of the CGNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)              | 0.041                       | 102,656              | 0.4               | 0.12                           | 0.0052 common dolphin (0.000005% of the CGNS MU reference population)  | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)              | 0.037                       | 102,656              | 0.4               | 0.12                           | 0.0046 common dolphin (0.0000045% of the CGNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)     | 0.038                       | 102,656              | 0.4               | 0.12                           | 0.0062 common dolphin (0.000006% of the CGNS MU reference population)  | Negligible          |

| Species scenario                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| <b>Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.073</b>                | <b>102,656</b>       | 0.4               | 0.12                           | 0.0092 common dolphin (0.000009% of the CGNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)           | 0.011                       | 43,951               | 0.4               | 0.12                           | 0.0015 white-beaked dolphin (0.0000034% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)           | 0.0052                      | 43,951               | 0.4               | 0.12                           | 0.0007 white-beaked dolphin (0.0000016% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)  | 0.017                       | 43,951               | 0.4               | 0.12                           | 0.0021 white-beaked dolphin (0.0000049% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|----------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.046</b>                | <b>43,951</b>        | 0.4               | 0.12                           | 0.006 white-beaked dolphin (0.000013% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East                                            | 0.01                        | 20,118               | 0.4               | 0.12                           | 0.0013 minke whale (0.000006% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West                                            | 0.01                        | 20,118               | 0.4               | 0.12                           | 0.0013 minke whale (0.000006% of the CGNS MU reference population)         | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)                 | 0.01                        | 20,118               | 0.4               | 0.12                           | 0.0009 minke whale (0.000005% of the CGNS MU reference population)         | Negligible          |
| <b>Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b>          | <b>0.01</b>                 | <b>20,118</b>        | 0.4               | 0.12                           | 0.0013 minke whale (0.0000062% of the CGNS MU reference population)        | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 0.4               | 0.12                           | 0.02 grey seal (0.00007% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 0.4               | 0.12                           | 0.02 grey seal (0.00004% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 0.4               | 0.12                           | 0.03 grey seal (0.00009% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 0.4               | 0.12                           | 0.03 grey seal (0.00005% of the Wider reference population)         | Negligible          |

| Species scenario                                                                            | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|---------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                 | 0.386                       | 34,461               | 0.4               | 0.12                           | 0.05 grey seal (0.00014% of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA, and the wider ref pop)        | 0.386                       | 60,310               | 0.4               | 0.12                           | 0.05 grey seal (0.00008% of the Wider reference population)          | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)</b>          | <b>0.531</b>                | <b>34,461</b>        | 0.4               | 0.12                           | 0.067 grey seal (0.00019% of the SE England MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)</b> | <b>0.531</b>                | <b>60,310</b>        | 0.4               | 0.12                           | 0.067 grey seal (0.00011% of the Wider reference population)         | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 0.4               | 0.12                           | 0.00021 harbour seal (0.0000044% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 0.4               | 0.12                           | 0.00019 harbour seal (0.0000039% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 0.4               | 0.12                           | 0.00019 harbour seal (0.0000039% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for ECC and the SE MU)             | 0.0017                      | 4,853                | 0.4               | 0.12                           | 0.00021 harbour seal (0.0000044% of the SE England MU reference population) | Negligible          |

## **11.4.4. Assessment for disturbance by other construction activity**

81. **Table 11-25** includes the assessment of the potential for disturbance due to other construction activity.

Table 11-25 Assessment for disturbance due to cable laying, suction dredging, trenching and rock placement undertaken at the same time ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area for harbour porpoise, bottlenose dolphin, common dolphin, white-beaked dolphin, minke whale, grey seal, and harbour seal, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)         | 0.275                       | 346,601              | 4                 | 50.27                          | 13.82 harbour porpoise (0.004% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Wag-gitt <i>et al.</i> 2019, DBS West array summer Ave)        | 0.427                       | 346601               | 4                 | 50.27                          | 21.46 harbour porpoise (0.006% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA) | 0.415                       | 346,601              | 4                 | 50.27                          | 20.86 harbour porpoise (0.006% of the NS MU reference population) | Negligible          |

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC) | 0.888                       | 346,601              | 4                 | 50.27                          | 44.64 harbour porpoise (0.013% of the NS MU reference population)     | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)       | 0.00025                     | 2,022                | 4                 | 50.27                          | 0.013 bottlenose dolphin (0.0006% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)       | 0.00014                     | 2,022                | 4                 | 50.27                          | 0.007 bottlenose dolphin (0.0003% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)        | 0.0016                      | 2,022                | 4                 | 50.27                          | 0.07 bottlenose dolphin (0.0035% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.0013</b>               | <b>2,022</b>         | 4                 | 50.27                          | 0.06 bottlenose dolphin (0.003% of the GNS MU reference population)  | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>              | <b>0.041</b>                | <b>102,656</b>       | 4                 | 50.27                          | 2.06 common dolphin (0.002% of the CGNS MU reference population)     | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>              | <b>0.037</b>                | <b>102,656</b>       | 4                 | 50.27                          | 1.86 common dolphin (0.002% of the CGNS MU reference population)     | Negligible          |

| Species scenario                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)        | 0.038                       | 102,656              | 4                 | 50.27                          | 1.91 common dolphin (0.0019% of the CGNS MU reference population)      | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.073</b>                | <b>102,656</b>       | 4                 | 50.27                          | 3.67 common dolphin (0.004% of the CGNS MU reference population)       | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>    | <b>0.011</b>                | <b>43,951</b>        | 4                 | 50.27                          | 0.6 white-beaked dolphin (0.0014% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                              | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|-----------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| <b>White-beaked dolphin (Wag-gitt <i>et al.</i> 2019, DBS East array summer Ave)</b>          | <b>0.0055</b>               | <b>43,951</b>        | 4                 | 50.27                          | 0.28 white-beaked dolphin (0.00063% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Wag-gitt <i>et al.</i> 2019 annual density estimate for the ODA)        | 0.017                       | 43,951               | 4                 | 50.27                          | 0.85 white-beaked dolphin (0.0019% of the CGNS MU reference population)  | Negligible          |
| <b>White-beaked dolphin (Wag-gitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.046</b>                | <b>43,951</b>        | 4                 | 50.27                          | 2.31 white-beaked dolphin (0.0053% of the CGNS MU reference population)  | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East                                             | 0.01                        | 20,118               | 4                 | 50.27                          | 0.5 minke whale (0.0025% of the CGNS MU reference population)            | Negligible          |

| Species scenario                                                                               | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                             | Magnitude of effect |
|------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------|---------------------|
| Minke whale (SCANS-III density estimate)<br>DBS West                                           | 0.01                        | 20,118               | 4                 | 50.27                          | 0.5 minke whale (0.0025% of the CGNS MU reference population)    | Negligible          |
| <b>Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b>            | <b>0.01</b>                 | <b>20,118</b>        | 4                 | 50.27                          | 0.5 minke whale (0.0025% of the CGNS MU reference population)    | Negligible          |
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)                   | 0.01                        | 20,118               | 4                 | 50.27                          | 0.5 minke whale (0.0025% of the CGNS MU reference population)    | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | <b>0.181</b>                | <b>34,461</b>        | 4                 | 50.27                          | 9.1 grey seal (0.003% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 4                 | 50.27                          | 9.1 grey seal (0.015% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 4                 | 50.27                          | 13.07 grey seal (0.04% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 4                 | 50.27                          | 13.07 grey seal (0.022% of the Wider reference population)        | Negligible          |

| Species scenario                                                                            | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|---------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA and the SE MU)                 | 0.386                       | 34,461               | 4                 | 50.27                          | 19.4 grey seal (0.056% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ODA, and the wider ref pop)        | 0.386                       | 60,310               | 4                 | 50.27                          | 19.4 grey seal (0.032% of the Wider reference population)         | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)</b>          | <b>0.531</b>                | <b>34,461</b>        | 4                 | 50.27                          | 26.69 harbour porpoise (0.077% of the NS MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)</b> | <b>0.531</b>                | <b>60,310</b>        | 4                 | 50.27                          | 26.69 grey seal (0.044% of the Wider reference population)        | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 4                 | 50.27                          | 0.085 harbour seal (0.0018% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 4                 | 50.27                          | 0.05 harbour seal (0.001% of the SE England MU reference population)   | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 4                 | 50.27                          | 0.075 harbour seal (0.0016% of the SE England MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                               | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|--------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU) | 0.0017                      | 4,853                | 4                 | 50.27                          | 0.09 harbour seal (0.0018% of the SE England MU reference population) | Negligible          |

## 11.5. Assessment of underwater noise effects from vessels (all phases)

### 11.5.1. Underwater Noise Modelling

82. Subacoustech Environmental Ltd undertook underwater noise modelling for the underwater noise associated with vessels at the Projects. This followed the same approach as outlined above for other noisy activities (section 11.4).
83. The predicted source levels of the two vessel types (medium and large vessels) has been derived based on Subacoustech Environmental Ltd's own underwater noise measurement database.
- Medium vessels;
    - Underwater source level of 161 dB re 1  $\mu$ Pa @ 1m (RMS), based on three datasets of moderately sized vessels less than 100m in length, with an assumed vessel speed of 10 knots.
  - Large vessels;
    - Underwater source level of 168 dB re 1  $\mu$ Pa @ 1m (RMS), based on five datasets of large vessels, including container ships, FPSOs, and other vessels of more than 100m in length, with an assumed vessel speed of 10 knots.
84. To account for the frequency weightings within the Southall *et al.* (2019) thresholds, reductions in the source levels have been applied for each species grouping. See **Appendix 11-2** for further detail, and for the corrected source noise levels for the vessel noise.
85. The results of the underwater noise modelling using this simple modelling approach does not define effect ranges of less than 100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably less than this).
86. For the cumulative exposure ranges for these noise sources it has been assumed that the noise will be present for 24 hours a day.

### 11.5.2. Assessment for auditory injury for one vessel

87. **Table 11-26** includes the assessment of the potential for TTS onset due to the vessels that may be present in either the construction or operation and maintenance phases. The cumulative exposures are based on the noise source being present for 24 hours a day.

Table 11-26 Underwater noise assessment for the potential of TTS onset due to the presence of one construction vessel ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt et al. 2019, DBS East array annual Ave)                | 0.275                       | 346,601              | 0.1               | 0.031                          | 0.009 harbour porpoise (0.000002% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt et al. 2019, DBS West array annual Ave)                | 0.427                       | 346601               | 0.1               | 0.031                          | 0.013 harbour porpoise (0.000004% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (Waggitt et al. 2019 annual density estimate of the ODA)</b> | <b>0.888</b>                | <b>346,601</b>       | 0.1               | 0.031                          | 0.028 harbour porpoise (0.000008% of the NS MU reference population) | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)           | 0.888                       | 346,601              | 0.1               | 0.031                          | 0.028 harbour porpoise (0.000008% of the NS MU reference population)       | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>          | <b>0.00025</b>              | <b>2,022</b>         | 0.1               | 0.031                          | 0.000008bottlenose dolphin (0.0000004% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>          | <b>0.00014</b>              | <b>2,022</b>         | 0.1               | 0.031                          | 0.000004bottlenose dolphin (0.0000002% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | <b>0.0016</b>               | <b>2,022</b>         | 0.1               | 0.031                          | 0.00005bottlenose dolphin (0.0000025% of the GNS MU reference population)  | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 0.1               | 0.031                          | 0.000041bottlenose dolphin (0.000002% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)              | 0.041                       | 102,656              | 0.1               | 0.031                          | 0.0013 common dolphin (0.0000013% of the GNS MU reference population)     | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)              | 0.037                       | 102,656              | 0.1               | 0.031                          | 0.0012 common dolphin (0.0000011% of the GNS MU reference population)     | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)     | 0.038                       | 102,656              | 0.1               | 0.031                          | 0.0012 common dolphin (0.0000012% of the GNS MU reference population)     | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|---------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.073                       | 102,656              | 0.1               | 0.031                          | 0.0023 common dolphin (0.0000022% of the GNS MU reference population)        | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)    | 0.011                       | 43,951               | 0.1               | 0.031                          | 0.0003 white-beaked dolphin (0.0000007% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)    | 0.0052                      | 43,951               | 0.1               | 0.031                          | 0.0002 white-beaked dolphin (0.0000003% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Wag-gitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 0.1               | 0.031                          | 0.0005 white-beaked dolphin (0.000001% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Wag-gitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.046                       | 43,951               | 0.1               | 0.031                          | 0.0014 white-beaked dolphin (0.000003% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East                                      | 0.01                        | 20,118               | 0.1               | 0.031                          | 0.0003 minke whale (0.0000016% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West                                      | 0.01                        | 20,118               | 0.1               | 0.031                          | 0.0003 minke whale (0.0000016% of the CGNS MU reference population)         | Negligible          |

| Species scenario                                                                               | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| <b>Minke whale (SCANS-III density estimate density estimate for the ODA)</b>                   | <b>0.01</b>                 | <b>20,118</b>        | 0.1               | 0.031                          | 0.0003 minke whale (0.0000016% of the CGNS MU reference population)        | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ECC)                          | 0.01                        | 20,118               | 0.1               | 0.031                          | 0.0003 minke whale (0.0000016% of the CGNS MU reference population)        | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b> | <b>0.181</b>                | <b>34,461</b>        | 0.1               | 0.031                          | 0.0057 grey seal (0.000017% of the SE England MU reference population) MU) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 0.1               | 0.031                          | 0.0057 grey seal (0.00009% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 0.1               | 0.031                          | 0.0082 grey seal (0.000024% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 0.1               | 0.031                          | 0.0082 grey seal (0.000014% of the Wider reference population)         | Negligible          |

| Species scenario                                                                                         | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|----------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for Off-shore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 0.1               | 0.031                          | 0.0121 grey seal (0.00002% of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                 | 0.386                       | 60,310               | 0.1               | 0.031                          | 0.0121 grey seal (0.000035% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                              | 0.531                       | 34,461               | 0.1               | 0.031                          | 0.0167 grey seal (0.000048% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)       | 0.531                       | 60,310               | 0.1               | 0.031                          | 0.0167 grey seal (0.000028% of the Wider reference population)               | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 0.1               | 0.031                          | 0.00005 harbour seal (0.0000011% of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 0.1               | 0.031                          | 0.00003 harbour seal (0.0000006 % of the SE England MU reference population) | Negligible          |

| Species scenario                                                                   | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU) | 0.0015                      | 4,853                | 0.1               | 0.031                          | 0.00005 harbour seal (0.0000010% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)     | 0.0017                      | 4,853                | 0.1               | 0.031                          | 0.00005 harbour seal (0.0000011% of the SE England MU reference population) | Negligible          |

## 11.5.1. Assessment for auditory injury (TTS) for multiple vessels

88. During construction, there is the potential that up to 66 vessels per array area, a total of 132 vessels may be present at the Projects at any one time. During O&M, there is the potential that up to 11 vessels per array area, a total of 21 vessels, may be present at the Projects at any one time
89. **Table 11-27** includes the assessment of the potential for TTS onset due to 66 construction vessels and **Table 11-28** for 132 construction vessels. The cumulative exposures are based on the noise source being present for 24 hours in a 24-hour period.
90. **Table 11-29** includes the assessment of the potential for TTS onset due to 11 operation & maintenance vessels and **Table 11-30** for 21 operation & maintenance vessels.

Table 11-27 Underwater noise assessment for the potential of TTS onset due to the presence of 66 construction vessels ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)                | 0.275                       | 346,601              | 0.1               | 2.07                           | 0.570 harbour porpoise (0.000165 % of the NS MU reference population) | Negligible          |
| Harbour porpoise (Wag-gitt <i>et al.</i> 2019, DBS West array annual Ave)               | 0.427                       | 346601               | 0.1               | 2.07                           | 0.885 harbour porpoise (0.000255% of the NS MU reference population)  | Negligible          |
| <b>Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA)</b> | <b>0.888</b>                | <b>346,601</b>       | 0.1               | 2.07                           | 1.84 harbour porpoise (0.000531% of the NS MU reference population)   | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)        | 0.888                       | 346,601              | 0.1               | 2.07                           | 1.84 harbour porpoise (0.000531% of the NS MU reference population)   | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.00025                     | 2,022                | 0.1               | 2.07                           | 0.0005 bottlenose dolphin (0.000026% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.00014                     | 2,022                | 0.1               | 2.07                           | 0.0003 bottlenose dolphin (0.000014% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0016                      | 2,022                | 0.1               | 2.07                           | 0.003 bottlenose dolphin (0.000164% of the GNS MU reference population)  | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 0.1               | 2.07                           | 0.003 bottlenose dolphin (0.00013% of the GNS MU reference population)   | Negligible          |

| Species scenario                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|---------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.041                       | 102,656              | 0.1               | 2.07                           | 0.09 common dolphin (0.000082% of the CGNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.037                       | 102,656              | 0.1               | 2.07                           | 0.08 common dolphin (0.000074% of the CGNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.038                       | 102,656              | 0.1               | 2.07                           | 0.08 common dolphin (0.000076% of the CGNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.073                       | 102,656              | 0.1               | 2.07                           | 0.15 common dolphin (0.00014% of the CGNS MU reference population)  | Negligible          |

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.011                       | 43,951               | 0.1               | 2.07                           | 0.02 white-beaked dolphin (0.000051% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.0052                      | 43,951               | 0.1               | 2.07                           | 0.01 white-beaked dolphin (0.000025% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 0.1               | 2.07                           | 0.03 white-beaked dolphin (0.00008% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.046                       | 43,951               | 0.1               | 2.07                           | 0.09 white-beaked dolphin (0.00021% of the CGNS MU reference population)  | Negligible          |
| Minke whale (Waggitt <i>et al.</i> , 2019 annual DBS East)                            | 0.0018                      | 20,118               | 0.1               | 2.07                           | 0.0037 minke whale (0.000018% of the CGNS MU reference population)        | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Minke whale (Wag-gitt <i>et al.</i> , 2019 annual DBS West                                             | 0.0025                      | 20,118               | 0.1               | 2.07                           | 0.0052 minke whale (0.0000258% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate density estimate for the ODA)</b>                           | <b>0.01</b>                 | <b>20,118</b>        | 0.1               | 2.07                           | 0.02 minke whale (0.0001% of the CGNS MU reference population)      | Negligible          |
| Minke whale (SCANS-III density estimate for the ECC                                                    | 0.01                        | 20,118               | 0.1               | 2.07                           | 0.02 minke whale (0.00010% of the CGNS MU reference population)     | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b>         | <b>0.181</b>                | <b>34,461</b>        | 0.1               | 2.07                           | 0.37 grey seal (0.0010% of the Wider reference population)          | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | <b>0.181</b>                | <b>60,310</b>        | 0.1               | 2.07                           | 0.37 grey seal (0.0006% of the SE England MU reference population)  | Negligible          |

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)                 | 0.26                        | 34,461               | 0.1               | 2.07                           | 0.53 grey seal (0.0015% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)         | 0.26                        | 60,310               | 0.1               | 2.07                           | 0.53 grey seal (0.0008% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 0.1               | 2.07                           | 0.80 grey seal (0.0023% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 0.1               | 2.07                           | 0.80 grey seal (0.001% of the SE England MU reference population)  | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                | 0.531                       | 34,461               | 0.1               | 2.07                           | 1.10 grey seal (0.0031% of the Wider reference population)                | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)       | 0.531                       | 60,310               | 0.1               | 2.07                           | 1.10 harbour seal (0.0018% of the SE England MU reference population)     | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 0.1               | 2.07                           | 0.0035 harbour seal (0.000072% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 0.1               | 2.07                           | 0.002 harbour seal (0.000042% of the SE England MU reference population)  | Negligible          |

| Species scenario                                                                   | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU) | 0.0015                      | 4,853                | 0.1               | 2.07                           | 0.0031 harbour seal (0.000064% of the Wider reference population)         | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)     | 0.0017                      | 4,853                | 0.1               | 2.07                           | 0.0035 harbour seal (0.000072% of the SE England MU reference population) | Negligible          |

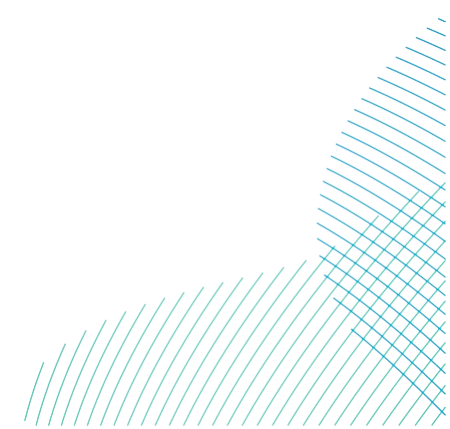


Table 11-28 Underwater noise assessment for the potential of TTS onset due to the presence of 132 construction vessels ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)                | 0.275                       | 346,601              | 0.1               | 4.15                           | 1.140 harbour porpoise (0.000329% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Wag-gitt <i>et al.</i> 2019, DBS West array annual Ave)               | 0.427                       | 346601               | 0.1               | 4.15                           | 1.771 harbour porpoise (0.000511% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA)</b> | <b>0.888</b>                | <b>346,601</b>       | 0.1               | 4.15                           | 3.7 harbour porpoise (0.0016% of the NS MU reference population)     | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)        | 0.888                       | 346,601              | 0.1               | 4.15                           | 3.7 harbour porpoise (0.0016% of the NS MU reference population)     | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)          | 0.00025                     | 2,022                | 0.1               | 4.15                           | 0.001 bottlenose dolphin (0.000051% of the GNS MU reference population)  | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)          | 0.00014                     | 2,022                | 0.1               | 4.15                           | 0.0005 bottlenose dolphin (0.000023% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0016                      | 2,022                | 0.1               | 4.15                           | 0.0066 bottlenose dolphin (0.00032% of the GNS MU reference population)  | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 0.1               | 4.15                           | 0.005 bottlenose dolphin (0.00026% of the GNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)              | 0.041                       | 102,656              | 0.1               | 4.15                           | 0.17 common dolphin (0.00016% of the GNS MU reference population)        | Negligible          |

| Species scenario                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|---------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)          | 0.037                       | 102,656              | 0.1               | 4.15                           | 0.15 common dolphin (0.00014% of the GNS MU reference population)         | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.038                       | 102,656              | 0.1               | 4.15                           | 0.15 common dolphin (0.00015% of the GNS MU reference population)         | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.073                       | 102,656              | 0.1               | 4.15                           | 0.3027 common dolphin (0.00029% of the GNS MU reference population)       | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)    | 0.011                       | 43,951               | 0.1               | 4.15                           | 0.04 white-beaked dolphin (0.00010% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)    | 0.0052                      | 43,951               | 0.1               | 4.15                           | 0.02 white-beaked dolphin (0.000051% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|----------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | <b>0.017</b>                | <b>43,951</b>        | 0.1               | 4.15                           | 0.07 white-beaked dolphin (0.00016% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.046</b>                | <b>43,951</b>        | 0.1               | 4.15                           | 0.19 white-beaked dolphin (0.00043% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East array annual Ave)                          | 0.0018                      | 20,118               | 0.1               | 4.15                           | 0.0075 minke whale (0.0000371% of the CGNS MU reference population)      | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West array annual Ave)                          | 0.0025                      | 20,118               | 0.1               | 4.15                           | 0.0104 minke whale (0.0000515% of the CGNS MU reference population)      | Negligible          |
| <b>Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b>          | <b>0.01</b>                 | <b>20,118</b>        | 0.1               | 4.15                           | 0.04 minke whale (0.0002% of the CGNS MU reference population)           | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)                           | 0.01                        | 20,118               | 0.1               | 4.15                           | 0.0415 minke whale (0.0002061% of the CGNS MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b>         | <b>0.181</b>                | <b>34,461</b>        | 0.1               | 4.15                           | 0.75 grey seal (0.002% of the SE England MU reference population)   | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | <b>0.181</b>                | <b>60,310</b>        | 0.1               | 4.15                           | 0.75 grey seal (0.001% of the Wider reference population)           | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)</b>         | <b>0.26</b>                 | <b>34,461</b>        | 0.1               | 4.15                           | 1.08 grey seal (0.003% of the SE England MU reference population)   | Negligible          |

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)         | 0.26                        | 60,310               | 0.1               | 4.15                           | 1.608 grey seal (0.001% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 0.1               | 4.15                           | 1.6 grey seal (0.0046% of the SE England MU reference population)) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 0.1               | 4.15                           | 1.6 grey seal (0.002% of the Wider reference population)           | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                             | 0.531                       | 34,461               | 0.1               | 4.15                           | 2.20 grey seal (0.006% of the SE England MU reference population)  | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)       | 0.531                       | 60,310               | 0.1               | 4.15                           | 2.20 grey seal (0.003 % of the Wider reference population)               | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 0.1               | 4.15                           | 0.007 harbour seal (0.00014% of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 0.1               | 4.15                           | 0.004 harbour seal (0.000085% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 0.1               | 4.15                           | 0.006 harbour seal (0.00014% of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)             | 0.0017                      | 4,853                | 0.1               | 4.15                           | 0.007 harbour seal (0.0004% of the SE England MU reference population)   | Negligible          |

Table 11-29 Underwater noise assessment for the potential of TTS onset due to the presence of 11 Operation & Maintenance vessels ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)         | 0.275                       | 346,601              | 0.1               | 0.35                           | 0.10 harbour porpoise (0.00003% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Wag-gitt <i>et al.</i> 2019, DBS West array annual Ave)        | 0.427                       | 346601               | 0.1               | 0.35                           | 0.15 harbour porpoise (0.00004% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA) | 0.888                       | 346,601              | 0.1               | 0.35                           | 0.31 harbour porpoise (0.00009% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC) | 0.888                       | 346,601              | 0.1               | 0.35                           | 0.31 harbour porpoise (0.00009% of the NS MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.00025                     | 2,022                | 0.1               | 0.35                           | 0.00008 bottlenose dolphin (0.000004% of the GNS MU reference population)  | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.00014                     | 2,022                | 0.1               | 0.35                           | 0.000048 bottlenose dolphin (0.000002% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0016                      | 2,022                | 0.1               | 0.35                           | 0.0005 bottlenose dolphin (0.00002% of the GNS MU reference population)    | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 0.1               | 0.35                           | 0.0004 bottlenose dolphin (0.00002% of the GNS MU reference population)    | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|---------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.041                       | 102,656              | 0.1               | 0.35                           | 0.013 common dolphin (0.000011% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.037                       | 102,656              | 0.1               | 0.35                           | 0.012 common dolphin (0.000010% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.038                       | 102,656              | 0.1               | 0.35                           | 0.012 common dolphin (0.00001% of the GNS MU reference population)  | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.073                       | 102,656              | 0.1               | 0.35                           | 0.025 common dolphin (0.000025% of the GNS MU reference population) | Negligible          |

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)          | 0.011                       | 43,951               | 0.1               | 0.35                           | 0.0038 white-beaked dolphin (0.000009% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.0055                      | 43,951               | 0.1               | 0.35                           | 0.0018 white-beaked dolphin (0.0000041% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 0.1               | 0.35                           | 0.0059 white-beaked dolphin (0.000013% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.046                       | 43,951               | 0.1               | 0.35                           | 0.016 white-beaked dolphin (0.000036% of the CGNS MU reference population)   | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Minke whale (SCANS-III density estimate) DBS East array annual Ave)          | 0.0018                      | 20,118               | 0.1               | 0.35                           | 0.0006 minke whale (0.0000031% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West array annual Ave)          | 0.0025                      | 20,118               | 0.1               | 0.35                           | 0.0009 minke whale (0.0000043% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate density estimate for the ODA)</b> | <b>0.01</b>                 | <b>20,118</b>        | <b>0.1</b>        | 0.35                           | 0.003 minke whale (0.00002% of the CGNS MU reference population)    | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ECC         | 0.01                        | 20,118               | 0.1               | 0.35                           | 0.0035 minke whale (0.0000172% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 0.1               | 0.35                           | 0.06 grey seal (0.0002% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 0.1               | 0.35                           | 0.063 grey seal (0.0001% of the Wider reference population)        | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 0.1               | 0.35                           | 0.09 grey seal (0.0003% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 0.1               | 0.35                           | 0.09 grey seal (0.0001% of the Wider reference population)         | Negligible          |

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 0.1               | 0.35                           | 0.13 grey seal (0.0004% of the SE England MU reference population)    | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 0.1               | 0.35                           | 0.13 grey seal (0.0002% of the Wider reference population)            | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                             | 0.531                       | 34,461               | 0.1               | 0.35                           | 0.18 grey seal (0.0005% of the Wider reference population)            | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)                    | 0.531                       | 60,310               | 0.1               | 0.35                           | 0.18 harbour seal (0.0003% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 0.1               | 0.35                           | 0.0006 harbour seal (0.000012% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 0.1               | 0.35                           | 0.0003 harbour seal (0.000007% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 0.1               | 0.35                           | 0.0005 harbour seal (0.00001% of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter et al. 2022 average density for ECC and the SE MU)             | 0.0017                      | 4,853                | 0.1               | 0.35                           | 0.0006 grey seal (0.000012% of the SE England MU reference population)    | Negligible          |

Table 11-30 Underwater noise assessment for the potential of TTS onset due to the presence of 21 Operation & Maintenance vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)                | 0.275                       | 346,601              | 0.1               | 0.66                           | 0.18 harbour porpoise (0.00005% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Wag-gitt <i>et al.</i> 2019, DBS West array annual Ave)               | 0.427                       | 346601               | 0.1               | 0.66                           | 0.28 harbour porpoise (0.00008% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA)</b> | <b>0.888</b>                | <b>346,601</b>       | 0.1               | 0.66                           | 0.59 harbour porpoise (0.0002% of the NS MU reference population)  | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)        | 0.888                       | 346,601              | 0.1               | 0.66                           | 0.59 harbour porpoise (0.00017% of the NS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                        | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)                 | 0.000226                    | 2,022                | 0.1               | 0.66                           | 0.00015 bottlenose dolphin (0.0000074% of the GNS MU reference population)  | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)                 | 0.00011                     | 2,022                | 0.1               | 0.66                           | 0.000073 bottlenose dolphin (0.0000036% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | <b>0.0016</b>               | <b>2,022</b>         | 0.1               | 0.66                           | 0.0009 bottlenose dolphin (0.00005% of the GNS MU reference population)     | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)        | 0.0013                      | 2,022                | 0.1               | 0.66                           | 0.00086 bottlenose dolphin (0.000042% of the GNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)                     | 0.032                       | 102,656              | 0.1               | 0.66                           | 0.02 common dolphin (0.000021% of the GNS MU reference population)          | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)                 | 0.029                       | 102,656              | 0.1               | 0.66                           | 0.02 common dolphin (0.000019% of the GNS MU reference population)           | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)        | 0.038                       | 102,656              | 0.1               | 0.66                           | 0.03 common dolphin (0.000024% of the GNS MU reference population)           | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.073</b>                | <b>102,656</b>       | 0.1               | 0.66                           | 0.048 common dolphin (0.00005% of the GNS MU reference population)           | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)           | 0.011                       | 43,951               | 0.1               | 0.66                           | 0.0073 white-beaked dolphin (0.000017% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)           | 0.0052                      | 43,951               | 0.1               | 0.66                           | 0.0034 white-beaked dolphin (0.0000078% of the CGNS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                       | Magnitude of effect |
|----------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)        | 0.017                       | 43,951               | 0.1               | 0.66                           | 0.011 white-beaked dolphin (0.000026% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)</b> | <b>0.046</b>                | <b>43,951</b>        | 0.1               | 0.66                           | 0.03 white-beaked dolphin (0.00007% of the CGNS MU reference population)   | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East array annual Ave)                          | 0.0018                      | 20,118               | 0.1               | 0.66                           | 0.001 minke whale (0.000006% of the CGNS MU reference population)          | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West array annual Ave)                          | 0.0025                      | 20,118               | 0.1               | 0.66                           | 0.002 minke whale (0.000008% of the CGNS MU reference population)          | Negligible          |
| <b>Minke whale (SCANS-III density estimate density estimate for the ODA)</b>                 | <b>0.01</b>                 | <b>20,118</b>        | 0.1               | 0.66                           | 0.007 minke whale (0.00003% of the CGNS MU reference population)           | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Minke whale (SCANS-III density estimate density estimate for the ECC)                           | 0.01                        | 20,118               | 0.1               | 0.66                           | 0.007 minke whale (0.00003% of the CGNS MU reference population)   | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 0.1               | 0.66                           | 0.12 grey seal (0.0003% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 0.1               | 0.66                           | 0.12 grey seal (0.0002% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 0.1               | 0.66                           | 0.17 grey seal (0.0005% of the SE England MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)         | 0.26                        | 60,310               | 0.1               | 0.66                           | 0.17 grey seal (0.00028 % of the Wider reference population)      | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 0.1               | 0.66                           | 0.25 grey seal (0.001% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 0.1               | 0.66                           | 0.25 grey seal (0.00042% of the Wider reference population)       | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)</b>                      | <b>0.531</b>                | <b>34,461</b>        | 0.1               | 0.66                           | 0.35 grey seal (0.001% of the SE England MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                            | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|---------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)</b> | <b>0.531</b>                | <b>60,310</b>        | 0.1               | 0.66                           | 0.35 grey seal (0.0006% of the Wider reference population)               | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)  | 0.0017                      | 4,853                | 0.1               | 0.66                           | 0.001 harbour seal (0.00003% of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)  | 0.001                       | 4,853                | 0.1               | 0.66                           | 0.001 harbour seal (0.000014% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)          | 0.0015                      | 4,853                | 0.1               | 0.66                           | 0.001 harbour seal (0.000020% of the SE England MU reference population) | Negligible          |

# RWE

Dogger Bank South Offshore Wind Farms

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for ECC and the SE MU) | 0.0017                      | 4,853                | 0.1               | 0.66                           | 0.001 harbour seal (0.00003% of the SE England MU reference population) | Negligible          |

## 11.5.2. Assessment for disturbance by vessel activity

91. **Table 11-31** to **Table 11-35** include the assessment of the potential for disturbance due to vessel activity at the Projects.

Table 11-31 Assessment for disturbance by the potential disturbance due to the presence of one construction vessel ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)                | 0.275                       | 346,601              | 2                 | 12.57                          | 3.457 harbour porpoise (0.001% of the                             | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)                | 0.427                       | 346601               | 2                 | 12.57                          | 5.367 harbour porpoise (0.002% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA)</b> | <b>0.888</b>                | <b>346,601</b>       | 2                 | 12.57                          | 11.2 harbour porpoise (0.003% of the NS MU reference population)  | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)        | 0.888                       | 346,601              | 2                 | 12.57                          | 11.2 harbour porpoise (0.003% of the NS MU reference population)  | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.00025                     | 2,022                | 2                 | 12.57                          | 0.003 bottlenose dolphin (0.0002% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.00014                     | 2,022                | 2                 | 12.57                          | 0.002 bottlenose dolphin (0.0001% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0016                      | 2,022                | 2                 | 12.57                          | 0.018 bottlenose dolphin (0.0009% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 2                 | 12.57                          | 0.016 bottlenose dolphin (0.0008% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)              | 0.041                       | 102,656              | 2                 | 12.57                          | 0.5 common dolphin (0.0005% of the CGNS MU reference population)      | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|---------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)          | 0.037                       | 102,656              | 2                 | 12.57                          | 0.5 common dolphin (0.0005% of the CGNS MU reference population)        | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.038                       | 102,656              | 2                 | 12.57                          | 0.5 common dolphin (0.0005% of the CGNS MU reference population)        | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.073                       | 102,656              | 2                 | 12.57                          | 1.0 common dolphin (0.0009 % of the CGNS MU reference population)       | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)    | 0.011                       | 43,951               | 2                 | 12.57                          | 0.1 white-beaked dolphin (0.0003% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)    | 0.0052                      | 43,951               | 2                 | 12.57                          | 0.07 white-beaked dolphin (0.0002% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 2                 | 12.57                          | 0.2 white-beaked dolphin (0.0005% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.046                       | 43,951               | 2                 | 12.57                          | 0.6 white-beaked dolphin (0.0013% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East                                     | 0.01                        | 20,118               | 2                 | 12.57                          | 0.13 minke whale (0.0006% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West                                     | 0.01                        | 20,118               | 2                 | 12.57                          | 0.13 minke whale (0.0006% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ODA)                 | 0.01                        | 20,118               | 2                 | 12.57                          | 0.13 minke whale (0.0006% of the CGNS MU reference population)         | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                             | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------|---------------------|
| Minke whale (SCANS-III density estimate density estimate for the ECC)                           | 0.01                        | 20,118               | 2                 | 12.57                          | 0.13 minke whale (0.0006% of the CGNS MU reference population)   | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 2                 | 12.57                          | 2.3 grey seal (0.006% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 2                 | 12.57                          | 2.3 grey seal (0.003% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 2                 | 12.57                          | 3.3 grey seal (0.009% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                             | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)         | 0.26                        | 60,310               | 2                 | 12.57                          | 3.3 grey seal (0.005% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 2                 | 12.57                          | 4.9 grey seal (0.014% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 2                 | 12.57                          | 4.9 grey seal (0.008% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                             | 0.531                       | 34,461               | 2                 | 12.57                          | 6.7 grey seal (0.019% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)       | 0.531                       | 60,310               | 2                 | 12.57                          | 6.7 grey seal (0.011% of the SE England MU reference population)      | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 2                 | 12.57                          | 0.02 harbour seal (0.0004% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 2                 | 12.57                          | 0.01 harbour seal (0.0003% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 2                 | 12.57                          | 0.02 harbour seal (0.0004% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                  | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour seal<br>(Carter <i>et al.</i> 2022 average density for ECC and the SE MU) | 0.0017                      | 4,853                | 2                 | 12.57                          | 0.02 harbour seal (0.0004% of the SE England MU reference population) | Negligible          |

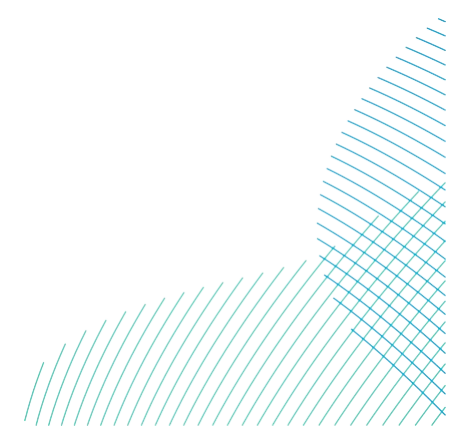


Table 11-32 Assessment for disturbance by the potential disturbance due to the presence of 66 construction vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt et al. 2019, DBS East array annual Ave)                | 0.275                       | 346,601              | 2                 | 829.62                         | 228.146 harbour porpoise (0.0658% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt et al. 2019, DBS West array annual Ave)                | 0.427                       | 346601               | 2                 | 829.62                         | 354.248 harbour porpoise (0.1022% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (Waggitt et al. 2019 annual density estimate of the ODA)</b> | <b>0.888</b>                | <b>346,601</b>       | 2                 | 829.62                         | 736.703 harbour porpoise (0.2126% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (Waggitt et al. 2019 annual density estimate of the ECC)</b> | <b>0.888</b>                | <b>346,601</b>       | 2                 | 829.62                         | 736.703 harbour porpoise (0.2126% of the NS MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.00025                     | 2,022                | 2                 | 829.62                         | 0.21 bottlenose dolphin (0.01% of the GNS MU reference population)    | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.00014                     | 2,022                | 2                 | 829.62                         | 0.012 bottlenose dolphin (0.0057% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0016                      | 2,022                | 2                 | 829.62                         | 1.3 bottlenose dolphin (0.065% of the GNS MU reference population)    | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 2                 | 829.62                         | 1.08 bottlenose dolphin (0.053% of the GNS MU reference population)   | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|---------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)          | 0.041                       | 102,656              | 2                 | 829.62                         | 34.01 common dolphin (0.033% of the CGNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)          | 0.037                       | 102,656              | 2                 | 829.62                         | 30.7 common dolphin (0.03% of the CGNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.038                       | 102,656              | 2                 | 829.62                         | 31.5 common dolphin (0.031% of the CGNS MU reference population)  | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.073                       | 102,656              | 2                 | 829.62                         | 60.6 common dolphin (0.059% of the CGNS MU reference population)  | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.011                       | 43,951               | 2                 | 829.62                         | 9.1 white-beaked dolphin (0.021% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.0052                      | 43,951               | 2                 | 829.62                         | 4.36 white-beaked dolphin (0.01% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 2                 | 12.57                          | 14.1 white-beaked dolphin (0.032% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.046                       | 43,951               | 2                 | 829.62                         | 38.2 white-beaked dolphin (0.087% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Minke whale (SCANS-III density estimate) DBS East                                       | 0.01                        | 20,118               | 2                 | 829.62                         | 8.3 minke whale (0.041% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West                                       | 0.01                        | 20,118               | 2                 | 829.62                         | 8.3 minke whale (0.041% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ODA)                   | 0.01                        | 20,118               | 2                 | 829.62                         | 8.3 minke whale (0.041% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ECC)                   | 0.01                        | 20,118               | 2                 | 829.62                         | 8.3 minke whale (0.041% of the CGNS MU reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.181                       | 34,461               | 2                 | 829.62                         | 150.16 grey seal (0.4357% of the SE England MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 2                 | 829.62                         | 150.16 grey seal (0.2490% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 2                 | 829.62                         | 215.70 grey seal (0.6259% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 2                 | 829.62                         | 215.70 grey seal (0.3577% of the Wider reference population)         | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 2                 | 829.62                         | 320.23 grey seal (0.9293% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 2                 | 829.62                         | 320.23 grey seal (0.5310% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                             | 0.531                       | 34,461               | 2                 | 829.62                         | 440.53 grey seal (1.2783% of the SE England MU reference population) | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)                    | 0.531                       | 60,310               | 2                 | 829.62                         | 440.53 grey seal (0.7304% of the Wider reference population)         | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 2                 | 829.62                         | 1.41 harbour seal (0.0291% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 2                 | 829.62                         | 0.83 harbour seal (0.0171% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 2                 | 829.62                         | 1.24 harbour seal (0.0256% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for ECC and the SE MU)             | 0.0017                      | 4,853                | 2                 | 829.62                         | 1.41 harbour seal (0.0291% of the SE England MU reference population) | Negligible          |

Table 11-33 Assessment for disturbance by the potential disturbance due to the presence of 132 construction vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt et al. 2019, DBS East array annual Ave)                | 0.275                       | 346,601              | 2                 | 1659.24                        | 456.291 harbour porpoise (0.1316% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Wag-gitt et al. 2019, DBS West array annual Ave)               | 0.427                       | 346601               | 2                 | 1659.24                        | 708.495 harbour porpoise (0.2044% of the NS MU reference population) | Negligible          |
| <b>Harbour porpoise (Waggitt et al. 2019 annual density estimate of the ODA)</b> | <b>0.888</b>                | <b>346,601</b>       | 2                 | 1659.24                        | 1473.4 harbour porpoise (0.425% of the NS MU reference population)   | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)           | 0.888                       | 346,601              | 2                 | 1659.24                        | 1473.405 harbour porpoise (0.4251% of the NS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>          | <b>0.00025</b>              | <b>2,022</b>         | 2                 | 1659.24                        | 0.42 bottlenose dolphin (0.02% of the GNS MU reference population)    | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>          | <b>0.00014</b>              | <b>2,022</b>         | 2                 | 1659.24                        | 0.23 bottlenose dolphin (0.011% of the GNS MU reference population)   | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | <b>0.0016</b>               | <b>2,022</b>         | 2                 | 1659.24                        | 2.3 bottlenose dolphin (0.11% of the GNS MU reference population)     | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 summer density estimate for the ECC) | 0.0013                      | 2,022                | 2                 | 1659.24                        | 2.2 bottlenose dolphin (0.106% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)              | 0.041                       | 102,656              | 2                 | 1659.24                        | 68.8 common dolphin (0.066% of the CGNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)              | 0.037                       | 102,656              | 2                 | 1659.24                        | 61.4 common dolphin (0.0597% of the CGNS MU reference population)  | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)     | 0.038                       | 102,656              | 2                 | 1659.24                        | 63.1 common dolphin (0.061% of the CGNS MU reference population)   | Negligible          |

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)       | 0.073                       | 102,656              | 2                 | 1659.24                        | 121.1 common dolphin (0.118% of the CGNS MU reference population)      | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.011                       | 43,951               | 2                 | 1659.24                        | 18.3 white-beaked dolphin (0.041% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.0055                      | 43,951               | 2                 | 1659.24                        | 9.1 white-beaked dolphin (0.02% of the CGNS MU reference population)   | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 2                 | 1659.24                        | 28.2 white-beaked dolphin (0.064% of the CGNS MU reference population) | Negligible          |

| Species scenario                                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|----------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| <b>White-beaked dolphin (Wag-gitt <i>et al.</i> 2019 annual density estimate for the ECC</b> | <b>0.046</b>                | <b>43,951</b>        | 2                 | 1659.24                        | 76.3 white-beaked dolphin (0.17% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East                                            | 0.01                        | 20,118               | 2                 | 1659.24                        | 16.6 minke whale (0.082% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West                                            | 0.01                        | 20,118               | 2                 | 1659.24                        | 16.6 minke whale (0.082% of the CGNS MU reference population)         | Negligible          |
| <b>Minke whale (SCANS-III density estimate for the ODA)</b>                                  | <b>0.01</b>                 | <b>20,118</b>        | 2                 | 1659.24                        | 16.6 minke whale (0.082% of the CGNS MU reference population)         | Negligible          |

| Species scenario                                                                                       | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|--------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Minke whale (SCANS-III density estimate density estimate for the ECC)                                  | 0.01                        | 20,118               | 2                 | 1659.24                        | 16.6 minke whale (0.082% of the CGNS MU reference population)     | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)</b>         | <b>0.181</b>                | <b>34,461</b>        | 2                 | 1659.24                        | 300.3 grey seal (0.87% of the SE England MU reference population) | Negligible          |
| <b>Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)</b> | <b>0.181</b>                | <b>60,310</b>        | 2                 | 1659.24                        | 300.3 grey seal (0.5% of the Wider reference population)          | Negligible          |

| Species scenario                                                                                         | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|----------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)                  | 0.26                        | 34,461               | 2                 | 1659.24                        | 431.4 grey seal (1.25% of the SE England MU reference population)  | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)          | 0.26                        | 60,310               | 2                 | 1659.24                        | 431.4 grey seal (0.72% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for Off-shore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 2                 | 1659.24                        | 640.5 grey seal (1.86 % of the SE England MU reference population) | Low                 |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)   | 0.386                       | 60,310               | 2                 | 1659.24                        | 640.5 grey seal (1.06 % of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                | 0.531                       | 34,461               | 2                 | 1659.24                        | 881.1 grey seal (2.56% of the SE England MU reference population)   | Low                 |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)       | 0.531                       | 60,310               | 2                 | 1659.24                        | 881.1 grey seal (1.46% of the Wider reference population)           | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 2                 | 1659.24                        | 2.8 harbour seal (0.058% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 2                 | 1659.24                        | 1.7 harbour seal (0.034% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 2                 | 1659.24                        | 2.5 harbour seal (0.051% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for ECC and the SE MU)             | 0.0017                      | 4,853                | 2                 | 1659.24                        | 2.8 harbour seal (0.058% of the SE England MU reference population) | Negligible          |

Table 11-34 Underwater noise assessment for the potential disturbance due to the presence of 11 Operation & Maintenance vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area for harbour porpoise, bottlenose dolphin, common dolphin, white-beaked dolphin, minke whale, grey seal, and harbour seal, including all potential density estimates and reference populations

| Species scenario                                                          | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|---------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt et al. 2019, DBS East array annual Ave)         | 0.275                       | 346,601              | 2                 | 138.27                         | 38.02 harbour porpoise (0.011% of the NS MU reference population)  | Negligible          |
| Harbour porpoise (Wag-gitt et al. 2019, DBS West array annual Ave)        | 0.427                       | 346601               | 2                 | 138.27                         | 59.041 harbour porpoise (0.017% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt et al. 2019 annual density estimate of the ODA) | 0.888                       | 346,601              | 2                 | 138.27                         | 122.78 harbour porpoise (0.035% of the NS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)    | 0.888                       | 346,601              | 2                 | 138.27                         | 122.78 harbour porpoise (0.035% of the NS MU reference population)    | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.00025                     | 2,022                | 2                 | 138.27                         | 0.031bottlenose dolphin (0.0016% of the GNS MU reference population)  | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.00014                     | 2,022                | 2                 | 138.27                         | 0.02 bottlenose dolphin (0.00075% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0016                      | 2,022                | 2                 | 138.27                         | 0.19 bottlenose dolphin (0.0096% of the GNS MU reference population)  | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 2                 | 138.27                         | 0.18 bottlenose dolphin (0.0089% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array annual Ave)              | 0.032                       | 102,656              | 2                 | 138.27                         | 4.43 common dolphin (0.0043% of the CGNS MU reference population)    | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array annual Ave)              | 0.029                       | 102,656              | 2                 | 138.27                         | 4.01 common dolphin (0.0039% of the CGNS MU reference population)    | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)     | 0.038                       | 102,656              | 2                 | 138.27                         | 5.25 common dolphin (0.0051% of the CGNS MU reference population)    | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)       | 0.073                       | 102,656              | 2                 | 138.27                         | 10.09 common dolphin (0.0098% of the CGNS MU reference population)       | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.011                       | 43,951               | 2                 | 138.27                         | 1.521 white-beaked dolphin (0.0035% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.0052                      | 43,951               | 2                 | 138.27                         | 0.72 white-beaked dolphin (0.0016% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 2                 | 138.27                         | 2.35 white-beaked dolphin (0.0054% of the CGNS MU reference population)  | Negligible          |

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.046                       | 43,951               | 2                 | 138.27                         | 6.36 white-beaked dolphin (0.014% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East                                     | 0.01                        | 20,118               | 2                 | 138.27                         | 1.38 minke whale (0.0068% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West                                     | 0.01                        | 20,118               | 2                 | 138.27                         | 1.38 minke whale (0.0068% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ODA)                 | 0.01                        | 20,118               | 2                 | 138.27                         | 1.38 minke whale (0.0068% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ECC)                 | 0.01                        | 20,118               | 2                 | 138.27                         | 1.38 minke whale (0.0068% of the CGNS MU reference population)         | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 2                 | 138.27                         | 25.03 grey seal (0.072 % of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 2                 | 138.27                         | 25.03 grey seal (0.042% of the Wider reference population)          | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 2                 | 138.27                         | 35.95 grey seal (0.10 % of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 2                 | 138.27                         | 35.95 grey seal (0.06% of the SE England MU reference population)   | Negligible          |

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 2                 | 138.27                         | 53.37 grey seal (0.15 % of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 2                 | 138.27                         | 53.37 grey seal (0.088% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                             | 0.531                       | 34,461               | 2                 | 138.27                         | 73.42 grey seal (0.21 % of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)                    | 0.531                       | 60,310               | 2                 | 138.27                         | 73.42 grey seal (0.12 % of the Wider MU reference population)      | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 2                 | 138.27                         | 0.24 harbour seal (0.0048% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 2                 | 138.27                         | 0.14 harbour seal (0.0029 of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 2                 | 138.27                         | 0.21 harbour seal (0.0027% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for ECC and the SE MU)             | 0.0017                      | 4,853                | 2                 | 138.27                         | 0.24 harbour seal (0.0048% of the SE England MU reference population) | Negligible          |

Table 11-35 Underwater noise assessment for the potential disturbance due to the presence of 21 operation & maintenance vessels ( $SEL_{cum}$ ) at the worst case modelling location for DBS array areas, offshore export cable corridor and the Offshore Development Area including all potential density estimates and reference

| Species scenario                                                          | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|---------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt et al. 2019, DBS East array annual Ave)         | 0.275                       | 346,601              | 2                 | 263.97                         | 72.59 harbour porpoise (0.021% of the NS MU reference population)  | Negligible          |
| Harbour porpoise (Wag-gitt et al. 2019, DBS West array annual Ave)        | 0.427                       | 346601               | 2                 | 263.97                         | 112.72 harbour porpoise (0.033% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt et al. 2019 annual density estimate of the ODA) | 0.888                       | 346,601              | 2                 | 263.97                         | 234.41 harbour porpoise (0.068% of the NS MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)    | 0.888                       | 346,601              | 2                 | 263.97                         | 234.41 harbour porpoise (0.068% of the NS MU reference population)   | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.00025                     | 2,022                | 2                 | 263.97                         | 0.07 bottlenose dolphin (0.0033% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.00014                     | 2,022                | 2                 | 263.97                         | 0.04 bottlenose dolphin (0.0018% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0016                      | 2,022                | 2                 | 263.97                         | 0.42 bottlenose dolphin (0.021% of the GNS MU reference population)  | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 2                 | 263.97                         | 0.34 bottlenose dolphin (0.017% of the GNS MU reference population) | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)              | 0.041                       | 102,656              | 2                 | 263.97                         | 10.82 common dolphin (0.011% of the CGNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)              | 0.037                       | 102,656              | 2                 | 263.97                         | 9.77 common dolphin (0.010% of the CGNS MU reference population)    | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)     | 0.038                       | 102,656              | 2                 | 263.97                         | 10.03 common dolphin (0.010% of the CGNS MU reference population)   | Negligible          |

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)       | 0.073                       | 102,656              | 2                 | 263.97                         | 19.27 common dolphin (0.019% of the CGNS MU reference population)       | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.011                       | 43,951               | 2                 | 263.97                         | 1.45 white-beaked dolphin (0.0033% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.0055                      | 43,951               | 2                 | 263.97                         | 2.9 white-beaked dolphin (0.0066% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 2                 | 263.97                         | 4.49 white-beaked dolphin (0.010% of the CGNS MU reference population)  | Negligible          |

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Wag-gitt <i>et al.</i> 2019 annual density estimate for the ECC | 0.046                       | 43,951               | 2                 | 263.97                         | 12.14 white-beaked dolphin (0.028% of the CGNS MU reference population) | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East                                     | 0.01                        | 20,118               | 2                 | 263.97                         | 2.64 minke whale (0.013% of the CGNS MU reference population)           | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West                                     | 0.01                        | 20,118               | 2                 | 263.97                         | 2.64 minke whale (0.013% of the CGNS MU reference population)           | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ODA)                 | 0.01                        | 20,118               | 2                 | 263.97                         | 2.64 minke whale (0.013% of the CGNS MU reference population)           | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Minke whale (SCANS-III density estimate density estimate for the ECC)                           | 0.01                        | 20,118               | 2                 | 263.97                         | 2.64 minke whale (0.013% of the CGNS MU reference population)     | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 2                 | 263.97                         | 47.78 grey seal (0.14% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 2                 | 263.97                         | 47.78 grey seal (0.079% of the Wider reference population)        | Negligible          |

| Species scenario                                                                                         | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|----------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)                  | 0.26                        | 34,461               | 2                 | 263.97                         | 68.63 grey seal (0.20% of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)          | 0.26                        | 60,310               | 2                 | 263.97                         | 68.63 grey seal (0.11% of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for Off-shore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 2                 | 263.97                         | 101.89 grey seal (0.30% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)   | 0.386                       | 60,310               | 2                 | 263.97                         | 101.89 grey seal (0.17% of the Wider reference population)            | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                | 0.531                       | 34,461               | 2                 | 263.97                         | 140.17 grey seal (0.41% of the SE England MU reference population)    | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)       | 0.531                       | 60,310               | 2                 | 263.97                         | 140.17 grey seal (0.23% of the Wider MU reference population)         | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 2                 | 263.97                         | 0.45 harbour seal (0.0092% of the SE England MU reference population) | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 2                 | 263.97                         | 0.26 harbour seal (0.0054% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 2                 | 263.97                         | 0.40 harbour seal (0.0082% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for ECC and the SE MU)             | 0.0017                      | 4,853                | 2                 | 263.97                         | 0.45 harbour seal (0.0092% of the SE England MU reference population) | Negligible          |

## 11.6. Assessment of underwater noise effects from operational turbine noise

92. The main source of noise during operation of the turbines is from a mechanically generated vibration from the rotating machinery within the wind turbine, which is transmitted into the water column through the wind turbine structure and foundations (Nedwell *et al.* 2003; Tougaard *et al.* 2020). Underwater noise levels associated with turbines at the size included for the Projects is not currently available, and therefore noise levels are calculated based on a formula presented by Tougaard *et al.* 2020. See **Appendix 11-2** for more detail on this process.
93. This data is used to predict the underwater noise levels, and therefore the potential effect ranges, of the operational turbines on marine mammal species groups. This modelling uses the same simple approach as described in section 11.4.
94. The results of the underwater noise modelling using this simple modelling approach does not define effect ranges of less than 100m, and therefore, where the effect ranges are less than that, the results show effect ranges of <100m (it is possible that the actual effect ranges are therefore considerably less than this).
95. For the cumulative exposure ranges for operational turbines, it has been assumed that the noise will be present for 24 hours a day.

### 11.6.1. Assessment for an auditory injury (TTS) from a single wind turbine

96. **Table 11-36** includes the assessment of the potential for TTS onset due to one operational small or large turbine. The cumulative exposures are based on the noise source being present for 24 hours a day.

Table 11-36 Underwater noise assessment for the potential of TTS onset from the operation of one wind turbine ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridors and the Offshore Development Area including all potential density estimates and reference populations

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                 | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|----------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)         | 0.275                       | 346,601              | 0.1               | 0.031                          | 0.009 harbour porpoise (0.000002% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)         | 0.427                       | 346601               | 0.1               | 0.031                          | 0.013 harbour porpoise (0.000004% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA) | 0.415                       | 346,601              | 0.1               | 0.031                          | 0.013 harbour porpoise (0.000004% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC) | 0.888                       | 346,601              | 0.1               | 0.031                          | 0.028 harbour porpoise (0.000008% of the NS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.00025                     | 2,022                | 0.1               | 0.031                          | 0.000008 bottlenose dolphin (0.00000039% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.00014                     | 2,022                | 0.1               | 0.031                          | 0.000004 bottlenose dolphin (0.00000022% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0016                      | 2,022                | 0.1               | 0.031                          | 0.00005 bottlenose dolphin (0.0000025% of the GNS MU reference population)   | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 0.1               | 0.031                          | 0.00004 bottlenose dolphin (0.000002% of the GNS MU reference population)    | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|---------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.041                       | 102,656              | 0.1               | 0.031                          | 0.0013 common dolphin (0.0000013% of the CGNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.037                       | 102,656              | 0.1               | 0.031                          | 0.0012 common dolphin (0.0000011% of the CGNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.038                       | 102,656              | 0.1               | 0.031                          | 0.0015 common dolphin (0.0000015% of the CGNS MU reference population)   | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.073                       | 102,656              | 0.1               | 0.031                          | 0.002293 common dolphin (0.0000022% of the CGNS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                           | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.012                       | 43,951               | 0.1               | 0.031                          | 0.00038 white-beaked dolphin (0.00000086% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.0055                      | 43,951               | 0.1               | 0.031                          | 0.00017 white-beaked dolphin (0.00000039% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 0.1               | 0.031                          | 0.00053 white-beaked dolphin (0.0000012% of the CGNS MU reference population)  | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.046                       | 43,951               | 0.1               | 0.031                          | 0.00145 white-beaked dolphin (0.0000033% of the CGNS MU reference population)  | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East                                     | 0.01                        | 20,118               | 0.1               | 0.031                          | 0.00031 minke whale (0.0000016% of the CGNS MU reference population)           | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Minke whale (SCANS-III density estimate) DBS West                                       | 0.01                        | 20,118               | 0.1               | 0.031                          | 0.00031 minke whale (0.000002% of the CGNS MU reference population)   | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ODA)                   | 0.01                        | 20,118               | 0.1               | 0.031                          | 0.00024 minke whale (0.000001% of the CGNS MU reference population)   | Negligible          |
| Minke whale (SCANS-III density estimate density estimate for the ECC)                   | 0.01                        | 20,118               | 0.1               | 0.031                          | 0.00031 minke whale (0.000002% of the CGNS MU reference population)   | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.181                       | 34,461               | 0.1               | 0.031                          | 0.0057 grey seal (0.00002% of the SE England MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                  | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-----------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop)         | 0.181                       | 60,310               | 0.1               | 0.031                          | 0.0057 grey seal (0.00001% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)                 | 0.26                        | 34,461               | 0.1               | 0.031                          | 0.0082 grey seal (0.00002% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop)         | 0.26                        | 60,310               | 0.1               | 0.031                          | 0.0082 grey seal (0.00001% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 0.1               | 0.031                          | 0.012 grey seal (0.00004% of the SE England MU reference population)  | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)   | 0.386                       | 60,310               | 0.1               | 0.031                          | 0.012 grey seal (0.00001% of the Wider reference population)                 | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                | 0.531                       | 34,461               | 0.1               | 0.031                          | 0.0167 grey seal (0.00005% of the SE England MU reference population)        | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)       | 0.531                       | 60,310               | 0.1               | 0.031                          | 0.0167 grey seal (0.00002% of the Wider reference population)                | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 0.1               | 0.031                          | 0.000053 harbour seal (0.0000011% of the SE England MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                         | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 0.1               | 0.031                          | 0.000031 harbour seal (0.0000006% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 0.1               | 0.031                          | 0.000047 harbour seal (0.000001% of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)             | 0.0017                      | 4,853                | 0.1               | 0.031                          | 0.000053 harbour seal (0.0000011% of the SE England MU reference population) | Negligible          |

## 11.6.2. Assessment for auditory injury for multiple wind turbines

97. More than one wind turbine will be operating at the same time, and therefore an assessment of the potential for auditory injury, due to all operational wind turbines, is required.
98. There could be between 48 and 100 wind turbines installed at each of DBS East and DBS West. The potential auditory effect ranges are the same for either the small or large wind turbine options, and therefore the worst case would be for a total of 100 operational wind turbines per site (200 in total).
99. **Table 11-37** includes the assessment of the potential for TTS onset due to 100 operational wind turbines.
100. **Table 11-38** includes the assessment of the potential for animals being disturbed due to 200 operational wind turbines.

Table 11-37 Underwater noise assessment for the potential of TTS onset from the operation of 100 wind turbines ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, offshore export cable corridor and the Offshore Development Area, including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                 | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                              | Magnitude of effect |
|----------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)         | 0.275                       | 346,601              | 0.1               | 3.142                          | 0.86 harbour porpoise (0.0002% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)         | 0.427                       | 346601               | 0.1               | 3.142                          | 1.34 harbour porpoise (0.0004% of the NS MU reference population) | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA) | 0.415                       | 346,601              | 0.1               | 3.142                          | 1.3 harbour porpoise (0.0004% of the NS MU reference population)  | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)    | 0.888                       | 346,601              | 0.1               | 3.142                          | 2.8 harbour porpoise (0.0008% of the NS MU reference population)        | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)          | 0.00025                     | 2,022                | 0.1               | 3.142                          | 0.0008 bottlenose dolphin (0.00004% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)          | 0.00014                     | 2,022                | 0.1               | 3.142                          | 0.0004 bottlenose dolphin (0.00002% of the GNS MU reference population) | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.0016                      | 2,022                | 0.1               | 3.142                          | 0.004 bottlenose dolphin (0.00024% of the GNS MU reference population)  | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.0013                      | 2,022                | 0.1               | 3.142                          | 0.005 bottlenose dolphin (0.00018% of the GNS MU reference population) | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>       | <b>0.041</b>                | <b>102,656</b>       | 0.1               | 3.142                          | 0.1 common dolphin (0.0001% of the CGNS MU reference population)       | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>       | <b>0.037</b>                | <b>102,656</b>       | 0.1               | 3.142                          | 0.09 common dolphin (0.00008% of the CGNS MU reference population)     | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)     | 0.038                       | 102,656              | 0.1               | 3.142                          | 0.12 common dolphin (0.00012% of the CGNS MU reference population)     | Negligible          |

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC)       | 0.073                       | 102,656              | 0.1               | 3.142                          | 0.23 common dolphin (0.00022% of the CGNS MU reference population)        | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>   | <b>0.012</b>                | <b>43,951</b>        | 0.1               | 3.142                          | 0.035 white-beaked dolphin (0.00008% of the CGNS MU reference population) | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)</b>   | <b>0.0055</b>               | <b>43,951</b>        | 0.1               | 3.142                          | 0.017 white-beaked dolphin (0.00004% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA) | 0.017                       | 43,951               | 0.1               | 3.142                          | 0.053 white-beaked dolphin (0.0001% of the CGNS MU reference population)  | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                      | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|---------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ECC) | 0.046                       | 43,951               | 0.1               | 3.142                          | 0.15 white-beaked dolphin (0.00033% of the CGNS MU reference population) | Negligible          |
| <b>Minke whale (SCANS-III density estimate) DBS East</b>                              | <b>0.01</b>                 | <b>20,118</b>        | 0.1               | 3.142                          | 0.031 minke whale (0.00016% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West                                     | 0.01                        | 20,118               | 0.1               | 3.142                          | 0.031 minke whale (0.00016% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate for the ODA)                                  | 0.01                        | 20,118               | 0.1               | 3.142                          | 0.031 minke whale (0.00016% of the CGNS MU reference population)         | Negligible          |
| Minke whale (SCANS-III density estimate for the ECC)                                  | 0.01                        | 20,118               | 0.1               | 3.142                          | 0.031 minke whale (0.00016% of the CGNS MU reference population)         | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 0.1               | 3.142                          | 0.57 grey seal (0.0017% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 0.1               | 3.142                          | 0.57 grey seal (0.0009% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 0.1               | 3.142                          | 0.82 grey seal (0.0024% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 0.1               | 3.142                          | 0.82 grey seal (0.0014% of the Wider reference population)         | Negligible          |

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 0.1               | 3.142                          | 1.21 grey seal (0.0035% of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 0.1               | 3.142                          | 1.21 grey seal (0.002% of the Wider reference population)           | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC and the SE MU)                             | 0.531                       | 34,461               | 0.1               | 3.142                          | 1.668 grey seal (0.0048% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for ECC, and the wider ref pop)                    | 0.531                       | 60,310               | 0.1               | 3.142                          | 1.668 grey seal (0.00277% of the Wider reference population)        | Negligible          |

| Species scenario                                                                    | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                     | Magnitude of effect |
|-------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter et al. 2022 average density for DBS East array, and the SE MU) | 0.0017                      | 4,853                | 0.1               | 3.142                          | 0.0053 harbour seal (0.0001% of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter et al. 2022 average density for DBS West array, and the SE MU) | 0.001                       | 4,853                | 0.1               | 3.142                          | 0.0031 harbour seal (0.00006% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter et al. 2022 average density for the ODA and the SE MU)         | 0.0015                      | 4,853                | 0.1               | 3.142                          | 0.0047 harbour seal (0.0001% of the SE England MU reference population)  | Negligible          |
| Harbour seal (Carter et al. 2022 average density for ECC and the SE MU)             | 0.0017                      | 4,853                | 0.1               | 3.142                          | 0.005 harbour seal (0.0001% of the SE England MU reference population)   | Negligible          |

Table 11-38 Assessment for disturbance through the operation of 200 wind turbines ( $SEL_{cum}$ ) at the worst case modelling location for the DBS array areas, export cable corridors and the Offshore Development Area including all potential density estimates and reference populations (density estimates and reference populations presented for assessment in Chapter 11 Marine Mammals are shown in bold)

| Species scenario                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|-----------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                | 0.275                       | 346,601              | 0.1               | 6.28                           | 1.7 harbour porpoise (0.0005% of the NS MU reference population)       | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                | 0.427                       | 346601               | 0.1               | 6.28                           | 2.7 harbour porpoise (0.00077% of the NS MU reference population)      | Negligible          |
| Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ODA)        | 0.415                       | 346,601              | 0.1               | 6.28                           | 2.6 harbour porpoise (0.00075% of the NS MU reference population)      | Negligible          |
| <b>Harbour porpoise (Waggitt <i>et al.</i> 2019 annual density estimate of the ECC)</b> | <b>0.888</b>                | <b>346,601</b>       | 0.1               | 6.28                           | 5.6 harbour porpoise (0.0016% of the NS MU reference population)       | Negligible          |
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)              | 0.00025                     | 2,022                | 0.1               | 6.28                           | 0.002 bottlenose dolphin (0.00008% of the GNS MU reference population) | Negligible          |

# RWE

## Dogger Bank South Offshore Wind Farms

| Species scenario                                                                           | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                   | Magnitude of effect |
|--------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|------------------------------------------------------------------------|---------------------|
| Bottlenose dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                 | 0.00014                     | 2,022                | 0.1               | 6.28                           | 0.009 bottlenose dolphin (0.00043% of the GNS MU reference population) | Negligible          |
| <b>Bottlenose dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | <b>0.0016</b>               | <b>2,022</b>         | 0.1               | 6.28                           | 0.01 bottlenose dolphin (0.0005% of the GNS MU reference population)   | Negligible          |
| <b>Common dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)</b>              | <b>0.041</b>                | <b>102,656</b>       | 0.1               | 6.28                           | 0.26 common dolphin (0.0003% of the CGNS MU reference population)      | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                     | 0.037                       | 102,656              | 0.1               | 6.28                           | 0.23 common dolphin (0.00023% of the CGNS MU reference population)     | Negligible          |
| Common dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)            | 0.039                       | 102,656              | 0.1               | 6.28                           | 0.25 common dolphin (0.00024% of the CGNS MU reference population)     | Negligible          |

| Species scenario                                                                             | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                      | Magnitude of effect |
|----------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|---------------------------------------------------------------------------|---------------------|
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS West array summer Ave)                 | 0.012                       | 43,951               | 0.1               | 6.28                           | 0.075 white-beaked dolphin (0.00017% of the CGNS MU reference population) | Negligible          |
| White-beaked dolphin (Waggitt <i>et al.</i> 2019, DBS East array summer Ave)                 | 0.0055                      | 43,951               | 0.1               | 6.28                           | 0.035 white-beaked dolphin (0.0008% of the CGNS MU reference population)  | Negligible          |
| <b>White-beaked dolphin (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b> | <b>0.017</b>                | <b>43,951</b>        | 0.1               | 6.28                           | 0.11 white-beaked dolphin (0.0002% of the CGNS MU reference population)   | Negligible          |
| Minke whale (SCANS-III density estimate) DBS East                                            | 0.01                        | 20,118               | 0.1               | 6.28                           | 0.06 minke whale (0.0003% of the CGNS MU reference population)            | Negligible          |
| Minke whale (SCANS-III density estimate) DBS West                                            | 0.01                        | 20,118               | 0.1               | 6.28                           | 0.06 minke whale (0.0003% of the CGNS MU reference population)            | Negligible          |
| <b>Minke whale (Waggitt <i>et al.</i> 2019 annual density estimate for the ODA)</b>          | <b>0.01</b>                 | <b>20,118</b>        | 0.1               | 6.28                           | 0.06 minke whale (0.0003% of the CGNS MU reference population)            | Negligible          |

| Species scenario                                                                                | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                               | Magnitude of effect |
|-------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|--------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)         | 0.181                       | 34,461               | 0.1               | 6.28                           | 1.14 grey seal (0.0033% of the SE England MU reference population) | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the wider ref pop) | 0.181                       | 60,310               | 0.1               | 6.28                           | 1.14 grey seal (0.0019% of the Wider reference population)         | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)         | 0.26                        | 34,461               | 0.1               | 6.28                           | 1.6 grey seal (0.0047% of the SE England MU reference population)  | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the wider ref pop) | 0.26                        | 60,310               | 0.1               | 6.28                           | 1.6 grey seal (0.0027% of the Wider reference population)          | Negligible          |

| Species scenario                                                                                        | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|---------------------------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| Grey seal (Carter <i>et al.</i> 2022 average density for Offshore Development Area (ODA) and the SE MU) | 0.386                       | 34,461               | 0.1               | 6.28                           | 2.4 grey seal (0.007% of the SE England MU reference population)        | Negligible          |
| Grey seal (Carter <i>et al.</i> 2022 average density for the ODA, and the wider ref pop)                | 0.386                       | 60,310               | 0.1               | 6.28                           | 2.4 grey seal (0.004% of the Wider reference population)                | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS East array, and the SE MU)              | 0.0017                      | 4,853                | 0.1               | 6.28                           | 0.011 harbour seal (0.00022% of the SE England MU reference population) | Negligible          |
| Harbour seal (Carter <i>et al.</i> 2022 average density for DBS West array, and the SE MU)              | 0.001                       | 4,853                | 0.1               | 6.28                           | 0.006 harbour seal (0.00013% of the SE England MU reference population) | Negligible          |

# RWE

Dogger Bank South Offshore Wind Farms

| Species scenario                                                                   | Density (/km <sup>2</sup> ) | Reference population | Impact range (km) | Impact area (km <sup>2</sup> ) | Assessment of effect                                                    | Magnitude of effect |
|------------------------------------------------------------------------------------|-----------------------------|----------------------|-------------------|--------------------------------|-------------------------------------------------------------------------|---------------------|
| Harbour seal (Carter <i>et al.</i> 2022 average density for the ODA and the SE MU) | 0.0015                      | 4,853                | 0.1               | 6.28                           | 0.009 harbour seal (0.00019% of the SE England MU reference population) | Negligible          |

**RWE Renewables UK Dogger Bank  
South (West) Limited**

**RWE Renewables UK Dogger Bank  
South (East) Limited**

**Windmill Hill Business Park  
Whitehill Way  
Swindon  
Wiltshire, SN5 6PB**

