Environmental Impact Assessment Report
Volume 3, Appendix 11.1: Marine Mammal Baseline Technical Report

MarramWind Offshore Wind Farm

December 2025

MarramWind

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Contents

1. Introduction

1.1.1.1 This Technical Report is an Appendix to **Volume 1, Chapter 11: Marine Mammals** of the **Environmental Impact Assessment (EIA) Report** and provides the technical baseline for marine mammal receptors identified within the study area for MarramWind Offshore Wind Farm (hereafter, referred to as 'the Project'). Data were collated through a detailed desktop study of the existing resources available for marine mammals within the region. Site-specific data from Digital Aerial Surveys (DAS) over two years of surveys (between April 2021 and March 2023) were also used to inform the baseline.

1.1.1.2 The aim of this Technical Report is to provide a robust baseline characterisation of the marine mammal receptors, against which the potential impacts of the Project are assessed. Marine mammals considered include cetaceans (whales, dolphins and porpoises) and pinnipeds (seals). In order to focus this baseline characterisation report on the most relevant data sources, the following structure to data sections has been applied:

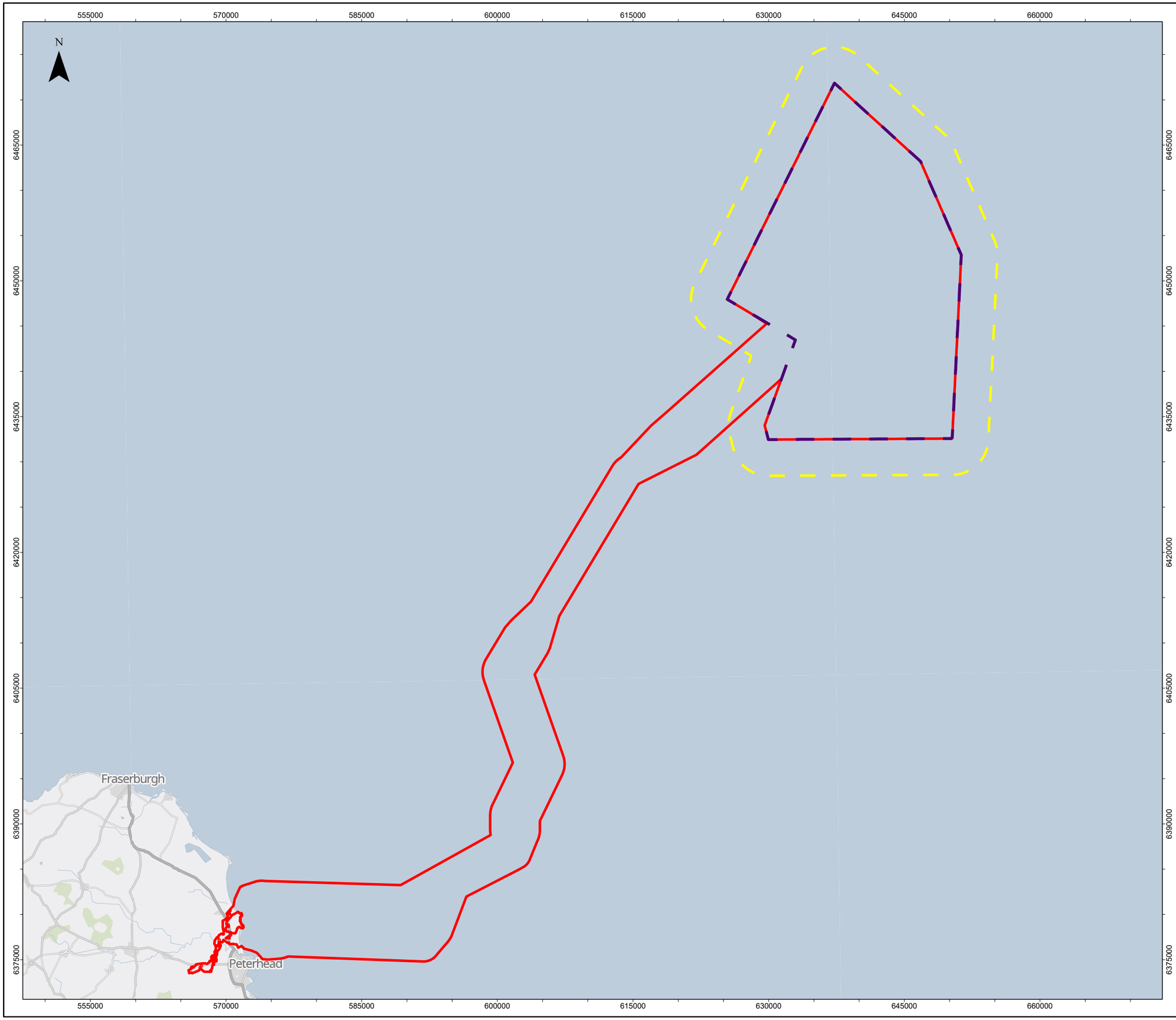
- **Section 4** outlines the key data sources considered in this Technical Report (including a table of all data sources examined).
- **Section 5** details all data sources and the evidence base for each of the marine mammal receptors. In each case, the Section details the data sources that were considered to be the most appropriate to focus on, given their proximity to the Project, the period over which they were collected and most appropriate methodology for the purposes of informing impact assessment. Each Section identifies the most appropriate density and abundance estimates that were then used in the quantitative impact assessment.
- **Section 6** provides a record of other data sources examined and considered, including information on why they were not deemed to be key data sources for the baseline characterisation (for example, age of data, lack of absolute density estimate, inappropriate scale of surveys).

2. Study Area

2.1.1.1 The marine mammal study area varies depending on the species, considering individual species ecology and behaviour. For all species, the study area covers the Project (for instance, Option Agreement Area (OAA) and the offshore export cable corridor) and is extended over an appropriate area considering the scale of movement and population structure for each species. The marine mammal study area has been defined at two spatial scales:

- a site-specific study area scale; and
- a broader regional study area scale using species Management Units (MUs) defined by the Inter-Agency Marine Mammal Working Group (IAMMWG) (IAMMWG, 2023), and the Seal Management Areas (SMAs) defined by the Special Committee on Seals (SCOS) (SCOS, 2024).

2.1.1.2 The site-specific study area is the area which covers the OAA plus a 4 kilometre (km) buffer, this is the same as the survey area for the DAS conducted for the Project. Surveys of the site-specific study area were conducted by APEM between April 2021 and March 2023. The DAS comprised 26 survey transects with a 2km spacing within the OAA plus a 4km buffer. The local scale study area provides an indication of the local densities of each species. The survey area is presented in **Figure 1**.



Red Line Boundary

Option Agreement Area

Site Specific Study Area

0 10 20 Kilometres

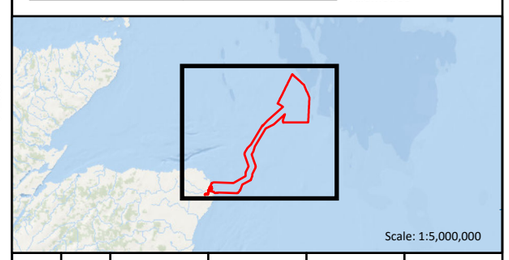


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Figure 1 Site specific marine mammal study area

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2.1.1.3 For each cetacean species, the regional-scale study area (**Figure 2**) is largely defined by the species-specific MU, outlined by the IAMMWG (IAMMWG, 2023). An MU typically refers to a geographical area in which the animals of a particular cetacean species are found, to which management of human activities is applied. It may be smaller than what is believed to be a 'population[1]', to reflect spatial differences in human activities and their management (IAMMWG, 2023). Using MUs in the assessment of cetacean species allows consideration of the scale of movement of a species and its respective populations, whilst taking account of jurisdictional boundaries and the management of human activities.

2.1.1.4 The Project is located within the following species-specific MUs:

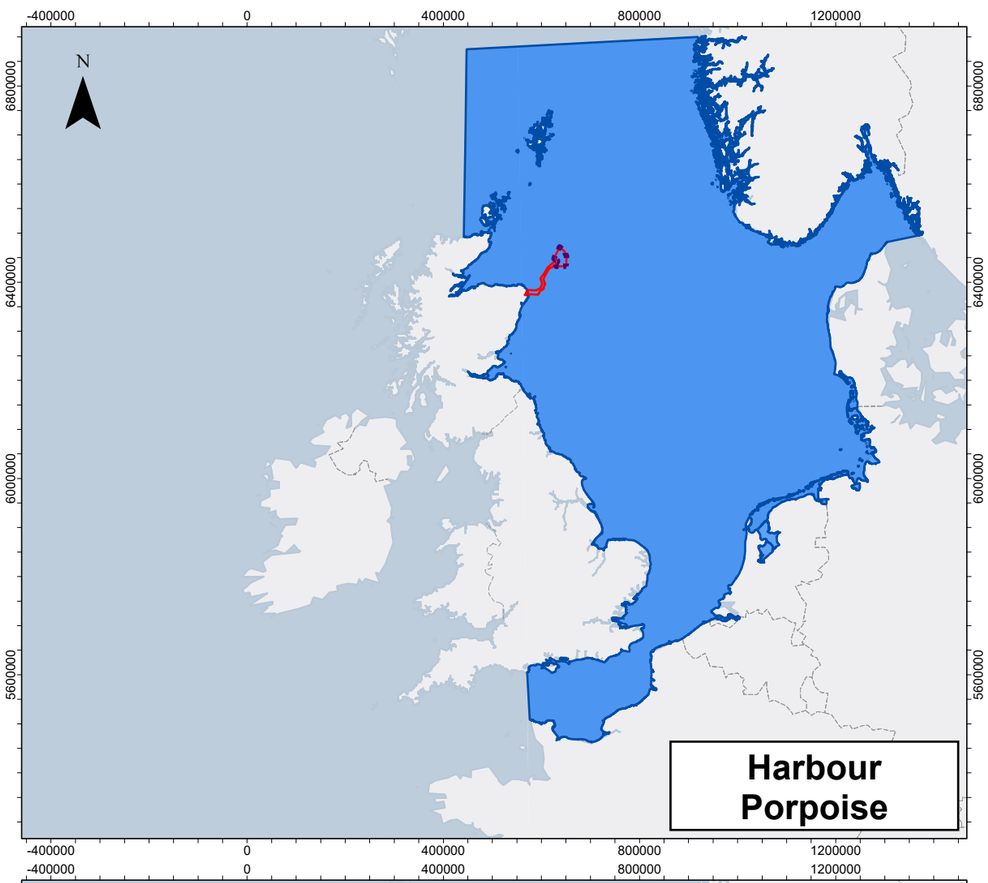
- harbour porpoise (*Phocoena phocoena*): North Sea (NS) MU;
- bottlenose dolphin (*Tursiops truncatus*): Coastal East Scotland (CES) MU and Greater North Sea (GNS) MU;
- short-beaked common dolphin (*Delphinus delphis*): Celtic and Greater North Seas (CGNS) MU;
- white-beaked dolphin (*Lagenorhynchus albirostris*): CGNS MU;
- Atlantic white-sided dolphin (*Lagenorhynchus acutus*): CGNS MU;
- Risso's dolphin (*Grampus griseus*): CGNS MU; and
- minke whale (*Balaenoptera acutorostrata*): CGNS MU.

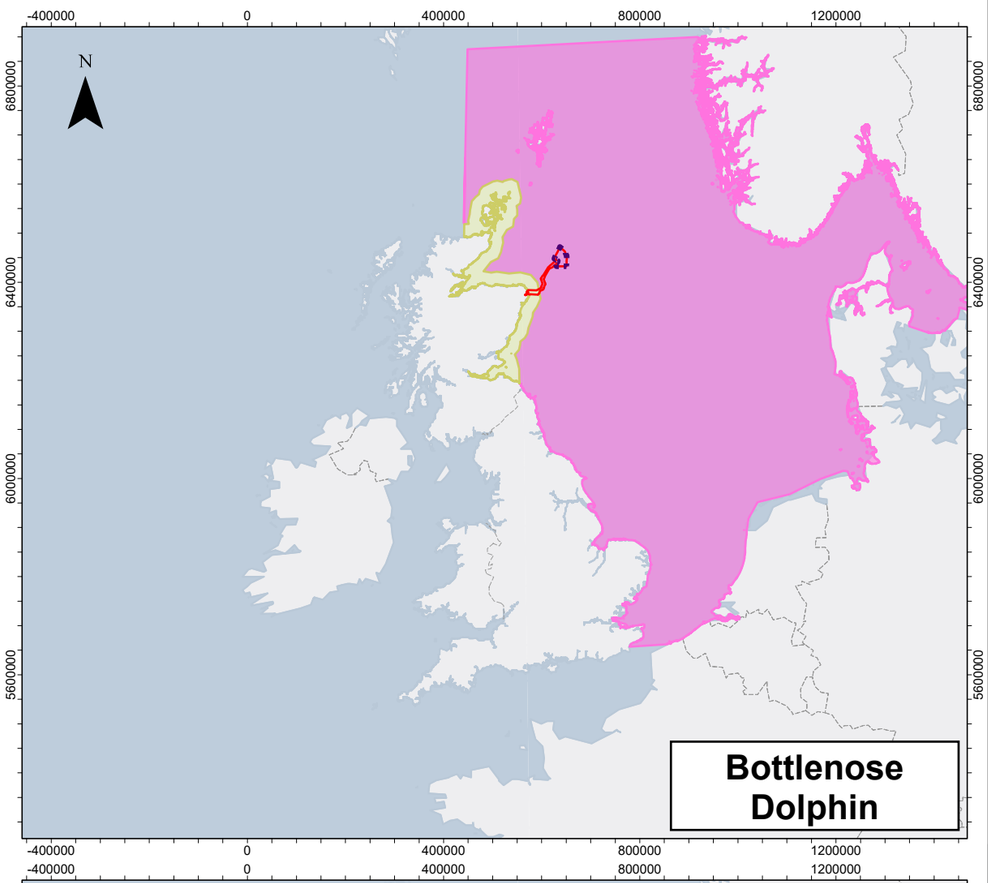
2.1.1.5 In addition to the seven cetacean species listed above and within the Scoping Report (MarramWind Limited, 2023), recognition within this baseline characterisation is also given to the humpback whale (*Megaptera novaeangliae*), which has no defined MU for the United Kingdom (UK).

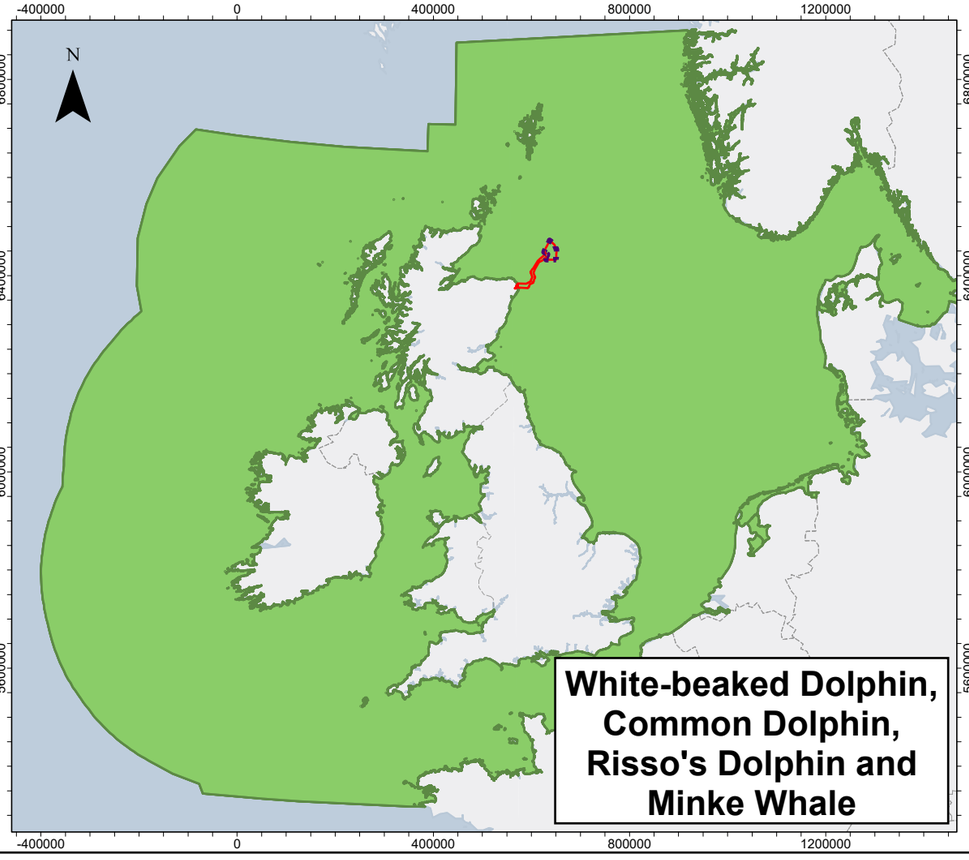
2.1.1.6 For seals, SMAs also refer to geographical areas which are defined based on the distribution of seal haul-out sites, for pragmatic reasons such as the ability to survey an SMA within one season, and the locations of jurisdictional boundaries (SCOS, 2022). SMAs are not explicit management divisions and should be combined appropriately when management is considered. The regional scale study area for seals is:

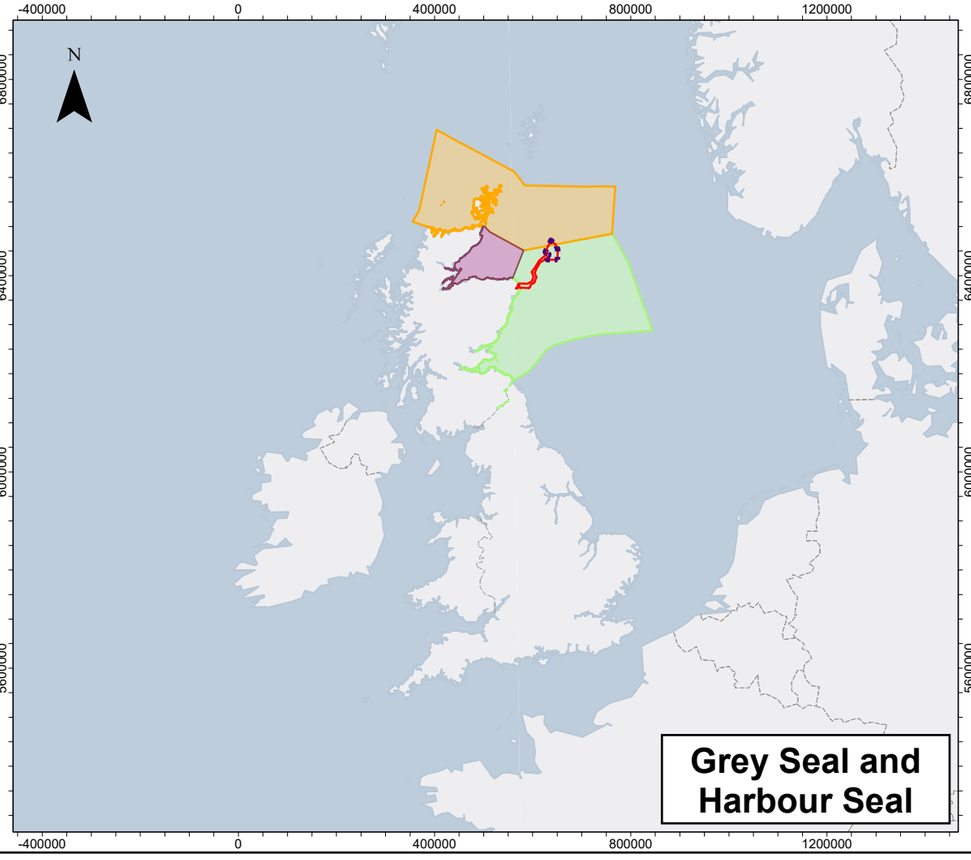
- grey seal (*Halichoerus grypus*): East Scotland SMA and North Coast and Orkney SMA; and
- harbour seal (*Phoca vitulina*): East Scotland SMA and North Coast and Orkney SMA.

[1] Defined as a collection of individuals of the same species found in the same area, where genetic variation occurs within the population and between other populations.









Red Line Boundary

Option Agreement Area

Cetacean Management Unit (MU)

Greater North Sea

Coastal East Scotland

North Sea

Celtic and Greater North Seas

Seal Management Area (SMA)

East Scotland

Moray Firth

North Coast & Orkney

0 250 500 Kilometres

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Figure 2 Regional marine mammal study area

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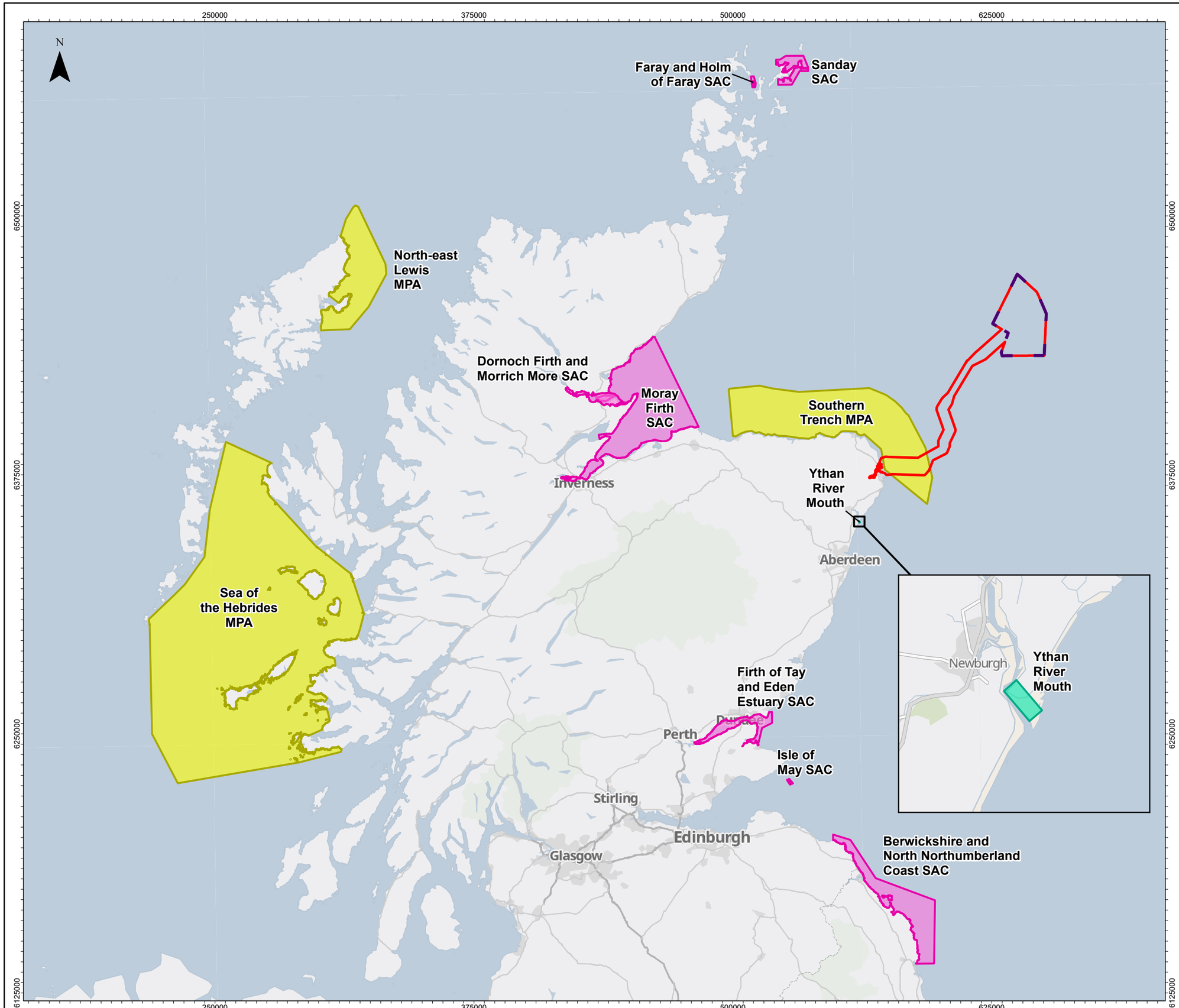
3. Designated Sites

3.1.1.1 There are several designated sites for marine mammals within their respective MUs (**Figure** 3 and **Table 3.1**).



Red Line Boundary

Option Agreement Area

Marine Protected Area (MPA)

Special Area of Conservation (SAC)

Protected Seal Haul Out Site

0 50 100 Kilometres

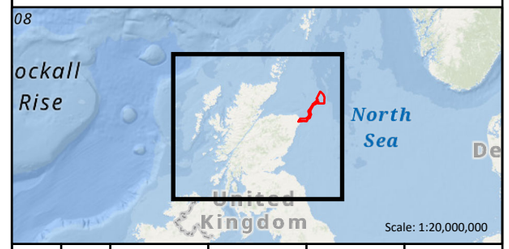


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Figure 3 Marine mammal designated sites

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Table 3.1 Relevant nature conservation sites designated for the protection of marine mammal receptors

Species	Designated site name	Distance from (km)		Site description
		OAA	Offshore export cable corridor	
Minke whale	Southern Trench Marine Protected Area (MPA).	53.59	0.00 (for instance, export cable corridor intersects the designated site).	The Southern Trench MPA was designated in 2020, listing minke whale as one of the primary justifications for the selection of the site. This area persistently supports higher than average densities of minke whale compared to the rest of Scotland (NatureScot, 2020).
Grey seal and harbour seal	Ythan Estuary Designated Seal haul-out.	105.67	27.04	In 2017 the Ythan Estuary was designated as an official seal haul-out site, predominantly for grey seals; however, harbour seals are also reported here regularly.
Bottlenose dolphin	Moray Firth Special Area of Conservation (SAC).	150.57	89.25	The Moray Firth SAC was designated in 2005 and lists bottlenose dolphin as a primary reason for selection of the site. This site supports the only known resident population of bottlenose dolphin in the North Sea.
Harbour seal	Firth of Tay and Eden Estuary SAC.	204.79	136.89	The Firth of Tay and Eden Estuary SAC was designated in 2005, listing harbour seals as a primary reason for the selection of the site. At the time of designation, the site supported a nationally important breeding colony of harbour seals, where around 600 adult seals hauled out to rest, pup and moult. The SAC's August haul-out counts have declined by 93.5% (95% CI: -95.4 to -90.9) since 1997, and the latest count recorded 55 individuals in August 2023 (SCOS, 2024).
Harbour seal	Sanday SAC.	142.26	158.54	The Sanday SAC was designated in 2005, listing harbour seals as a primary reason for the selection of the site. The site supports a large breeding colony of harbour seals, found on intertidal haul-out sites that are unevenly distributed around the Sanday coast. This SAC supports over 4% of the UK population; however, this population is in decline. The latest count in 2019 showed around 5% of the North Coast and Orkney SMA population use this SAC, compared to around 19%

Species	Designated site name	Distance from (km)		Site description
		OAA	Offshore export cable corridor	
				in 1993, with a reported decline of 96% (95% CI: -97.6 to 93.5; SCOS, 2024).
Grey seal	Isle of May SAC.	228.68	161.51	The Isle of May SAC was designated in 2005, listing grey seals as a primary reason for the selection of the site. The site supports a large breeding colony of grey seals. The site used to be the main breeding colony in the East Scotland SMA and is currently described as potentially declining. The latest pup production estimate at the Isle of May SAC in 2021 was 2,005, which is approximately 20% lower than the historic high recorded in 2004 (SCOS, 2024). This slight increase from the previous estimate is likely due to the expanding nature of the colony as a whole rather than production within the SAC (SCOS, 2024).
Grey seal	Berwickshire and North Northumberland Coast SAC.	245.12	180.08	The Berwickshire and North Northumberland Coast SAC was designated as an SAC in 2005, due to its importance to the grey seal breeding colonies in this area. The north corner of the SAC falls within the East Scotland SMA; however, the majority of the site is located within English waters. The Berwickshire and North Northumberland SAC population is one of the largest breeding colonies on the North Sea coast. The latest pup production estimate at the Berwickshire and North Northumberland Coast SAC in 2021 was 2,668, resulting in a current trend estimate of a 1.1% (95% CI: -4.6 to 7.1) increase per annum (SCOS, 2024).
Grey seal	Faray and Holm of Faray SAC.	155.53	169.80	The Faray and Holm of Faray SAC was designated in 2005, listing grey seals as a primary reason for the selection of the site. The islands support the second-largest breeding colony in the UK, contributing to around 9% of the annual UK pup production. The pup production has however been in decline since reaching its peak in the late 1990s, with a reported decline since 1992 of 46.3% (95% CI: -53.8 to -37.5; SCOS, 2024).

Species	Designated site name	Distance from (km)		Site description
		OAA	Offshore export cable corridor	
Risso's dolphin	North-east Lewis MPA.	293.76	254.88	The North-east Lewis MPA designated in 2020 lists Risso's dolphin as a primary feature. Located on the west side of Scotland, north of the Isle of Lewis covering an area 907km^2. With many Risso's dolphin re-sighted year on year, including mothers and calves.
Minke whale	Sea of the Hebrides MPA.	332.34	259.98	The Sea of the Hebrides MPA was designated as an MPA in 2020, listing minke whale as a primary reason for the selection of the site. The MPA is located on the west coast of Scotland, within the Sea of the Hebrides, between the east coast of the Outer Hebrides and the west coasts of the islands of Skye and Mull, and the Ardnamurchan Peninsula, covering an area of 10,039km^2.
Harbour porpoise	Southern North Sea SAC.	291.24	264.18	The Southern North Sea SAC was designated in 2019, listing harbour porpoise as a primary reason for the selection of the site. The SAC sits along the east coast of England, predominantly in the offshore waters of the central and southern North Sea, from north of Dogger Bank to the Straits of Dover in the south. It covers an area of 36,951km^2.

4. Methodology to Inform the Baseline

4.1 Overview

4.1.1.1 The following sections provide detail on key data sources used to characterise the site-specific study area (**Table 4.1**) and the regional study area (**Table 4.2**) for marine mammals in relation to the Project. These sections detail the survey and analysis methodology implemented in each study and the potential limitations associated with these. The actual results of the surveys in terms of the species presence are detailed in subsequent species-specific sections (see **Section 5**).

4.1.1.2 For full record of other data sources examined and considered, including information on why they were not considered to be key data sources for the baseline characterisation (for example, age of data, lack of absolute density estimate, inappropriate scale of surveys) see **Section 6**.

Table 4.1 Marine mammal baseline datasets – site-specific study area

Data source	Description	Spatial coverage
MarramWind site-specific DAS (APEM, 2024a)	Site-specific baseline characterisation DAS conducted by APEM between April 2021 and March 2023.	OAA plus a 4km buffer.

Table 4.2 Marine mammal baseline datasets – regional study area

Data source	Description	Spatial coverage
Spatial model of cetacean density in European Atlantic waters based on SCANS-IV Summer 2022 survey data (Gilles *et al.,* 2025)	The report describes the density surface modelling for those cetacean species for which sufficient data were obtained during SCANS-IV surveys. Species included harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin*),* striped dolphin (*Stenella coeruleoalba*), beaked whale species combined (*Ziphiidae*), minke whale and fin whale (*Balaenoptera physalus*).	The Project is located within SCANS-IV block NS-E and NS-D.
Updated Habitat-Based At-Sea Distribution Maps for Harbour and Grey Seals in Scotland (Carter *et al.,* 2025)	This report provides updated habitat-based models of at-sea distribution for harbour and grey seals in Scottish and adjacent waters (updated from Carter *et al.,* 2022).	This report covers the whole of Scotland, inclusive of the site-specific study area for the Project.
Scientific advice on matters related to the management of seal populations: 2024, Interim advice. Natural Environment Research Council (NERC): SCOS	Under the Conservation of Seals Act 1970 and the Marine (Scotland) Act 2010, NERC has a duty to provide scientific advice to the government on matters related to seal population management. SCOS has been appointed to formulate this advice on behalf of NERC. There have been 34 reports collated by SCOS since 1990 that identify any	This report covers the whole of UK waters, inclusive of the site-specific study area for the Project.

Data source	Description	Spatial coverage
Main Advice Report (SCOS, 2024)	conservation and management issues, including ecology, behaviour, population trends and estimates, important areas and the status of both grey and harbour seals in the UK. This 2024 report provides formal advice in response to questions raised in Summer 2023 by the Marine Directorate and Department of the Environment, Food and Rural Affairs.	
Estimates of cetacean abundance in European Atlantic waters in Summer 2022 from the Small Cetaceans in European Atlantic Waters and the North Sea (SCANS)-IV aerial and shipboard surveys (Gilles *et al.,* 2023)	SCANS-IV report provides estimates of cetacean abundance and density in European Atlantic waters in Summer 2022 using the SCANS-IV aerial and shipboard surveys.	The Project is located within SCANS-IV block NS-E and NS-D.
Modelled density surfaces of cetaceans in European Atlantic waters in Summer 2016 from the SCANS-III aerial and shipboard surveys (Lacey *et al.,* 2022)	Report provides modelled density surfaces of cetaceans in European Atlantic waters in Summer 2016 using the SCANS-III aerial and shipboard surveys, as well as data from SCANS-II / CODA.	The Project is located within SCANS-III block T and R.
Updated abundance estimates for cetacean MUs in UK waters (Revised 2022; IAMMWG, 2022)	Report provides abundance estimates for the seven most common cetacean species found in UK waters. MUs were defined across UK waters and abundance estimates were calculated for each species within their respective MU.	This report covers the whole of UK waters, inclusive of the site-specific study area for the Project.
Production of Seabird and Marine Mammal Distribution Models for the East of Scotland (Paxton *et al.,* 2022)	This report describes temporal and spatial patterns of densities for seabird and marine mammal species in the eastern waters of Scotland from DAS between February 2020 and March 2021. With four cetacean species of particular interest minke whale, common dolphin, white beaked dolphin and harbour porpoise.	The east coast of Scotland, including the Project.
Sympatric Seals, Satellite Tracking and Protected Areas: Habitat-Based Distribution Estimates for Conservation and Management (Carter *et al.,* 2022)	This report provides estimates of at-sea distribution for both grey and harbour seals from haul-outs in the British Isles (UK, Ireland and the Isle of Man). The predictions are based on regional models of habitat preference. Estimates are calculated using satellite tracking (telemetry tagging) and abundance data (haul-out counts).	This report covers the whole of UK waters, inclusive of the site-specific study area for the Project.
Estimates of cetacean abundance in European Atlantic waters in Summer 2016 from the SCANS-III aerial and shipboard	SCANS-III report on cetacean abundance following vessel and aerial surveys of the North Sea and European Atlantic continental shelf waters conducted in July 2016. Species included harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin,	The Project is located within SCANS-III block T and R.

Data source	Description	Spatial coverage
surveys (Hammond *et al.,* 2021)	striped dolphin, long-finned pilot whale (*Globicephala melas*), beaked whale species combined, minke whale and fin whale.	
Regional baselines for marine mammal knowledge across the North Sea and Atlantic areas of Scottish waters (Hague *et al.,* 2020)	This report collates and provides information on the abundance and distribution of marine mammal species in the Scottish Northern North Sea region and Scottish Atlantic waters, with a focus on what were the draft plan option sites identified in the Draft Sectoral Marine Plan for Offshore Wind Energy for Scotland.	This report covers the whole of Scotland, inclusive of the site-specific study area for the Project.
Distribution Maps of Cetacean and Seabird Populations in the North-East Atlantic, Marine Ecosystems Research Programme (MERP; Waggitt *et al.,* 2019)	This study provides the largest ever collation and standardisation of diverse survey data for cetaceans and seabirds, and the most comprehensive distribution maps of these taxa in the North-East Atlantic. Aerial and vessel survey data were collated between 1980 and 2018. Distributional maps for 12 cetacean species were produced at 10km resolution.	North-East Atlantic.
East Coast Scotland Marine Mammal Acoustic Surveys (ECOMMAS) and the Scottish Passive Acoustic Network (SPAN) project (Brookes, 2017; Palmer *et al.,* 2019)	The ECOMMAS project, a Scottish Government funded project, used click detectors (Continuous Porpoise monitoring Detectors (C-PODs); Chelonia Ltd, 2014), at 30 locations off the east coast of Scotland, to detect echolocation clicks of cetaceans. C-POD data are presented in detection-positive days and detection-positive hours. At ten of these locations, a broadband acoustic recorder was also deployed, to record ambient noise levels, as well as other animal vocalisations. In 2022, ScotMER decided to broaden the study scope of ECOMMAS to include additional monitoring locations on the western and northern coasts, where less data are currently available. Original mooring locations have continued to use the C-PODs; however, all new moorings have upgraded to the successor, the Full Waveform Capture POD (F-POD). In addition to collecting fine-scale temporal data on marine mammals, the SPAN moorings can also detect fish tagged through other monitoring projects, such as Predators and Prey Around Renewable Energy Developments (PrePARED) and SeaMonitor. Data have been used in numerous outputs, including peer reviewed publications and EIA Reports for major infrastructure projects on the east coast of Scotland. These data will also contribute to the UK's reporting under the UK Marine Strategy.	Sites along the east coast of Scotland and broadened to cover locations on the western and northern coasts.

Data source	Description	Spatial coverage
Revised Phase III Data Analysis of Joint Cetacean Protocol (JCP) Data Resources (Paxton *et al.*, 2016)	Effort-linked sightings data contained within the JCP data resource (38 data sources between 1994 to 2010) have been used to estimate spatio-temporal patterns of abundance for seven species of cetacean over a 17-year period from 1994 to 2010.	This report covers the whole of UK waters, inclusive of the site-specific study area for the Project.
JCP data analysis tool (Joint Nature Conservation Committee (JNCC), 2016)	The JCP Phase III Data Analysis Product was used to extract abundance estimates averaged for Summer 2007 to 2010 and scaled to the SCANS-III estimates for user-specified areas.	This report covers the whole of UK waters, inclusive of the site-specific study area for the Project.
Statistical approaches to aid the identification of MPAs for minke whale, Risso's dolphin, white-beaked dolphin and basking shark (Paxton *et al.*, 2014)	JCP dataset plus additional data sourced by Scottish Natural Heritage were used to generate estimated densities for minke whale (2000 to 2012), Risso's dolphin (1994 to 2012) and white-beaked dolphin (1994 to 2012).	Generated estimated densities per area surveyed which includes the North Sea and includes the Project.
Site-specific survey information from nearby Offshore Wind Farms (Moray East, 2012; Moray Offshore Windfarm (West) Limited, 2018; Royal HaskoningDHV, 2023; HiDef Aerial Surveying Limited, 2023a; HiDef Aerial Surveying Limited 2023b; APEM, 2024b)	Baseline survey data from nearby offshore wind farms.	Caledonia Offshore Wind Farm, Green Volt Offshore Wind Farm, Moray East Offshore Wind Farm, Moray West Offshore Wind Farm, Muir Mhòr Offshore Wind Farm and, Salamander Offshore Wind Farm.
Various reports and papers on the distribution and abundance of bottlenose dolphin in Scottish waters (Cheney *et al.*, 2012; 2013; 2014a; 2014b; Quick *et al.*, 2014; Cheney *et al.*, 2018; Arso Civil *et al.*, 2019; 2021; Cheney *et al.*, 2024)	Various studies have focussed of the distribution, abundance and behaviour of the resident population of bottlenose dolphins found in the Moray Firth with links to further sites across the UK and Ireland. These reports cover data for bottlenose dolphin protected in the Moray Firth SAC and CES MU. Reports include: Condition monitoring of bottlenose dolphin within the Moray Firth SAC; Reports from Photo-identification (photo-ID) surveys and Passive Acoustic Monitoring (PAM) surveys; Moray Firth Marine Mammal Monitoring Programme developed in 2014 (studies of reproduction, survival rates, assessments of trends in abundance and patterns of distribution); and Wider east coast of Scotland population inclusive of photo-ID data in the Firth of Forth and Firth of Tay.	Covers the CES MU for bottlenose dolphin, and the Moray Firth SAC.

4.2 Site-specific surveys

4.2.1.1 The MarramWind site-specific baseline characterisation surveys consisted of monthly DAS conducted by APEM. A total of 24 high-resolution digital video aerial surveys were conducted, between April 2021 and March 2023; however, due to poor weather conditions, particularly throughout Winter months, the monthly DAS programme was interrupted. Prolonged periods of sustained poor weather meant no DAS were flown in November 2021, February, June and December 2022 and January 2023; therefore, DAS were flown twice in July and November 2022, and March 2023, as well as three DAS flown in February 2023 to ensure that seasonal sample sizes were maintained and at least one DAS was conducted in each of the 12 calendar months across the 24-month survey period (APEM, 2024a).

4.2.1.2 Surveys were conducted using APEM's bespoke camera system, termed 'Shearwater V', on an aircraft flown at an altitude of approximately 395m and a speed of approximately 120 knots. The Shearwater V had a resolution of 1.5 centimetres (cm) Ground Sampling Distance (GSD). APEM designed the survey with 2km-spaced transects across the entire OAA, plus a 4km surrounding buffer. For the purposes of data analysis, a 4km buffer is being used. The total survey area was approximately 1,253km^2 comprising of the OAA (727.66km^2) and 4km buffer (525.38km^2). The survey design included 26 strip transects extending roughly south to north, perpendicular to the depth contours along the coast. This design ensured that each transect sampled a similar range of habitats (primarily relating to water depth), to reduce the variation in marine mammal abundance estimates between transects. Images were collected continuously along the survey flight lines and a minimum of 30% coverage was captured, with a minimum of 10% of the data subject to analysis. Full details of the site-specific surveys can be found in the two-year survey report (APEM, 2024a).

4.2.1.3 Data analysis for these surveys occurred across multiple stages. During each survey, APEM's on-board camera technician continually monitored the imagery as it was collected to ensure the data collected was fit for purpose. Imagery was captured in raw format and post-processed to ensure optimal quality for the subsequent stage of image analysis, to extract information on marine fauna or other notable occurrences. When a survey was completed, data were checked to ensure the number of flight lines and the number of images collected were correct, and that the quality of the imagery was acceptable. Once the image analysis was completed, further quality assurance (QA) processes took place.

4.2.1.4 Images were assessed in batches with a different person responsible for each batch. Each image containing birds and / or marine megafauna was reviewed and checked by APEM's dedicated QA Manager, ensuring that at least 10% of birds and marine megafauna recorded were subject to internal QA to confirm that all species were correctly identified (for further detail, refer to APEM, 2024a).

4.2.1.5 Over year 1 and 2 of the surveys, there were 430 marine mammal sightings within the OAA plus 4km buffer. These comprised:

- 328 harbour porpoises (76.28% of marine mammal sightings);
- 88 white-beaked dolphins (20.47% of marine mammal sightings);
- 7 Risso's dolphins (1.63% of marine mammal sightings); and
- 7 grey seals (1.63% of marine mammal sightings).

4.3 Regional baseline data for marine mammals

4.3.1.1 There is a significant volume of data available for cetaceans within the regional study area for the Project. These data are often used to investigate seasonal and / or interannual trends in occurrence (for example, Waggitt *et al.*, 2019) and to make inference on habitat use through abundance and density maps (for example, Gilles *et al.,* 2025; Lacey *et al.*, 2022). These data also contribute to Management Unit (MU) delineation and reporting (IAMMWG, 2023). The IAMMWG (2022) report has combined the results and data from multiple studies to update the abundance estimates presented in IAMMWG (2015) for the relevant MU of the seven most common cetacean species in UK waters.

4.3.1.2 Hague *et al.* (2020) present a comprehensive review on the abundance and distribution of marine mammals within Scottish waters, specifically focusing on the Northern North Sea and Atlantic regions. The study places particular emphasis on areas identified in the Draft Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2019; currently undergoing an update in the Scottish Government, 2025), including the 17 Draft Plan Option sites distributed across five designated regions. The report synthesizes a wide array of data sources (from over 40 data sources), encompassing various survey methods and sampling techniques, to provide a broad overview of marine mammal presence in Scottish waters. In addition to mapping current knowledge, the study highlights significant data gaps, particularly in relation to species abundance and distribution, underscoring areas where further research and monitoring are needed (Hague *et al.*, 2020).

4.3.1.3 Large-scale dedicated surveys have covered the Project's Offshore Red Line Boundary periodically, such as the SCANS survey programme. The primary goal of the SCANS surveys is to assess the abundance and density of small cetaceans in the North Sea and European Atlantic continental shelf waters. As of 2025, there have been four complete SCANS surveys, each with published results:

- SCANS-I in the Summer of 1994 (Borchers *et al.*, 1995);
- SCANS-II in the Summer of 2005 (Hammond *et al.*, 2013);
- SCANS-III in the Summer of 2016 (Hammond *et al.*, 2017, Hammond *et al.*, 2021); and
- SCANS-IV in the Summer of 2022 (Gilles *et al.*, 2023).

4.3.1.4 The SCANS surveys used a combination of aerial and boat-based surveys. Both aerial and boat-based survey methodologies were designed to correct for availability and detection bias, allowing for the estimation of absolute abundance (Hammond *et al.*, 2021). Within this Technical Report, only the two most recent surveys (SCANS-III and IV) were considered. Where data are available, SCANS-IV was used primarily as it contains the most up to date data; however, if data are missing then results from SCANS-III were considered.

4.3.1.5 Although SCANS provide insight into sightings, density, and abundance across a regional spatial scale, these surveys do not provide fine-scale spatial or temporal information on species abundance and distribution as they are conducted periodically (conducted every five to ten years) and only during the Summer months. This limitation means that the data may not accurately reflect species distribution and abundances throughout the year, particularly for those species with seasonal movements. For example, there is a potential for over-estimation of average annual abundance for species with greater presence during the Summer period when using SCANS estimates alone.

4.3.2 SCANS-IV

4.3.2.1 The Project is situated within SCANS-IV survey blocks NS-E and NS-D (**Figure 4**), both of which were surveyed using an aircraft. Block NS-E has a surface area of 65,423km^2 and a

total of 1,603.9km was surveyed under primary effort and 11.7km under trailing search effort, which is the coverage during circle-back procedures from both vessels and aircraft. Block NS-D has a surface area of 64,455km^2 and a total of 1,703.8km was surveyed under primary effort and 15.7km under trailing search effort. During these surveys, the most common cetacean sightings in block NS-E included harbour porpoise, white-beaked dolphin, Atlantic white-sided dolphin, Risso's dolphin, and minke whale. Within block NS-D, the most common cetacean species were harbour porpoise, white-beaked dolphin, and minke whale (Gilles *et al.*, 2023).

4.3.3 SCANS-IV surface densities

4.3.3.1 The SCANS-IV survey data were used to inform predictive habitat-based models for cetacean densities in relation to spatially-linked environmental variables. These models produced surface density maps for cetacean species including harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin, striped dolphin, minke whale, fin whale, unidentified dolphin (either common or striped dolphin) and beaked whale species (Gilles *et al.*, 2025).

4.3.3.2 The cetacean data used to inform the models were the same as those gathered in 2022, which were used by Gilles *et al.* (2023) to provide block-specific abundance estimates. The methodology followed is similar to that of Lacey *et al.* (2022), using a range of environmental covariates such as water depth and sea surface temperature (refer to Gilles *et al.* (2025) for the full list of environmental covariates). The models used were fitted using a spatial resolution of 10km and projected onto a 10km x 10km spatial grid. Density and abundance estimates can be generated for an entire survey area or a defined area within it (for example, the Project) from the predicted density estimates from the surface models.

4.3.4 SCANS-III

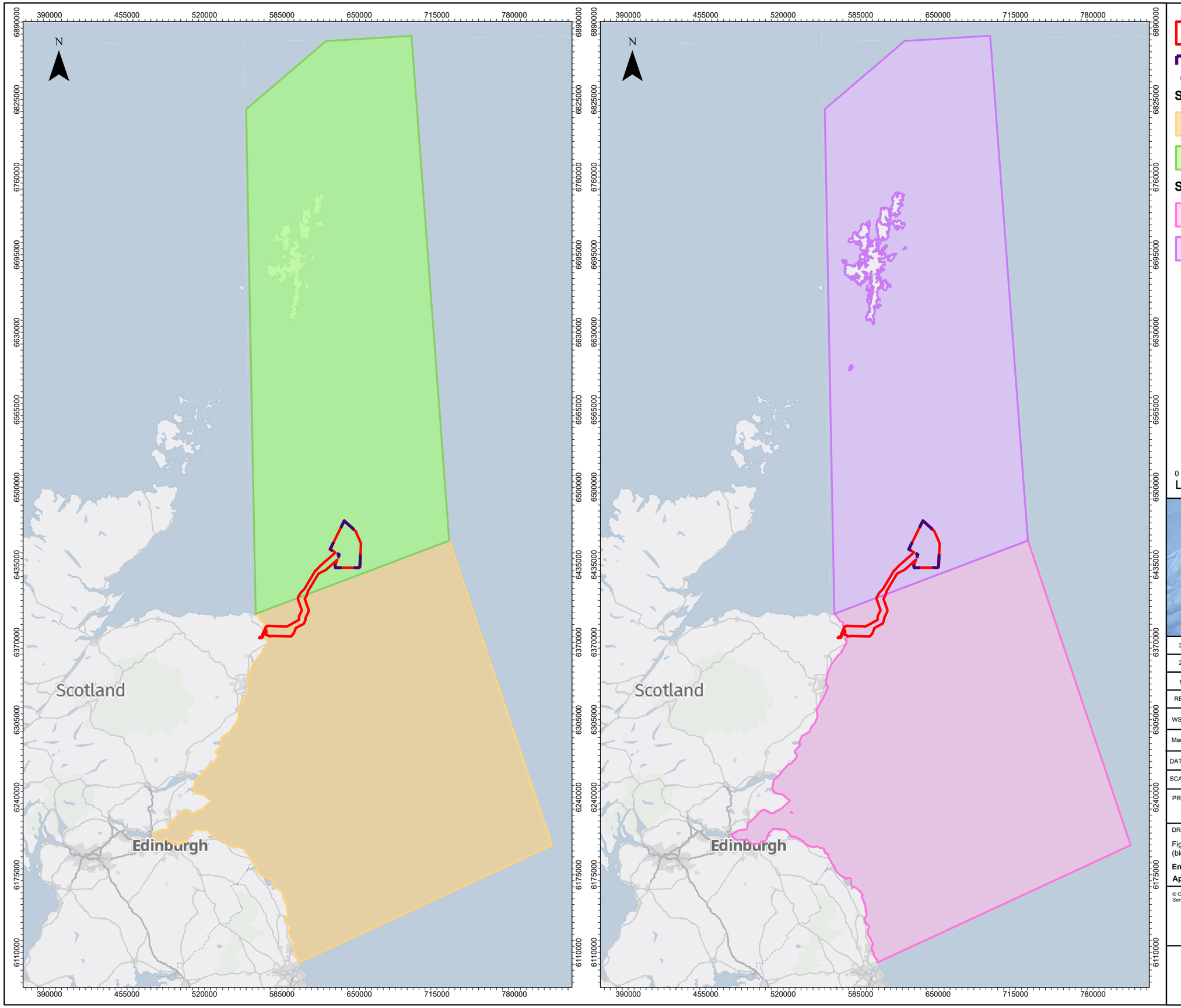
4.3.4.1 The Project lies within survey blocks T and R of SCANS-III (**Figure 4**), both of which were surveyed using aerial methods. Block T covers an area of 65,417km^2 with a total of 2,259km surveyed under primary effort, and 24km under trailing search effort. Block R spans an area of 64,464km^2 with a total of 2,179km surveyed under primary effort, and 40.5km under trailing search effort. The most common cetacean sightings in block T included harbour porpoise, white-beaked dolphin, Atlantic white-sided dolphin and minke whale. In block R, the most common cetacean species were harbour porpoise, bottlenose dolphin, Atlantic white-sided dolphin, white-beaked dolphin, and minke whale (Hammond *et al.*, 2021).

4.3.5 SCANS-III surface densities

4.3.5.1 SCANS-III data were used to develop density models based on spatially-linked environmental variables. These models produced surface density maps for cetacean species including harbour porpoise, bottlenose dolphin, white-beaked dolphin, common dolphin, striped dolphin, long-finned pilot whale, beaked whale species, minke whale and fin whale (Lacey *et al.*, 2022).

4.3.5.2 The cetacean data used to inform the models were the same as those obtained in 2016, which were used by Hammond *et al.* (2021) to provide block-specific abundance estimates. A range of environmental covariates (full list available in Lacey *et al.* (2022)) were selected for modelling due to their potential to explain additional variation in cetacean density estimates. The models used were fitted using a spatial resolution of 10km and projected onto a 10km x 10km spatial grid. Density and abundance estimates can be generated for an entire survey area or a defined area within it (for example, the Project) from the predicted density estimates from the surface models. Gilles *et al.* (2025) now supersedes Lacey *et al.*

(2022) with more recent data; therefore, where data are available, the updated values were used in place of the SCANS-III surface densities.



Red Line Boundary

Option Agreement Area

SCANS III Survey Block

R

T

SCANS IV Survey Block

NS-D

NS-E

0 50 100 Kilometres

REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER
3	04/11/2025	EH	LT	MR	NC
2	15/10/2025	EH	LT	MR	NC
1	28/08/2025	EH	LT	MR	NC

WSP DRAWING NUMBER	808368-WEIS-IA-E5-FG-M8-79605
MarramWind DRAWING NUMBER	MAR-GEN-ENV-MAP-WSP-000400

DATUM	ETRS 89	PROJECTION	UTM Zone 30N
SCALE	1:3,000,000	PAGE SIZE	A3

PROJECT TITLE

MarramWind Offshore Wind Farm

DRAWING TITLE

Figure 4 Relevant SCANS-III and IV survey blocks in relation to the Project (blocks presented in Hammond *et al.* (2021) and Gilles *et al.* (2023))

Environmental Impact Assessment Report

Appendix 11.1

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NOT TO BE USED FOR NAVIGATION

wsp

MarramWind

4.4 Bottlenose dolphin surveys

4.4.1.1 The Moray Firth SAC supports one of the few resident populations of bottlenose dolphin in UK waters. The SAC spans from the inner firths to Helmsdale on the north coast and to Lossiemouth on the south coast, encompassing areas frequently used by the East Coast bottlenose dolphin population. NatureScot is responsible for reporting on the condition of this population every six years, with the latest site monitoring report covering data from 2017 to 2022 (Cheney *et al.*, 2012; 2014b; 2018; 2024).

4.4.1.2 A long-term research programme was initiated in 1989 through a collaboration between the University of Aberdeen and the Sea Mammal Research Unit (SMRU) at the University of St Andrews. This initiative, supported by NatureScot since 2004, has focused on evaluating the condition of the SAC's dolphin population using photo-ID and PAM. The primary objective has been to estimate population size through mark-recapture analysis and acoustic data.

4.4.1.3 Beyond the Moray Firth SAC, broader research efforts have investigated the distribution and demographics of the wider East Coast bottlenose dolphin population (Quick *et al.*, 2014). These studies have primarily employed photo-ID techniques to monitor individual movements, estimate population size, and assess demographic trends along the Scottish east coast. Key areas of interest include the Firth of Tay, Firth of Forth, and the coastal waters near Aberdeen. More recent investigations have examined the ecological importance of the Tay Estuary and St Andrews Bay for dolphins frequenting the region (Arso Civil *et al.*, 2019). Building on this work, Arso Civil *et al.* (2021) provided the most up-to-date estimate of the proportion of Moray Firth dolphins that extend their range into these southern waters, offering valuable insights into movement patterns and spatial ecology.

4.4.1.4 It is important to note that the primary focus of these studies has been on monitoring population trends and estimating the abundance of the protected bottlenose dolphin population. This has involved the use of individual-based photo-ID to build a comprehensive catalogue of known animals. While this approach is highly effective for tracking population structure and long-term trends, it is not designed to produce spatially-explicit density estimates. Consequently, although these studies contribute significantly to understanding of dolphin ecology and movement, they are not directly applicable for generating fine-scale density maps

4.5 Existing offshore windfarm data

4.5.1 Caledonia

4.5.1.1 The Caledonia Offshore Wind Farm is located in the Moray Firth, immediately adject to the Moray East Offshore Wind Farm development and approximately 83km east of the Project. At the time of writing this Technical Report, Caledonia Offshore Wind Farm is undergoing consent determination, with a plan to be operational in 2030. Site-specific DAS for Caledonia Offshore Wind Farm were conducted by APEM between May 2021 and April 2023. Caledonia Offshore Wind Farm was subdivided in two smaller areas, Caledonia North and Caledonia South, with both surveyed with an additional 4km buffer. The Caledonia North survey area covers an area of approximatively 557km^2 while Caledonia South survey area covered an area of approximatively 534km^2, both of which consisted of 13 transect lines spaced roughly 2.6km apart (APEM, 2024b).

4.5.1.2 Eight species of marine mammal were identified during the surveys: harbour porpoise (n=141), bottlenose dolphin (n=2), white-beaked dolphin (n=64), common dolphin (n=39), Risso's dolphin (n=7), minke whale (n=12) and grey seal (n=26).

4.5.2 Green Volt

4.5.2.1 The Green Volt Offshore Wind Farm is a floating development on the east coast of Scotland, located approximately 9km south from the Project. This project received consent in 2024, with a planned construction phase between 2025 to 2028 and operational phase from 2029. Site-specific DAS for Green Volt Offshore Wind Farm were conducted by HiDef Aerial Surveying Limited between May 2020 and April 2022. The surveys consisted of 1km spaced transects over the OAA plus a 4km buffer, resulting in a total survey area of 391km^2 (Royal HaskoningDHV, 2023). Five species of marine mammal were identified during the surveys: harbour porpoise, bottlenose dolphin, white-beaked dolphin, Risso's dolphin and grey seal. Monthly density estimates were generated for harbour porpoise, with data corrected for availability bias following the methodology outlined by Teilmann *et al.* (2013).

4.5.3 Moray East

4.5.3.1 The Moray East Offshore Wind Farm is located within the Moray Firth on the east coast of Scotland, approximately 100km from the Project. This offshore wind farm has been fully operational since 2022. The site-specific surveys for Moray East Offshore Wind Farm were conducted via vessel surveys by the University of Aberdeen (Moray Offshore Renewables Ltd, 2012). There were 28 surveys with transects spaced 2km apart conducted between April 2010 and March 2012 of the Moray East Offshore Wind Farm site plus a 4km buffer (Moray Offshore Renewables Ltd, 2012).

4.5.3.2 Ten species of marine mammal were identified during the surveys: grey seal (n=178), harbour seal (n=6), minke whale (n=49), killer whale (n=9), sperm whale (n=1), common dolphin (n=64), bottlenose dolphin (n=1), Risso's dolphin (n=1), white-beaked dolphin (n=18), and harbour porpoise (n=835). However, only three species (harbour porpoise, minke whale and grey seal) were sighted sufficiently in order to generate site-specific density estimates.

4.5.4 Moray West

4.5.4.1 The Moray West Offshore Wind Farm is also located within the Moray Firth on the east coast of Scotland, approximately 116km from the Project. This offshore wind farm is

currently in the final stages of construction with an estimation of becoming fully operational in 2025. Site-specific DAS for Moray West Offshore Wind Farm were conducted by HiDef Aerial Surveying Limited between April 2016 and March 2017. The surveys consisted of 2.5km spaced transects over the OAA plus a 4km buffer, resulting in a total survey area of 1,230km^2 (Moray Offshore Windfarm (West) Limited, 2018). There was only a single definite marine mammal species identified across these surveys: harbour porpoise (n=189). Other categorisations included cetacean species (n=1) and seal / small cetacean species (n=6).

4.5.5 Muir Mhòr

4.5.5.1 The Muir Mhòr Offshore Wind Farm is a floating development in the waters east of Scotland located approximately 59km south of the Project. At the time of writing this Report, the Muir Mhòr Offshore Wind Farm is going through the consenting process; having gained consent for the onshore portion of the project in 2025, but still awaiting approval for the offshore component. Site-specific DAS for Muir Mhòr Offshore Wind Farm were conducted by HiDef Aerial Surveying Limited between April 2021 and March 2023. The site-specific survey design consisted of 26 transects spaced 2.5km over the OAA plus a 4km buffer, resulting in a total survey area of 1,541km^2 (HiDef Aerial Surveying Limited, 2023b). A total of six marine mammal species were identified during the surveys: harbour porpoise, white-beaked dolphin, Risso's dolphin, minke whale, harbour seal and grey seal. Density estimates were generated for harbour porpoise, with data corrected for availability bias following the methodology outlined by Teilmann *et al.* (2013).

4.5.6 Salamander

4.5.6.1 The Salamander Offshore Wind Farm is a floating development situated approximately 47km south-south-east from the Project site. This offshore wind farm gained planning consent in 2025 and is estimated to start onshore construction in 2027, followed by offshore construction in 2028. Between March 2021 and February 2023, HiDef Aerial Surveying Limited carried out site-specific DAS' to assess marine wildlife in the Salamander Offshore Wind Farm area (HiDef Aerial Surveying Limited, 2023a). During these surveys, two marine mammal species were recorded: harbour porpoise and minke whale. Monthly density estimates for harbour porpoise were generated and adjusted for availability bias following the methodology outlined by Teilmann *et al.* (2013).

4.6 Special Committee on Seals

4.6.1.1 Seal conservation in the UK is guided by legislation including the Conservation of Seals Act 1970 (England) and the Marine (Scotland) Act 2010. NERC, operating through UK Research and Innovation, provides scientific guidance on seal population management via SCOS. SCOS publishes an annual report that offers an overview of seal populations across the UK, outlines their current conservation status, and addresses specific queries raised by regulators and stakeholders. These findings are also shared through regular briefings with government bodies and stakeholders.

4.6.1.2 Seals are broadly distributed along the UK coastline. Population monitoring is primarily conducted during the harbour seal moulting season (August), when seals are more likely to be hauled out and visible, as well as during the species-specific breeding seasons. Aerial surveys, typically carried out using light aircraft or helicopters, are the standard method for counting individuals. In Scotland and along the east coast of England (notably in Lincolnshire and Norfolk), SMRU leads these efforts, with additional support from organisations such as NatureScot, Natural England, Natural Resources Wales, and the National Trust. These surveys focus on haul-out sites, where seals congregate on land, providing the most reliable opportunity for accurate population counts.

4.6.2 August haul-out counts

4.6.2.1 Annual monitoring of harbour seal populations is primarily conducted during their moulting period, which occurs in the first three weeks of August. This timeframe is strategically chosen because it coincides with the peak haul-out period, when the majority of harbour seals are ashore and therefore most visible. Surveys conducted during this window aim to count the number of seals present on land, providing a minimum estimate of the population, as individuals at sea during the survey are not accounted for.

4.6.2.2 Conducting surveys during this consistent period each year allows for standardised comparisons over time; however, the accuracy of these counts is influenced by haul-out behaviour and timing. Research by Lonergan *et al.* (2013) suggests that approximately 72% of the total harbour seal population is hauled out during the August survey period. As a result, raw counts can be adjusted using this proportion to generate a more representative estimate of the overall population, accounting for seals likely to be at sea.

4.6.2.3 Grey seal population assessments also rely on haul-out counts. While Summer (August) surveys are conducted to coincide with the harbour seal surveys, the number of grey seals hauled out and available to count at this time is subject to greater variability and is generally considered less reliable than counts taken during the breeding season. Nonetheless, August surveys still offer a useful indicator of the population, which can be used alongside population information gathered during the breeding season. According to SCOS (2024), an estimated 25.15% of the grey seal population is hauled out during the Summer period. As with harbour seals, population estimates for grey seals can be scaled based on this proportion to account for individuals not hauled out on land at the time of the survey.

4.6.3 Grey seal pup counts

4.6.3.1 Grey seal populations are primarily monitored during their breeding season, which typically spans from September to December within Scottish regions. SMRU conducts the majority of these surveys using fixed-wing aircraft to capture aerial photographs of breeding colonies. Key survey regions include the Hebrides, Orkney, northern and north-eastern Scotland, and much of the Firth of Forth. In addition, ground-based counts are carried out by other organisations at select sites, such as those in Shetland and Inchcolm.

4.6.3.2 The grey seal pup production database, covering the period from 1989 to 2022, contains records from 74 breeding colonies. However, survey coverage has not been uniform across all sites or years. While most colonies were surveyed annually in the earlier phases of the programme, financial limitations and rising costs associated with aerial surveys (SCOS, 2015) led to a transition to biennial monitoring at many locations from 2010 onward. Smaller or less accessible colonies have often been surveyed on a more ad hoc basis.

4.6.4 Seal at-sea distribution

4.6.4.1 To estimate seal distribution at sea, long-term telemetry data are necessary to record animal distribution, movements and behaviour at-sea. Carter *et al.* (2022) combined data from various sources including telemetry data (from 114 grey seals and 239 harbour seals), and environmental data (for instance, water depth, seabed topography, sea surface temperature) to predict seal distribution based on habitat preferences. This approach aimed to uncover the ecological drivers of seal distribution. Additional data from haul-out data across UK waters helped predict distribution patterns. This model generated maps showing predicted at-sea seal distribution across 5km x 5km grids. These maps represent the proportion of the seal population (excluding hauled out individuals) expected to be present in each grid cell at any one time during the primary foraging period (Carter *et al.*, 2020).

4.6.4.2 To estimate the number of seals in a specific location, Carter *et al.* (2020) used the percentage of the UK at-sea seal population (again excluding hauled out individuals) present in a given 5km x 5km grid. This figure was then multiplied by the total estimated seal population, which for grey seals is approximately 168,400 individuals and approximately 40,525 for harbour seals (Carter *et al.*, 2020), to estimate the absolute number of seals within the cell. The result is then divided by 25 to convert the number into a density per square kilometre.

4.6.4.3 The habitat usage data primarily reflects predicted Summer movements for grey seals and Spring movements for harbour seals, as this is when most telemetry data were gathered during these periods (Carter *et al.*, 2020). These time periods coincides with typical movement periods outside of key haul-out periods (breeding and moulting), providing useful insights into at-sea distributions outside these seasons. However, the data may not accurately represent behaviour during the breeding or moulting season, when seals tend to haul-out more frequently and exhibit different movement patterns. The habitat preference models assume temporal consistency in seal distribution patterns.

4.6.4.4 Carter *et al.* (2025) presents updated at-sea distribution maps for both harbour and grey seals in Scotland, taking advantage of various improvements to the existing methods (Carter *et al.*, 2022). Carter *et al.* (2025) also provides updated estimated seal populations for Scotland; for grey seals they estimated approximately 86,797 individuals and for harbour seals it is approximately estimated at 30,425 individuals. These updated maps are generated using regional habitat preference relationships derived from the new tracking data, in combination with previously used tracking data and the most recent available estimates of seal abundance (haul-out counts). This presents new relative (percentage of at-sea population) and absolute (number of animals) estimates of harbour and grey seal at-sea density on a 5km x 5km grid for seals hauling out in Scotland.

5. Baseline Environment

5.1 Cetaceans

5.1.1 Harbour porpoise

Overview

5.1.1.1 The harbour porpoise is the most widespread and frequently observed cetacean in the North Sea (Evans *et al.*, 2003; Hague *et al.,* 2020). Globally, it is classified as a species of Least Concern on the International Union for Conservation of Nature (IUCN) Red List, reflecting its extensive distribution and relatively stable population trends (Braulik *et al.*, 2023). However, within UK waters, its conservation status remains uncertain due to insufficient data (JNCC, 2019a).

5.1.1.2 Harbour porpoises are highly mobile and typically inhabit temperate continental shelf waters, generally at depths between 20m to 200m (Braulik *et al.*, 2023; Evans, 2019; Reid *et al.*, 2003). Although they are most commonly associated with shallow coastal seas, individuals have been recorded in waters exceeding 2,500 metres in depth (Nabe-Nielsen *et al.*, 2018). Nonetheless, they tend to occur in higher densities in nearshore areas characterised by strong tidal currents (Evans and Waggitt, 2023).

5.1.1.3 Harbour porpoises are usually encountered alone or in small groups, with their distribution closely linked to the availability of prey (Gilles *et al.*, 2023; Hammond *et al.*, 2021; Reid *et al.*, 2003). The species has a diverse and opportunistic diet, feeding on seasonally abundant fish such as whiting (*Merlangius merlangus),* herring (*Clupea harengus*), and sandeel (*Ammodytes marinus*) (Reid *et al.*, 2003).

5.1.1.4 Long-term monitoring through SCANS surveys has documented a gradual southward shift in the distribution of harbour porpoises in the North Sea over recent decades. The most recent survey estimated densities in Scottish waters ranging from 0.0150 individuals/km² (block Celtic Sea (CS)-G) to 0.5985 individuals/km² (block NS-D; Gilles *et al.*, 2023). Within the NS MU, the Southern North Sea SAC has been designated specifically for the protection of this species.

Site-specific surveys

5.1.1.5 Across the two years of site-specific surveys, conducted from April 2021 to March 2023, harbour porpoise were the most abundant marine mammal species present. A total of 134 sightings were recorded in year one (April 2021 to March 2022) and 194 sightings in year two (April 2022 to March 2023). A peak of 55 harbour porpoise was observed in August 2022 (for further details refer to APEM (2024a)). Density estimates ranged from 0.00 individuals/km^2 (October, December 2021 and January 2022) to 0.34 individuals/km^2 (Coefficient of Variation (CV): 0.13) in August 2022 (**Table 5.1**; for further details refer to APEM (2024a)).

5.1.1.6 Harbour porpoise had an average density estimate over the two years of site-specific surveys of 0.087 individuals/km^2. This species appeared to show some extent of seasonality within the site-specific survey area, with a maximum estimated absolute density of 0.205 individuals/km^2 during Summer surveys (June, July and August), compared to a lowest estimated absolute density of 0.024 individuals/km^2 during Winter surveys (January, February and December; **Table 5.1**).

5.1.1.7 There was no clear spatial variation in harbour porpoise across the survey area, with surveys indicating a widespread distribution (for further details refer APEM (2024a)). To illustrate, in April 2021, there were higher recorded sightings in the central and western areas of the survey area compared to March 2023, where higher sightings were recorded in the northern and eastern side. As for the peak observation period in August 2022, the higher recorded sightings were in the central and southern areas of the survey area.

Table 5.1 Monthly density and abundance estimates for harbour porpoise in the site-specific survey area between April 2021 and March 2023 (corrected for availability bias; data from APEM (2024a))

Survey	Raw count	Abundance				Density
		Abundance	95% CI lower	95% CI upper	Precision (CV)	
S1 April 2021	41	326	207	470	0.16	0.26
S2 May 2021	5	40	5	103	0.45	0.03
S3 June 2021	36	289	185	409	0.17	0.23
S4 July 2021	13	101	39	178	0.28	0.08
S5 August 2021	32	261	138	407	0.18	0.21
S6 September 2021	3	23	3	70	0.58	0.02
S7 October 2021	-	-	-	-	-	-
S8 December 2021	-	-	-	-	-	-
S9 January 2022	-	-	-	-	-	-
S10 March 2022	4	32	4	80	0.5	0.03
S11 April 2022	6	48	16	88	0.41	0.04
S12 May 2022	2	16	2	48	0.71	0.01
S13 July (I) 2022	17	137	64	209	0.24	0.11
S14 July (II) 2022	41	330	209	467	0.16	0.26
S15 August 2022	55	430	282	603	0.13	0.34
S16 September 2022	2	16	2	41	0.71	0.01
S17 October 2022	16	127	48	230	0.25	0.1
S18 November (I) 2022	4	32	4	79	0.5	0.03
S19 November (II) 2022	6	49	8	106	0.41	0.04
S20 February (I) 2023	7	56	16	113	0.38	0.04
S21 February (II) 2023	3	24	3	57	0.58	0.02

Survey	Raw count	Abundance				Density
		Abundance	95% CI lower	95% CI upper	Precision (CV)	
S22 February (III) 2023	10	79	32	135	0.32	0.06
S23 March (I) 2023	24	192	56	392	0.2	0.15
S24 March (II) 2023	1	8	1	24	<1	0.01
Mean	**16**	**125**	**63**	**205**	**0.366**	**0.087**
Spring average (March, April, May)						**0.076**
Summer average (June, July, August)						**0.205**
Autumn average (September, October, November)						**0.033**
Winter average (December, January, February)						**0.024**

Management unit

5.1.1.8 The most recent estimate for the harbour porpoise population within the NS MU is 346,601 individuals, with a 95% Confidence Interval (CI) ranging from 289,498 to 419,967 and a CV of 0.09 (IAMMWG, 2022). Within the UK's portion of this management unit, the estimated population is 159,632 individuals (95% CI: 127,442 to 199,954; CV: 0.12; IAMMWG, 2022).

5.1.1.9 Long-term monitoring through the SCANS series, conducted in 1994, 2005, 2016, and most recently in 2022, has provided valuable insights into harbour porpoise abundance within the NS MU. Despite the temporal span of these surveys, no statistically significant changes in population size have been detected over time (Gilles *et al.*, 2023). However, it is important to note that the ability of these surveys to detect subtle population trends is limited by the statistical power of the data.

SCANS surveys

SCANS-IV

5.1.1.10 The Project is located within the SCANS-IV survey block NS-D and NS-E. Block NS-D has an estimated block-wide abundance of 38,577 harbour porpoise (95% CI: 18,017 to 76,361) and an estimated density of 0.5985 individuals/km^2 (CV: 0.367). Block NS-E has an estimated abundance of 33,735 harbour porpoise (95% CI: 21,757 to 50,324) and a density estimate of 0.516 individuals/km^2 (CV: 0.208; Gilles *et al.*, 2023).

SCANS-IV surface densities

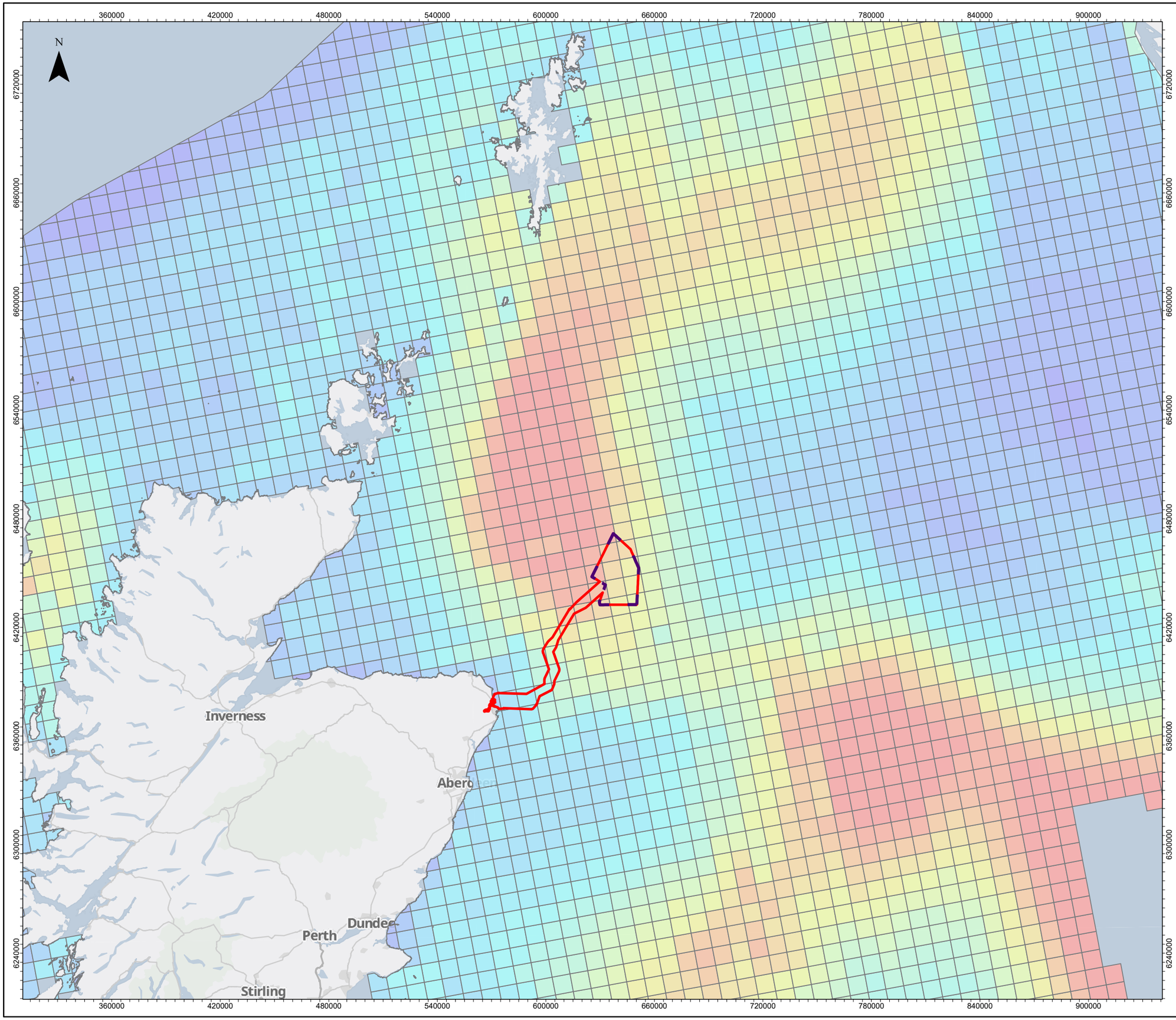
5.1.1.11 Using the data from SCANS-IV, the highest densities for harbour porpoise around Scotland were located around the east and south-east of Scotland; however, these density estimates are still considerably lower than those in central and southern region of the NS. Density estimates within the site-specific study area, extracted from the modelling by Gilles *et al.* (2025) using SCANS-IV data, indicate a range of 0.554 to 0.993 individuals/km^2 and an average of 0.752 individuals/km^2 (**Figure 5**).

SCANS-III

5.1.1.12 The Project is located within the SCANS-III survey block R and T. Within block R, there was an estimated block-wide abundance of 38,646 harbour porpoise (95% CI: 20,584 to 66,524) and an estimated density of 0.599 individuals/km^2 (CV: 0.287). Block T had an estimated abundance of 26,309 harbour porpoise (95% CI: 14,219 to 45,208) and a density estimate of 0.402 individuals/km^2 (CV: 0.295; Hammond *et al.,* 2021).

SCANS-III surface densities

5.1.1.13 Density estimates within the site-specific study area, extracted from the modelling by Lacey *et al.* (2022) using SCANS-III data, indicate a range of 0.471 to 0.557 individuals/km^2 and an average of 0.519 individuals/km^2 within the site-specific study area. Compared to the regional study area of the NS, the densities of harbour porpoise in the site-specific study area are lower compared other blocks in the NS, highest densities were predicted in the Southern North Sea (Lacey *et al.*, 2022).



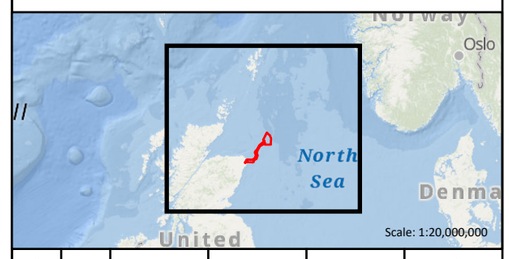
Red Line Boundary

Option Agreement Area

Harbour Porpoise Density (ind./km²)

- 0 - 0.025
- 0.025 - 0.05
- 0.05 - 0.1
- 0.1 - 0.015
- 0.15 - 0.2
- 0.2 - 0.25
- 0.25 - 0.3
- 0.3 - 0.35
- 0.35 - 0.4
- 0.4 - 0.45
- 0.45 - 0.5
- 0.5 - 0.55
- 0.55 - 0.6
- 0.6 - 0.65
- 0.65 - 0.7
- 0.7 - 0.75
- 0.75 - 0.8
- 0.8 - 0.85
- 0.85 - 0.9
- 0.9 - 1
- >1

0 50 100 Kilometres



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2	15/10/2025	EH	LT	MR	NC
1	04/09/2025	EH	LT	MR	NC

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MarramWind DRAWING NUMBER	MAR-GEN-ENV-MAP-WSP-000402

DATUM	ETRS 89	PROJECTION	UTM Zone 30N
SCALE	1:2,000,000	PAGE SIZE	A3

PROJECT TITLE

MarramWind Offshore Wind Farm

DRAWING TITLE

Figure 5 Harbour porpoise surface density (Gilles *et al.*, 2025)

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Other offshore windfarms

Caledonia

5.1.1.14 Harbour porpoises were recorded in the Caledonia Offshore Wind Farm site-specific surveys. Sightings occurred throughout the extent of the survey area, with no specific distributional patterns observed. Harbour porpoises were present in all but three months of DAS (November 2021, January and October 2022). The average density estimate (corrected) across the two years of surveys was 0.09 individuals/km^2 (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.1.1.15 Harbour porpoises were recorded throughout the Green Volt Offshore Wind Farm site-specific surveys. The highest densities were recorded in the south-east of the survey area during Summer surveys (July and August). The lowest density estimate was 0.09 individuals/km^2 in December (2020 and 2021) and the highest estimate occurred in July (2020) at 8.89 individuals/km^2, with an average absolute density estimate over the 24 months of 0.76 individuals/km^2 (Royal HaskoningDHV, 2023).

Moray East

5.1.1.16 The vessel and PAM surveys for the Moray East Offshore Wind Farm recorded harbour porpoise throughout the site and wider Moray Firth. Density plots generated using the site-specific survey data indicated that while there is an even distribution across the survey area, sightings are slightly more abundant towards the western edge (Moray Offshore Renewables Ltd, 2012). Harbour porpoises were observed throughout the year, with two peaks in sightings during the Spring (April) and late Summer (August and September). The average density reported across all surveys was 0.72 individuals/km^2 (95% CI: 0.57 to 0.91) within the site (Moray Offshore Renewables Ltd, 2012).

Moray West

5.1.1.17 Harbour porpoises were recorded in the Moray West Offshore Wind Farm site-specific surveys. Sightings occurred throughout the extent of the survey area, with no specific distributional patterns observed. The lowest density estimate across the Moray West Offshore Wind Farm site plus the 4km buffer was 0.00 individuals/km^2 and the highest estimate was 1.07 individuals/km^2. The average density across all survey months were 0.35 individuals/km^2 (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.1.1.18 The Muir Mhòr Offshore Wind Farm site-specific surveys recorded harbour porpoise. There was no clear spatial pattern observed within the site. The average absolute density estimate over the 24 surveys was 0.47 individuals/km^2, with the lowest density estimate at 0.00 individuals/km^2 in February and March (2022) and the highest estimate in May (2022) at 2.55 individuals/km^2. There was a clear seasonal variation in harbour porpoise density observed, with the average density recording highest during Spring (March, April and May) at 0.79 individuals/km^2 and lowest in Winter (December, January and February) at 0.19 individuals/km^2 (Stevens and Sinclair, 2023).

Salamander

5.1.1.19 The Salamander Offshore Wind Farm site-specific surveys recorded harbour porpoise as the most abundant non-avian species. Harbour porpoise presence showed seasonal variation at the site, with peak estimated densities in the DAS area reaching 3.00 individuals/km² in Summer, compared to 1.33 individuals/km² in Winter. The peaks in occurrence were reported in July 2022, with a density estimate of 3.00 animals/km^2 (95% CI: 1.46 to 4.92), and the lowest estimates were found in November 2022 with a density estimate of 0.19 individuals/km^2 (95% CI: 0.00 to 0.56). The average density estimate during the two-year DAS was 0.710 individuals/km^2 (Klementisová *et al.,* 2023).

Harbour porpoise summary

5.1.1.20 Harbour porpoise average density estimates collated from various data sources across the east coast of Scotland range from 0.09 individuals/km^2 to 0.76 individuals/km^2 (**Table 5.2**). These data support the results of the Project site-specific surveys in reporting that harbour porpoise is an abundant species in this region and is often the most frequently encountered cetacean.

5.1.1.21 The Project site-specific surveys concluded an average absolute density of 0.087 individuals/km^2. This site-specific density estimate is lower than the SCANS-IV density estimates and is only relevant to the respective survey area and should not be extrapolated beyond this. Therefore, it is recommended that the SCANS-IV block NS-E density (0.5985 individuals/km^2; Gilles *et al.,* 2023) and SCANS-IV modelled density (0.752 individuals/km^2; Gilles *et al.,* 2025) for harbour porpoise are brought forward to the quantitative impact assessment for the Project.

Table 5.2 Summary of publicly available density estimates for harbour porpoise within sites surrounding the Project

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Site-specific survey	April 2021 to March 2023.	OAA + 4km buffer.	0.087	APEM (2024a).
SCANS-III	Summer 2016.	Block T	0.402	Hammond *et al.* (2021).
		Block R	0.599	
SCANS-III surface density	Summer 2016.	Grid cell specific average density within OAA.	0.519	Lacey *et al.* (2022).
SCANS-IV	Summer 2022.	Block NS-E	0.516	Gilles *et al.* (2023).
		Block NS-D	0.5985	
SCANS-IV surface density	Summer 2022.	Grid cell specific average density within OAA.	0.752	Gilles *et al.* (2025).
Caledonia	May 2021 to April 2023.	Caledonia site + 4km buffer.	0.09	Caledonia Offshore Wind Farm Ltd (2024).

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Green Volt	May 2020 to April 2022.	Green Volt site + 4km buffer.	0.76	Royal HaskoningDHV (2023).
Moray East	April 2010 to March 2012.	Moray East site + wider Moray Firth.	0.72	Moray Offshore Renewables Ltd (2012).
Moray West	April 2016 to March 2017.	Moray West site + 4km buffer.	0.35	Moray Offshore Windfarm (West) Limited (2018).
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0.47	Stevens and Sinclair (2023).
Salamander	March 2021 to February 2023.	Salamander site + 4km buffer.	0.71	Klementisová *et al.* (2023).

5.1.2 Bottlenose dolphin

Overview

5.1.2.1 Bottlenose dolphins are widely distributed across UK waters and occur as two distinct ecotypes: coastal and offshore (Cheney *et al.*, 2013). In Scotland, sightings are most frequent in coastal areas along both the east and west coasts. Two resident populations are recognised within Scotland: one along the east coast from the Moray Firth to Fife, and another in the Hebrides (Cheney *et al.*, 2013). Coastal ecotype individuals have been recorded moving between SACs in the Moray Firth (Scotland), Cardigan Bay (Wales), and the Shannon Estuary (Ireland; Robinson *et al.*, 2012). Regular observations of calves and juveniles off Scotland's east coast suggest active breeding within this region (Arso Civil *et al.*, 2021). Although listed as Least Concern on the IUCN Red List (Wells *et al.*, 2019), the species' conservation status in the UK remains uncertain due to limited data (JNCC, 2019b), though current evidence suggests stable population trends.

5.1.2.2 Bottlenose dolphins inhabit a broad range of environments, from shallow coastal zones to deeper offshore waters, depending on ecotype (Wells and Scott, 1999, as cited by Wells *et al.*, 2019). Coastal ecotypes typically occupy estuaries, bays, lagoons, and occasionally venture into rivers, while offshore ecotypes have a wider and less restricted distribution. In UK waters, most sightings occur within 10km of the coast, indicating a strong inshore presence (JNCC, 2025). Individuals from coastal ecotypes may move further offshore during Winter, likely driven by factors such as prey availability and water temperature; however, this is yet to be reported of the Moray Firth population and offshore sightings are generally attributed to the offshore ecotype (Wood, 1998; Garagouni, 2019).

5.1.2.3 Bottlenose dolphins are usually seen alone or in small groups of up to 25 individuals (JNCC, 2025). Their diet is diverse, including species such as whiting, blue whiting (*Micromesistius poutassou*), pollock (*Pollachius pollachius*), saithe (*Pollachius virens*), haddock (*Melanogrammus aeglefinus*), poor cod, European hake (*Merluccius merluccius*), horse mackerel (*Trachurus trachurus*), flatfish (*Pleuronectiformes*), pelagic squid (*Loligo spp.*), and octopus (Hernandez-Milian *et al.*, 2015).

5.1.2.4 The latest SCANS survey (SCANS-IV) reported bottlenose dolphin densities in Scottish waters ranging from 0 individuals/km² (in blocks CS-J, CS-K, NS-D, and NS-E) to a maximum of 0.4048 individuals/km² (in block CS-I; Gilles *et al.*, 2023). Within the North Sea, the Moray Firth SAC is the only designated SAC for bottlenose dolphins.

Site-specific surveys

5.1.2.5 No bottlenose dolphins were observed during the two years of site-specific surveys (APEM, 2024a).

Management unit

5.1.2.6 There are two bottlenose dolphin MUs in which the Project is situated:

- GNS MU covering the OAA and part of the export cable corridor; and
- CES MU which includes the coastal section (within 12 nautical miles (nm)) of the export cable corridor.

5.1.2.7 The GNS MU represents the 'offshore' bottlenose dolphin ecotype, with an estimated 2,022 individuals (95% CI: 548 to 7,453; CV: 0.75) within the population, including approximately 1,885 within UK waters (95% CI: 476 to 7,461; CV: 0.8; IAMMWG, 2022). The CES MU supports the protected coastal east coast population, estimated at 226 individuals (95% CI: 214 to 239; CV: 0.028; Cheney *et al.*, 2024).

SCANS Surveys

5.1.2.8 When considering the bottlenose dolphin populations, SCANS surveys do not differentiate between either the coastal or offshore populations of bottlenose dolphin. This is due to survey design being for a larger spatial scale, hence the small coastal population densities are better suited to be obtained from photo-ID studies, such as Arso Civil *et al.* (2019) and Cheney *et al.* (2024).

SCANS-IV

5.1.2.9 The Project is located within the SCANS-IV survey blocks NS-D and NS-E where there were no bottlenose dolphin sightings in either (Gilles *et al.*, 2023).

SCANS-IV surface densities

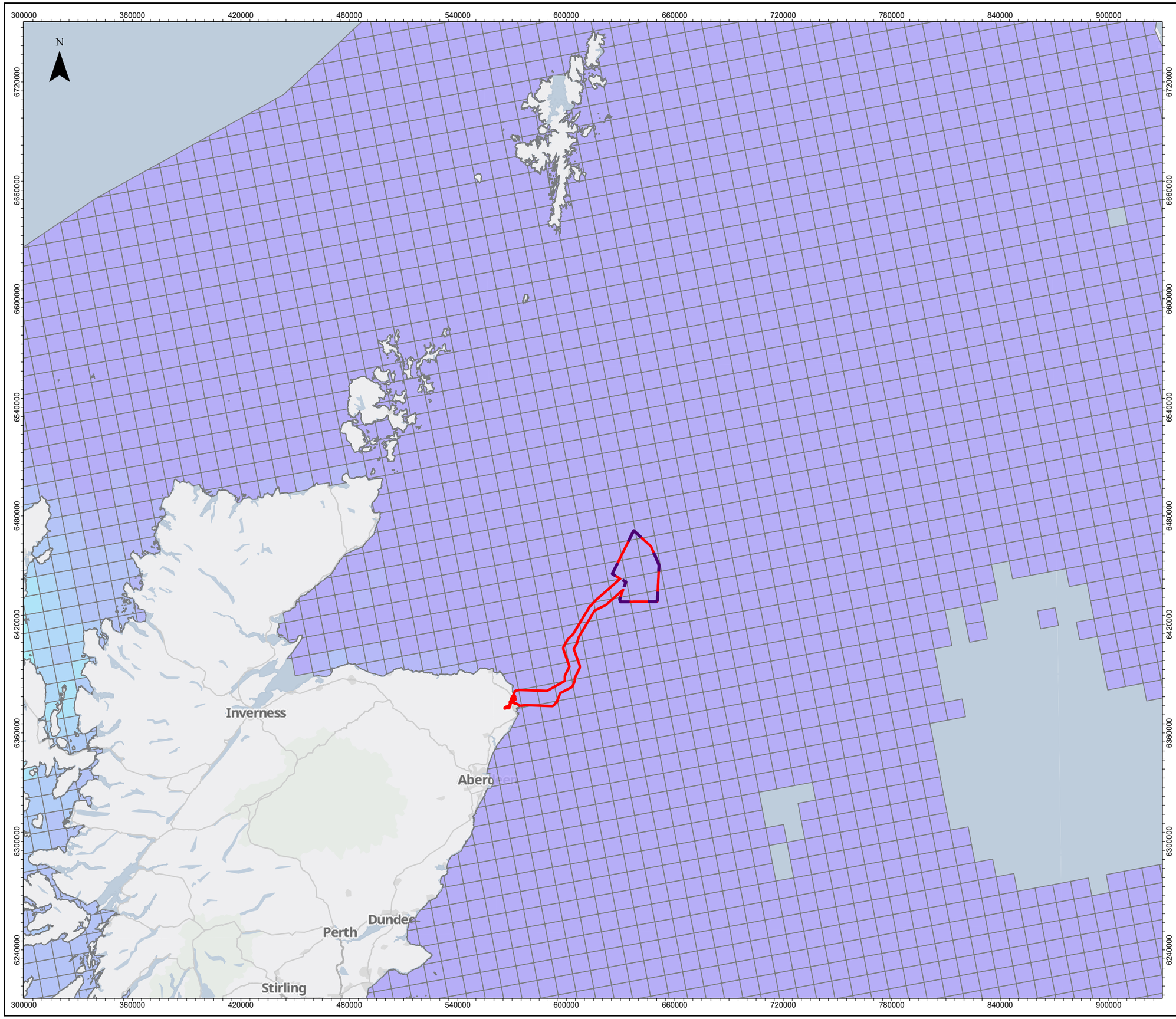
5.1.2.10 Density estimates within the site-specific study area, extracted from the modelling by Gilles *et al.* (2025) using SCANS-IV data, indicate a range of 0.0009 to 0.0019 individuals/km^2 and an average of 0.001 individuals/km^2 within the site-specific study area (**Figure 6**). Compared to the regional study area of the NS, the densities of bottlenose dolphin in the site-specific study area are similar, for instance, density is low throughout most of the NS (Gilles *et al.*, 2025).

SCANS-III

5.1.2.11 The Project is partially located within the SCANS-III survey block R, where there was an estimated block-wide abundance of 1,924 bottlenose dolphin (95% CI: 0 to 5,048) and an estimated density of 0.0298 individuals/km^2 (CV: 0.861; Hammond *et al.*, 2021). As for block T, in which the Project is also located, there were no bottlenose dolphin sightings.

SCANS-III surface densities

5.1.2.12 Density estimates within the site-specific study area, extracted from the modelling by Lacey *et al.* (2022) using SCANS-III data, indicate a range of 0.0015 to 0.0024 individuals/km^2 and an average of 0.002 individuals/km^2 within the site-specific study area (Lacey *et al.,* 2022). Compared to the regional study area of the NS, the densities of bottlenose dolphin in the site-specific study area are similar, for instance, density is low throughout the NS (Lacey *et al.,* 2022).



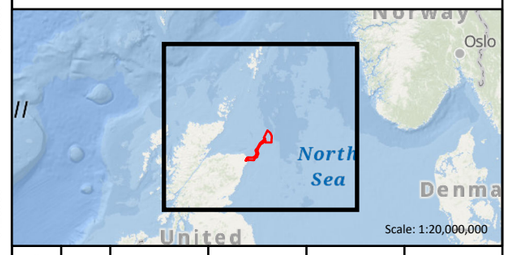
Red Line Boundary

Option Agreement Area

Bottlenose Dolphin Density (ind./km²)

- 0 - 0.025
- 0.025 - 0.05
- 0.05 - 0.1
- 0.1 - 0.15
- 0.15 - 0.2
- 0.2 - 0.25
- 0.25 - 0.3
- 0.3 - 0.35
- 0.35 - 0.4
- 0.4 - 0.45
- 0.45 - 0.5
- 0.5 - 0.55
- 0.55 - 0.6
- 0.6 - 0.65
- 0.65 - 0.7
- 0.7 - 0.75
- 0.75 - 0.8
- 0.8 - 0.85
- 0.85 - 0.9
- 0.9 - 1
- >1

0 50 100 Kilometres



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2	16/10/2025	EH	LT	MR	NC
1	04/09/2025	EH	LT	MR	NC

WSP DRAWING NUMBER	808368-WEIS-IA-E5-FG-M8-69967
MarramWind DRAWING NUMBER	MAR-GEN-ENV-MAP-WSP-000404
DATUM	ETRS 89
PROJECTION	UTM Zone 30N
SCALE	1:2,000,000
PAGE SIZE	A3

PROJECT TITLE

MarramWind Offshore Wind Farm

DRAWING TITLE

Figure 6 Bottlenose dolphin surface density (Gilles *et al.*, 2025)

Environmental Impact Assessment Report

Appendix 11.1

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MarramWind

Bottlenose dolphin surveys

5.1.2.13 Photo-ID methods have been used to estimate bottlenose dolphin numbers in the Scottish resident populations. In the Summers of 2012 and 2013, from the Firth of Forth to Aberdeen, Quick *et al.* (2014) captured monthly records of individuals which were uniquely marked to build a database. Forty-nine individuals were recorded in 2012 and 52 in 2013, which resulted in a bottlenose dolphin population estimation of 118 (95% CI: 98 to 143) and 119 individuals (95% CI: 101 to 140) for each respective year. This was an increase from previous estimates in 2006 and 2007, estimated at 88 and 93 individuals respectively (Cheney *et al.*, 2013).

5.1.2.14 More recent photo identification work by Arso Civil *et al.* (2021) in the Tay Estuary and surrounding waters across the Summers of 2017, 2018 and 2019, which contributed to a long-term dataset created in 1989, and allowed for CES MU bottlenose dolphin abundance estimates to be updated. Between 2009 and 2019 data collected during Summer months estimated an average population of 203 bottlenose dolphins (95% CI: 186 to 222; Arso Civil *et al.,* 2021) which was later revised to 226 individuals (95% CI: 214 to 239) based on monitoring from 2022 (Cheney *et al.,* 2024). Cheney *et al.* (2024) further analysed population trends, indicating an annual bottlenose dolphin increase of 2.07% within the CES MU despite the increase in anthropogenic pressures (for instance, offshore wind farm developments).

5.1.2.15 Research shows that the range of bottlenose dolphins in the CES MU population has expanded southward since the 1990s, reaching areas like the Tay Estuary and Firth of Forth (Arso Civil *et al.,* 2019, 2021; Cheney *et al.,* 2024). The number of dolphins using these southern waters increased from 144 (95% CI: 118 to 177) in 2017 to 195 (95% CI: 170 to 223) in 2022. Sightings along the northern English coast also suggest continued range expansion. However, despite the overall growth in the CES MU, numbers within the Moray Firth SAC have declined, from 122 (95% CI: 111 to 134) in 2017 to 94 (95% CI: 84 to 106) individuals in 2022 (Cheney *et al.,* 2024).

Other offshore windfarms

Caledonia

5.1.2.16 There were a total of two bottlenose dolphins recorded in the Caledonia Offshore Wind Farm site-specific surveys. Both sightings were recorded in May 2022. The site was estimated to have an average un-corrected relative density estimate of 0.002 individuals/km^2 (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.1.2.17 A single bottlenose dolphin was sighted during the Green Volt Offshore Wind Farm site-specific surveys, therefore no density estimate could be calculated (Royal HaskoningDHV, 2023).

Moray East

5.1.2.18 A single bottlenose dolphin was sighted during the Moray East Offshore Wind Farm site-specific surveys, therefore no density estimate could be calculated (Moray Offshore Renewables Ltd, 2012).

Moray West

5.1.2.19 There were no bottlenose dolphins observed during the Moray West Offshore Wind Farm site-specific surveys, therefore no density estimates were calculated (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.1.2.20 There were no bottlenose dolphins observed during the Muir Mhòr Offshore Wind Farm site-specific surveys, therefore no density estimates were calculated (Stevens and Sinclair, 2023).

Salamander

5.1.2.21 There were no bottlenose dolphins observed during the Salamander Offshore Wind Farm site-specific surveys, therefore no density estimates were calculated (Klementisová *et al.,* 2023).

Uniform density estimates

5.1.2.22 In the absence of robust density estimates for coastal bottlenose dolphin populations, this baseline Technical Report presents an alternative method for deriving a density estimate relevant to this population by assuming a uniform distribution across the CES MU within a 2km buffer zone along the coast of mainland Scotland.

5.1.2.23 With sections of the Project (for example, export cable corridor) crossing through the CES MU, and density estimates lacking for this MU, using studies on bottlenose dolphins within the area allows for assumptions of densities to be made. The primary survey method for bottlenose dolphin within the CES MU is photo-ID, and whilst these have allowed for estimations of population size, they are not suitable for estimations of density. The most recent site condition monitoring report provides an estimated population of 226 bottlenose dolphins (95% CI: 224 to 268) within the CES MU, based on data from 2022 (Cheney *et al*., 2024). Additionally, within the CES MU bottlenose dolphins are often reported to be more commonly encountered within 2km of the coast (Quick *et al.,* 2014). Therefore, applying a 2km buffer to the east coast of Scotland, which is encompassed by the CES MU, and utilising the population estimate of 226 bottlenose dolphins calculated by Cheney *et al.* (2024), a uniform density estimate of 0.116 individuals/km^2 can be applied within 2km from the Scottish coast in the CES MU.

5.1.2.24 There are limitations to applying uniform density estimates for bottlenose dolphins as in reality individuals are not evenly spread across their habitat. Surveys report groups between one and 50 individuals within a single event, with an average of 11 dolphins reported per sighting by Arso Civil *et al.* (2021) over 157 encounters. These uneven and often fluctuating distributions highlight the limitations of a uniform density for such a species, nevertheless using a uniform density estimate remains the most practical approach. This is due to the fact that currently no spatially-explicit density estimates exist which account for the coastal population. Therefore, in the absence of more refined data, this method is considered the most suitable for estimating bottlenose dolphin density within the CES MU.

Bottlenose dolphin summary

5.1.2.25 Bottlenose dolphin density estimates are relatively low in eastern Scotland (**Table 5.3**). Large-scale surveys like SCANS assume uniform distribution across a large regional survey block, which does not reflect the coastal bottlenose dolphin population's preference for nearshore habitats or their tendency to form groups. As a result, applying a single, uniform

density across the entire area is unsuitable for the coastal bottlenose dolphin population (CES MU) and would misrepresent their likely distribution in impact assessments. To improve accuracy, a separate density estimate of 0.116 individuals/km² has been applied within 2km of the coast. This approach captures the higher nearshore densities, while SCANS-III block R data is used beyond 2km offshore to the edge of the CES MU. This distinction is important, as the CES MU population includes individuals from the protected Moray Firth SAC (Cheney *et al.,* 2024).

5.1.2.26 In summary, it is recommended that the following density estimates be used in the quantitative impact assessment: for CES MU bottlenose dolphins, a uniform density of 0.116 individuals/km² within 2km of the coast (Cheney *et al.,* 2024) and a SCANS-III block R density of 0.0298 individuals/km² beyond the 2km buffer (Hammond *et al.,* 2021); and for GNS MU bottlenose dolphins, the SCANS-IV modelled density surface of 0.001 individuals/km² (Gilles *et al.,* 2025) along with the SCANS-III block R density of 0.0298 individuals/km² (Hammond *et al.,* 2021).

Table 5.3 Summary of publicly available density estimates for bottlenose dolphin within sites surrounding the Project

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Site-specific survey	April 2021 to March 2023.	OAA + 4km buffer.	0	APEM (2024a).
SCANS-III	Summer 2016.	Block T	0	Hammond *et al.* (2021).
		Block R	0.0298	
SCANS-III surface density	Summer 2016.	Grid cell specific average density within OAA.	0.002	Lacey *et al.* (2022).
SCANS-IV	Summer 2022.	Block NS-E	0	Gilles *et al.* (2023).
		Block NS-D	0	
SCANS-IV surface density	Summer 2022.	Grid cell specific average density within OAA.	0.001	Gilles *et al.* (2025).
CES MU – 2km buffer	2024	Uniform density across CES MU within 2km of the coast.	0.116	Calculated using Cheney *et al.* (2024).
Caledonia	May 2021 to April 2023.	Caledonia site + 4km buffer.	0.002	Caledonia Offshore Wind Farm Ltd (2024).
Green Volt	May 2020 to April 2022.	Green Volt site + 4km buffer.	0	Royal HaskoningDHV (2023).

Source	Survey dates	Detail	Density estimate (individuals/km²)	Reference
Moray East	April 2010 to March 2012.	Moray East site + wider Moray Firth.	0	Moray Offshore Renewables Ltd (2012).
Moray West	April 2016 to March 2017.	Moray West site + 4km buffer.	0	Moray Offshore Windfarm (West) Limited (2018).
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0	Stevens and Sinclair (2023).
Salamander	March 2021 to February 2023.	Salamander site + 4km buffer.	0	Klementisová *et al.* (2023).

5.1.3 Short-beaked common dolphin

Overview

5.1.3.2 Within the UK, common dolphins are most frequently recorded in the CS, the Sea of the Hebrides, and occasionally in the North Sea (primarily in the Moray Firth region; Robinson *et al.,* 2010). They are listed as Least Concern on the IUCN Red List. While their range is considered favourable, the UK conservation status is assessed as unknown due to insufficient data on population size, habitat, and future prospects (JNCC, 2019c). No designated conservation sites currently exist for this species within the CGNS MU.

5.1.3.3 This small, agile species is found in temperate and tropical waters worldwide. Common dolphins are highly mobile and exhibit seasonal movements in response to prey availability, primarily feeding on small pelagic fish such as Atlantic mackerel (*Scomber scombrus*), herring, and sardines (*Sardinia pilchardius*), as well as squid and other cephalopods (Murphy *et al.,* 2021). They are highly social, typically forming groups of several dozen to hundreds of individuals and occasionally aggregate into super-pods of thousands during feeding or migration (Bearzi *et al.,* 2003).

5.1.3.4 The most recent SCANS survey (SCANS-IV) reported common dolphin densities in Scottish waters ranging from 0 to 0.0863 individuals/km², with the highest density recorded in block CS-H (Gilles *et al.,* 2023).

Site-specific surveys

5.1.3.5 No short-beaked common dolphins were observed during the two years of site-specific surveys (APEM, 2024a).

Management unit

5.1.3.6 The population estimate for common dolphin in the CGNS MU is 102,656 individuals (95% CI: 58,932 to 178,822; CV: 0.59; IAMMWG, 2022). The UK portion of this MU is 57,417 (95% CI: 30,850 to 106,863; CV: 0.32) individuals (IAMMWG, 2022).

SCANS surveys

SCANS-IV

5.1.3.7 The Project is located within the SCANS-IV survey blocks NS-D and NS-E, where there were no common dolphins recorded (Gilles *et al.,* 2023).

SCANS-IV surface densities

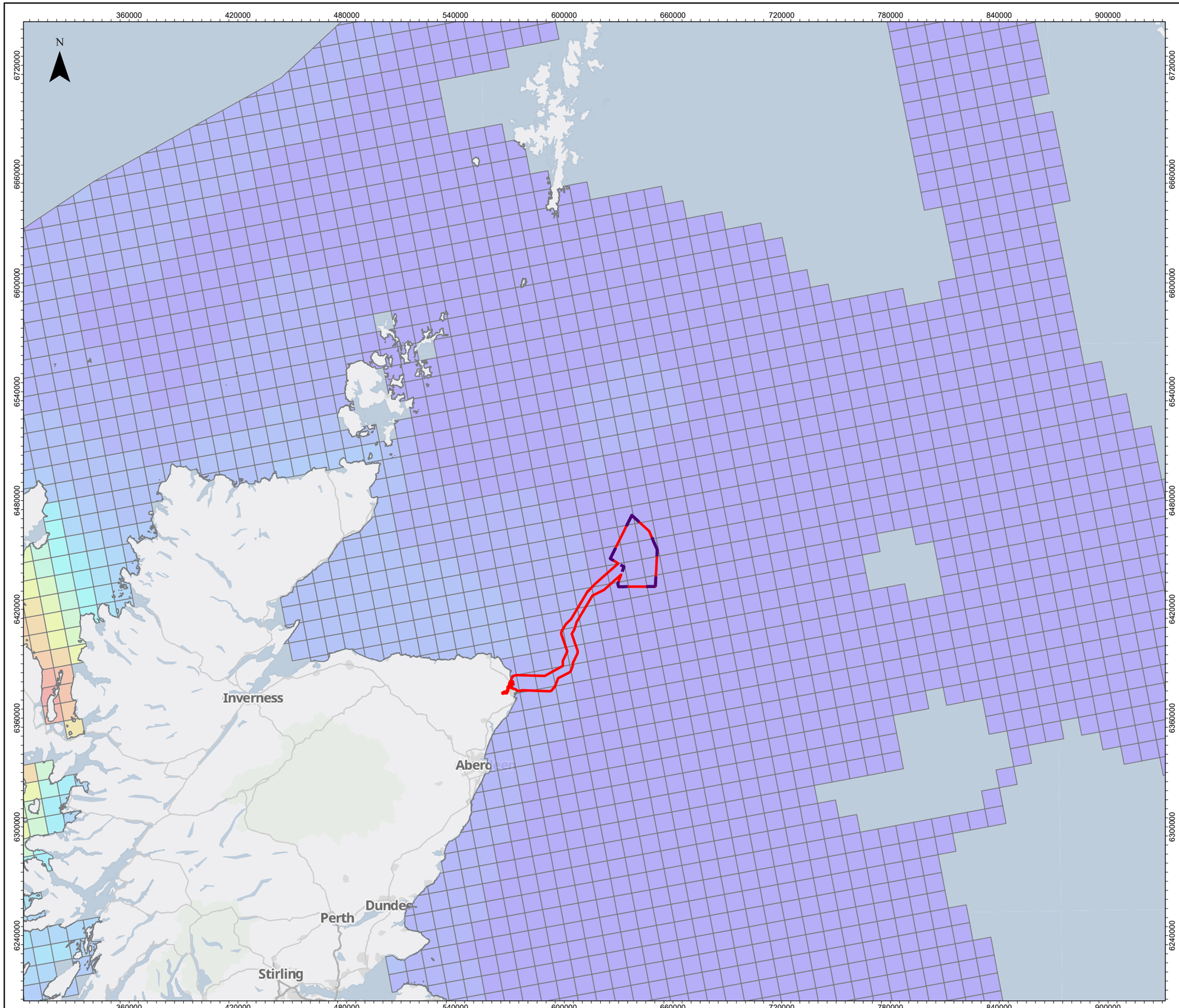
5.1.3.8 Around Scotland the highest densities for common dolphin were located around the west of Scotland (**Figure 7**). Density estimates within the site-specific study area, extracted from the modelling by Gilles *et al.* (2025) using SCANS-IV data, indicate a range of 0.0136 to 0.0203 individuals/km^2 and an average of 0.017 individuals/km^2 within the site-specific study area. Compared to the regional study area of the CGNS, the densities of common dolphin in the site-specific study area are similar to the densities in other areas in the NS, for instance, very low. Densities are also lower compared to the densities found along the south-west of England and west coast of Scotland (Gilles *et al.,* 2025).

SCANS-III

5.1.3.9 The Project is located within the SCANS-III survey blocks T and R, where there were no common dolphins recorded (Hammond *et al.,* 2021).

SCANS-III surface densities

5.1.3.10 Density estimates within the site-specific study area, extracted from the modelling by Lacey *et al.* (2022) using SCANS-III data, indicate a range of 0.0017 to 0.0027 individuals/km^2 and an average of 0.002 individuals/km^2 within the site-specific study area. Compared to the regional study area of the CGNS, the densities of common dolphin in the site-specific study area are similar to the densities in other areas in the NS (for instance, very low). Similar to trends found within SCANS-IV data that densities are lower than those found along the south-west of England (Lacey *et al.,* 2022).



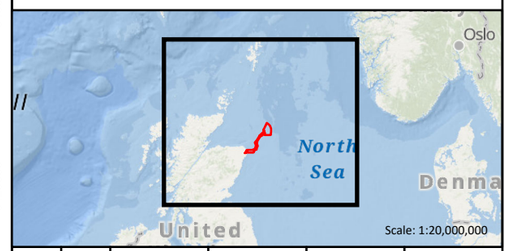
Red Line Boundary

Option Agreement Area

Common Dolphin Density (ind./km²)

- 0 - 0.025
- 0.025 - 0.05
- 0.05 - 0.1
- 0.1 - 0.015
- 0.15 - 0.2
- 0.2 - 0.25
- 0.25 - 0.3
- 0.3 - 0.35
- 0.35 - 0.4
- 0.4 - 0.45
- 0.45 - 0.5
- 0.5 - 0.55
- 0.55 - 0.6
- 0.6 - 0.65
- 0.65 - 0.7
- 0.7 - 0.75
- 0.75 - 0.8
- 0.8 - 0.85
- 0.85 - 0.9
- 0.9 - 1
- >1

0 50 100 Kilometres



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2	15/10/2025	EH	LT	MR	NC
1	04/09/2025	EH	LT	MR	NC

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MarramWind DRAWING NUMBER	MAR-GEN-ENV-MAP-WSP-000406
DATUM	ETRS 89
PROJECTION	UTM Zone 30N
SCALE	1:2,000,000
PAGE SIZE	A3

PROJECT TITLE

MarramWind Offshore Wind Farm

DRAWING TITLE

Figure 7 Short-beaked dolphin surface density (Gilles *et al.*, 2025)

Environmental Impact Assessment Report
Appendix 11.1

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wsp

MarramWind

Other offshore windfarms

Caledonia

5.1.3.11 Common dolphins were observed only in one of the 24 surveys (October 2022) for Caledonia Offshore Wind Farm, with a total of 39 individuals recorded. Across the two-year survey period, the average uncorrected relative density was 0.01 individuals/km² (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.1.3.12 No common dolphins were observed during the Green Volt Offshore Wind Farm site-specific surveys, therefore no density estimates were calculated (Royal HaskoningDHV, 2023).

Moray East

5.1.3.13 The vessel surveys for the Moray East Offshore Wind Farm observed 64 common dolphins between April 2010 and March 2012, with an increase in sightings between the months of June and August. Sighting plots indicate that while there is an even distribution across the survey area, sightings are slightly more abundant towards the central and west edge. However, there were no density estimates provided for this species (Moray Offshore Renewables Ltd, 2012).

Moray West

5.1.3.14 No common dolphins were observed during the Moray West Offshore Wind Farm site-specific surveys, therefore no density estimates were calculated (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.1.3.15 No common dolphins were observed during the Muir Mhòr Offshore Wind Farm site-specific surveys, therefore no density estimates were calculated (Stevens and Sinclair, 2023).

Salamander

5.1.3.16 No common dolphins were observed during the Salamander Offshore Wind Farm site-specific surveys, therefore no density estimates were calculated (Klementisová *et al.,* 2023).

Short-beaked common dolphin summary

5.1.3.17 Common dolphins have only been observed sporadically around the east coast of Scotland, and during the Project site-specific surveys this species was not recorded. Common dolphins have occasionally been observed in low numbers during other survey data reviewed and analysed (**Table 5.4**). It is recommended that the latest density estimate from the SCANS-IV modelled surface estimates is used in the quantitative assessment for common dolphin (0.017 individuals/km^2; Gilles *et al.,* 2025).

Table 5.4 Summary of publicly available density estimates for common dolphin within sites surrounding the Project

Source	Survey Dates	Detail	Density Estimate (individuals/km^2)	Reference
Site-specific survey	April 2021 to March 2023.	OAA + 4km buffer.	0	APEM (2024a).
SCANS-III	Summer 2016.	Block T	0	Hammond *et al.* (2021).
		Block R	0	
SCANS-III surface density	Summer 2016.	Grid cell specific average density within OAA.	0.002	Lacey *et al.* (2022).
SCANS-IV	Summer 2022.	Block NS-E	0	Gilles *et al.* (2023).
		Block NS-D	0	
SCANS-IV surface density	Summer 2022.	Grid cell specific average density within OAA.	0.017	Gilles *et al.* (2025).
Caledonia	May 2021 to April 2023.	Caledonia site + 4km buffer.	0.01	Caledonia Offshore Wind Farm Ltd (2024).
Green Volt	May 2020 to April 2022.	Green Volt site + 4km buffer.	0	Royal HaskoningDHV (2023).
Moray East	April 2010 to March 2012.	Moray East site + wider Moray Firth.	0	Moray Offshore Renewables Ltd (2012).
Moray West	April 2016 to March 2017.	Moray West site + 4km buffer.	0	Moray Offshore Windfarm (West) Limited (2018).
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0	Stevens and Sinclair (2023).
Salamander	March 2021 to February 2023.	Salamander site + 4km buffer.	0	Klementisová *et al.* (2023).

5.1.4 White-beaked dolphin

Overview

5.1.4.1 White-beaked dolphins are widespread across the northern European continental shelf and are the second most abundant cetacean in the North Sea after harbour porpoise (Banhuera-Hinestroza *et al.*, 2009). In Scottish offshore waters, they are present year-round, with sightings peaking in Summer (Hague *et al.,* 2020). They are particularly common in the central and northern North Sea and off north-west Scotland. While listed as Least Concern on the IUCN Red List (Kiszka and Braulik, 2018a), their UK conservation status remains unknown due to limited data (JNCC, 2019d). No designated conservation sites currently exist for this species within the CGNS MU.

5.1.4.2 White-beaked dolphins typically inhabit shelf waters less than 120m deep, favouring depths between 50m to 100m (MacLeod *et al.,* 2007; Reid *et al.,* 2003). They are generally found in cooler waters, preferring temperatures below 13°C and rarely occur where temperatures exceed 18°C (Tetley and Dolman, 2013; MacLeod *et al.,* 2008). Although occasionally seen in large aggregations, white-beaked dolphins usually form small groups of ten to 20 individuals. On Scotland's east coast, average group sizes have been recorded as 5.7 (Weir *et al.,* 2001) and 4.2 (Canning *et al.,* 2008). Group size may vary seasonally, with larger groups observed in early Summer in the northern North Sea (Canning *et al.*, 2008). In Scottish waters, white-beaked dolphins primarily feed on benthic species, gadoid fish, particularly haddock, whiting, and cod, which are key components of their diet (Canning *et al.,* 2008).

5.1.4.3 Long-term SCANS survey data indicate that white-beaked dolphin distribution has remained stable since 1994 (Gilles *et al.,* 2023). The most recent estimates show densities in Scottish waters ranging from 0 (blocks CS-F and CS-I) to 0.2565 individuals/km² (block CS-J).

Site-specific surveys

5.1.4.4 Across the two years of site-specific surveys conducted from April 2021 to March 2023, white-beaked dolphin were the second most abundant marine mammal species present, with a total of eight sightings in year one (April 2021 to April 2022) and 80 sightings in year two (May 2022 to March 2023), with a peak of 50 white-beaked dolphins observed in August 2022 (for further details refer to APEM (2024a)). Density estimates ranged from 0 individuals/km^2 to 0.31 individuals/km^2 (CV: 0.14) (**Table 5.5**; for further details refer to APEM (2024a)).

5.1.4.5 White-beaked dolphin had an average density estimate over the two years of site-specific surveys of 0.023 individuals/km^2. This species appeared to show some extent of seasonality within the site-specific survey area, with a maximum estimated density of 0.075 individuals/km^2 during Summer surveys (June, July and August), compared to a minimum estimated density of 0.00 individuals/km^2 during Winter surveys (January, February and December; **Table 5.5**). There was no clear spatial variation in white-beaked dolphin presence across the survey area, with surveys indicating a widespread distribution (for further details refer to APEM (2024a)).

Table 5.5 Monthly density and abundance estimates for white-beaked dolphin in the site-specific survey area between April 2021 and March 2023 (data from APEM (2024a))

Survey	Raw count	Abundance				Density
		Abundance	95% CI lower	95% CI upper	Precision (CV)	
S1 April 2021	-	-	-	-	-	-
S2 May 2021	-	-	-	-	-	-
S3 June 2021	-	-	-	-	-	-
S4 July 2021	1	8	1	23	<1	0.01
S5 August 2021	7	57	7	147	0.38	0.05
S6 September 2021	-	-	-	-	-	-
S7 October 2021	-	-	-	-	-	-
S8 December 2021	-	-	-	-	-	-
S9 January 2022	-	-	-	-	-	-
S10 March 2022	-	-	-	-	-	-
S11 April 2022	-	-	-	-	-	-
S12 May 2022	-	-	-	-	-	-
S13 July (I) 2022	6	48	6	113	0.41	0.04
S14 July (II) 2022	6	48	6	145	0.41	0.04
S15 August 2022	50	391	180	665	0.14	0.31
S16 September 2022	2	16	2	49	0.71	0.01
S17 October 2022	7	56	7	151	0.38	0.04
S18 November (I) 2022	5	40	5	119	0.45	0.03
S19 November (II) 2022	-	-	-	-	-	-
S20 February (I) 2023	-	-	-	-	-	-
S21 February (II) 2023	-	-	-	-	-	-
S22 February (III) 2023	-	-	-	-	-	-
S23 March (I) 2023	-	-	-	-	-	-
S24 March (II) 2023	4	32	4	96	0.5	0.03
Mean	**10**	**78**	**25**	**168**	**0.423**	**0.023**

Survey	Raw count	Abundance				Density
		Abundance	95% CI lower	95% CI upper	Precision (CV)	
Spring average (March, April, May)						**0.004**
Summer average (June, July, August)						**0.075**
Autumn average (September, October, November)						**0.013**
Winter average (December, January, February)						**0.00**

Management unit

5.1.4.6 The population estimate for white-beaked dolphin in the CGNS MU is 43,951 individuals (95% CI: 28,439 to 67,924; CV: 0.22; IAMMWG, 2022). The UK portion of this MU is 34,025 (95% CI: 20,026 to 57,807; CV: 0.32) individuals (IAMMWG, 2022).

SCANS surveys

SCANS-IV

5.1.4.7 The Project is located within the SCANS-IV survey block NS-D and NS-E. Block NS-D had an estimated block-wide abundance of 5,149 white-beaked dolphins (95% CI: 961 to 10,586) and an estimated density of 0.0799 individuals/km^2 (CV: 0.481). Block NS-E had an estimated abundance of 11,611 white-beaked dolphin, (95% CI: 3,975 to 21,601) and a density estimate of 0.1775 individuals/km^2 (CV: 0.383; Gilles *et al.,* 2023).

SCANS-IV surface densities

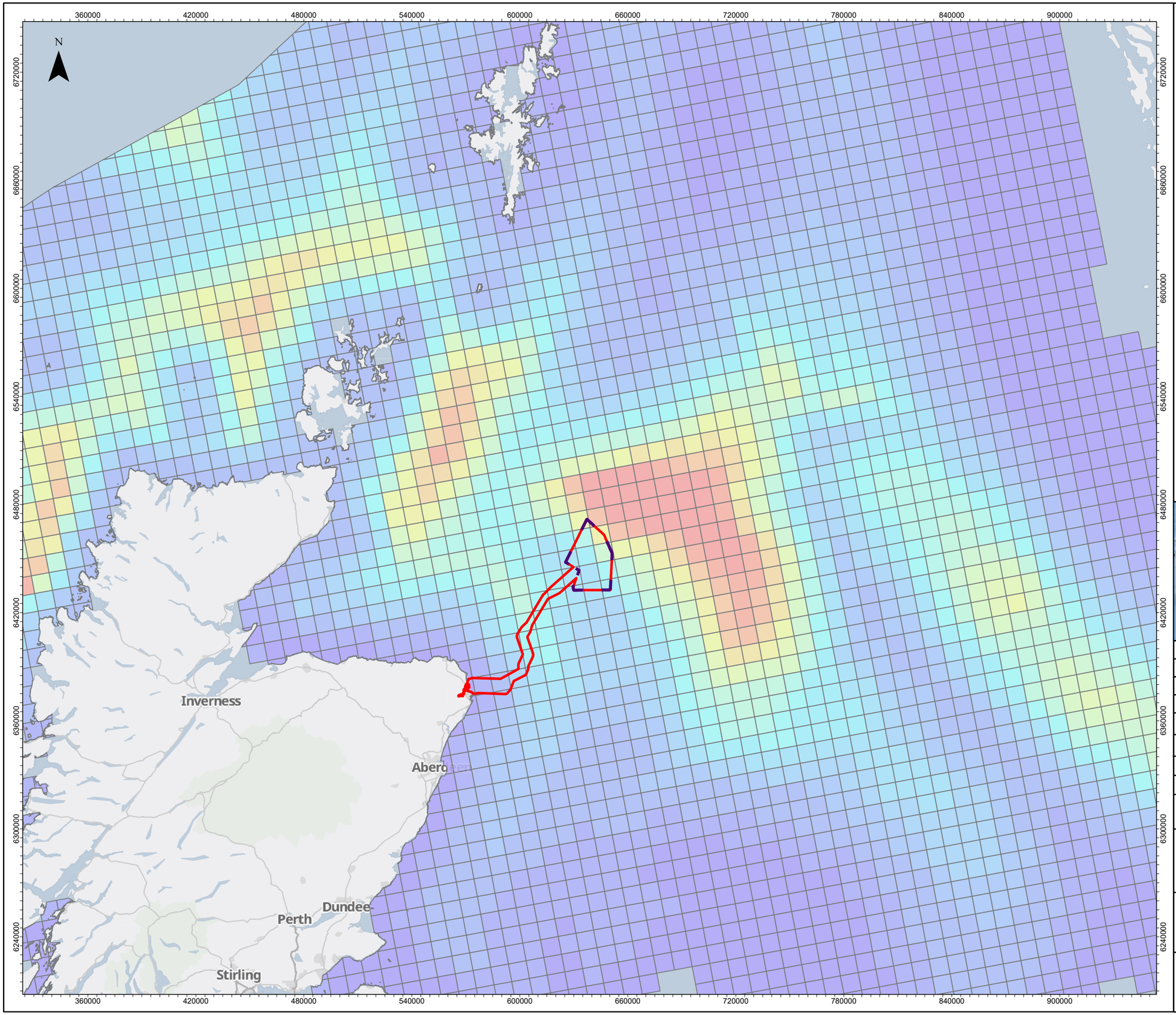
5.1.4.8 Around Scotland the highest densities for white-beaked dolphin were located around the east and north-east of Scotland (**Figure 8**). Density estimates within the site-specific study area, extracted from the modelling by Gilles *et al.* (2025) using SCANS-IV data, indicate a range of 0.215 to 0.892 individuals/km^2 and an average of 0.416 individuals/km^2 within the site-specific study area. Compared to the regional study area of the CGNS, the densities of white-beaked dolphin around the site-specific study area are high (Gilles *et al.,* 2025).

SCANS-III

5.1.4.9 The Project is partially located within the SCANS-III survey block R, where there was an estimated block-wide abundance of 15,694 white-beaked dolphin (95% CI: 3,022 to 33,340) and an estimated density of 0.243 individuals/km^2 (CV: 0.484). The Project is also located within block T which has an estimated abundance of 2,417 white-beaked dolphin, (95% CI: 593 to 5,091) and a density estimate of 0.037 individuals/km^2 (CV: 0.463) (Hammond *et al.,* 2021).

SCANS-III surface densities

5.1.4.10 Density estimates within the site-specific study area, extracted from the modelling by Lacey *et al.* (2022) using SCANS-III data, indicate a range of 0.288 to 0.724 individuals/km^2 and an average of 0.495 individuals/km^2 within the site-specific study area. Compared to the regional study area of the CGNS, the densities of white-beaked dolphin around the site-specific study area are high (Lacey *et al.,* 2022).



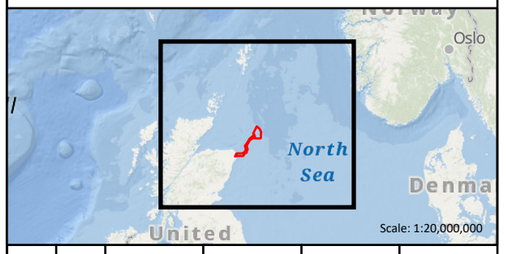
Red Line Boundary

Option Agreement Area

White-beaked Dolphin Density (ind./km²)

- 0 - 0.025
- 0.025 - 0.05
- 0.05 - 0.1
- 0.1 - 0.015
- 0.15 - 0.2
- 0.2 - 0.25
- 0.25 - 0.3
- 0.3 - 0.35
- 0.35 - 0.4
- 0.4 - 0.45
- 0.45 - 0.5
- 0.5 - 0.55
- 0.55 - 0.6
- 0.6 - 0.65
- 0.65 - 0.7
- 0.7 - 0.75
- 0.75 - 0.8
- 0.8 - 0.85
- 0.85 - 0.9
- 0.9 - 1
- >1

0 50 100 Kilometres



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2	16/10/2025	EH	LT	MR	NC
1	04/09/2025	EH	LT	MR	NC

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DATUM	ETRS 89	PROJECTION	UTM Zone 30N
SCALE	1:2,000,000	PAGE SIZE	A3

PROJECT TITLE

MarramWind Offshore Wind Farm

DRAWING TITLE

Figure 8 White-beaked dolphin surface density (Gilles *et al.*, 2025)

Environmental Impact Assessment Report
Appendix 11.1

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NOT TO BE USED FOR NAVIGATION

wsp

MarramWind

Other offshore windfarms

Caledonia

5.1.4.11 White-beaked dolphins were recorded in the Caledonia Offshore Wind Farm site-specific surveys. Sightings occurred throughout the extent of the survey area, with no specific distributional patterns observed. The peak in sightings was recorded in September 2022, with 14 individuals, and peak density was estimated to be 0.19 individuals/km^2. The average density estimate across the two years of surveys was 0.09 individuals/km^2 (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.1.4.12 A total of five white-beaked dolphin were sighted all in one survey during the Green Volt Offshore Wind Farm site-specific surveys, and hence no density estimates were calculated (Royal HaskoningDHV, 2023).

Moray East

5.1.4.13 The vessel surveys for the Moray East Offshore Wind Farm observed 18 white-beaked dolphins, in January 2011 only. Sighting plots from these surveys indicate that while there is an even distribution across the survey area, sightings are slightly more abundant towards the south-eastern edge; however, there were no density estimates provided for this species (Moray Offshore Renewables Ltd, 2012).

Moray West

5.1.4.14 There were no white-beaked dolphins observed during the Moray West Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.1.4.15 The Muir Mhòr Offshore Wind Farm site-specific surveys recorded white-beaked dolphin, with the highest densities recorded during Summer surveys (July). The peak density recorded in July (2022) was 0.09 individuals/km^2, and the average absolute density estimate over the 24 months was 0.01 individuals/km^2 (Stevens and Sinclair, 2023).

Salamander

5.1.4.16 There were no white-beaked dolphins observed during the Salamander Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Klementisová *et al.,* 2023).

White-beaked dolphin summary

5.1.4.17 White-beaked dolphin density estimates were collated from various data sources. These ranged from 0.00 individuals/km^2 to 0.243 individuals/km^2 (**Table 5.6**). The highest density reported is from the SCANS-III survey (block R), however this is not considered to represent the densities likely to be present at the Project given the more recent SCANS-IV surveys where the densities were lower. Therefore, despite being the highest, this density estimate is not considered the most representative of white-beaked dolphin densities in the Project and was not used in the quantitative impact assessment.

5.1.4.18 The Project site-specific surveys concluded an average absolute density of 0.023 individuals/km^2. The site-specific density estimates are lower than the SCANS-IV density estimates and are only relevant to the site-specific survey areas and should not be extrapolated beyond this. Therefore, it is recommended that the SCANS-IV block NS-E density (0.1775 individuals/km^2; Gilles *et al.,* 2023) and SCANS-IV modelled density surface (0.416 individuals/km^2; Gilles *et al.,* 2025) for white-beaked dolphin are brought forward to the quantitative impact assessment.

Table 5.6 Summary of publicly available density estimates for white-beaked dolphin within sites surrounding the Project

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Site-specific survey	April 2021 to March 2023.	OAA + 4km buffer.	0.023	APEM (2024a).
SCANS-III	Summer 2016.	Block T	0.037	Hammond *et al.* (2021).
		Block R	0.243	
SCANS-III surface density	Summer 2016.	Grid cell specific average density within OAA.	0.495	Lacey *et al.* (2022).
SCANS-IV	Summer 2022.	Block NS-E	0.1775	Gilles *et al.* (2023).
		Block NS-D	0.0799	
SCANS-IV surface density	Summer 2022.	Grid cell specific average density within OAA.	0.416	Gilles *et al.* (2025).
Caledonia	May 2021 to April 2023.	Caledonia site + 4km buffer.	0.09	Caledonia Offshore Wind Farm Ltd (2024).
Green Volt	May 2020 to April 2022.	Green Volt site + 4km buffer.	0	Royal HaskoningDHV (2023).
Moray East	April 2010 to March 2012.	Moray East site + wider Moray Firth.	0	Moray Offshore Renewables Ltd (2012).
Moray West	April 2016 to March 2017.	Moray West site + 4km buffer.	0	Moray Offshore Windfarm (West) Limited (2018).
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0.01	Stevens and Sinclair (2023).
Salamander	March 2021 to February 2023.	Salamander site + 4km buffer.	0	Klementisová *et al.* (2023).

5.1.5 Risso's dolphin

Overview

5.1.5.1 Risso's dolphins are regularly observed in Scottish waters, particularly along the west coast (JNCC, 2019d). They are listed as Least Concern on the IUCN Red List (Kiszka and Braulik, 2018b), but their UK conservation status remains unknown due to limited data (JNCC, 2019e). The North-east Lewis MPA is currently the only designated site for this species within the CGNS MU.

5.1.5.2 Sightings of Risso's dolphins show seasonal variation, with more offshore records on the continental shelf during Winter (Reid *et al.,* 2003). They are typically found over shelf slopes at depths of 50m to 100m but also inhabit shallower coastal waters (20m to 30m) in some areas (Evans *et al.,* 2003). Coastal waters off north-east Scotland have been identified as important habitat, with frequent sightings of mothers and calves suggesting these areas serve as nursery grounds (Hodgins *et al.,* 2024). Group sizes usually range from 2-45 individuals, though larger, temporary aggregations of several hundred have been recorded (Sea Watch Foundation, 2012a). Their diet mainly consists of cephalopods, including squid, cuttlefish, and octopus (MacLeod *et al.,* 2014).

5.1.5.3 SCANS survey data indicate little change in Risso's dolphin distribution or abundance since 2016 (Hammond *et al.,* 2021; Gilles *et al.,* 2023). Recent density estimates in Scottish waters range from 0 (blocks CS-G, CS-I, NS-D) to 0.0702 individuals/km² (block NS-E) (Gilles *et al.,* 2023).

Site-specific surveys

5.1.5.4 Across the two years of site-specific surveys conducted between April 2021 and March 2023, Risso's dolphins were recorded, with one sighting in year one (April 2021 to April 2022) and seven sightings in year two (May 2022 to March 2023), with a peak of five Risso's dolphins observed in November 2022 (for further details refer to APEM (2024a)). Density estimates ranged from 0 individuals/km^2 to 0.03 individuals/km^2 (CV: 0.45; **Table 5.7**; for further details refer to APEM (2024a)).

5.1.5.5 Risso's dolphin had an average density estimate over the two years of site-specific surveys of 0.002 individuals/km^2. This species appeared to show some extent of seasonality within the site-specific survey area, with a maximum estimated density of 0.005 individuals/km^2 during Autumn surveys (September, October, and November), compared to a minimum estimated density of 0 individuals/km^2 during Summer (June, July and August) and Spring surveys (March, April and May; **Table 5.7**). There was no clear spatial variation in Risso's dolphin presence across the survey area, with surveys indicating a widespread distribution (for further details refer to APEM (2024a)).

Table 5.7 Monthly density and abundance estimates for Risso's dolphin in the site-specific survey area between April 2021 and March 2023 (data from APEM (2024a))

Survey	Raw count	Abundance				Density
		Abundance	95% CI lower	95% CI upper	Precision (CV)	
S1 April 2021	-	-	-	-	-	-
S2 May 2021	-	-	-	-	-	-
S3 June 2021	-	-	-	-	-	-
S4 July 2021	-	-	-	-	-	-
S5 August 2021	-	-	-	-	-	-
S6 September 2021	-	-	-	-	-	-
S7 October 2021	-	-	-	-	-	-
S8 December 2021	-	-	-	-	-	-
S9 January 2022	1	8	1	24	<1	0.01
S10 March 2022	-	-	-	-	-	-
S11 April 2022	-	-	-	-	-	-
S12 May 2022	-	-	-	-	-	-
S13 July (I) 2022	-	-	-	-	-	-
S14 July (II) 2022	-	-	-	-	-	-
S15 August 2022	-	-	-	-	-	-
S16 September 2022	-	-	-	-	-	-
S17 October 2022	-	-	-	-	-	-
S18 November (I) 2022	5	40	5	119	0.45	0.03
S19 November (II) 2022	-	-	-	-	-	-
S20 February (I) 2023	1	8	1	24	<1	0.01
S21 February (II) 2023	-	-	-	-	-	-
S22 February (III) 2023	-	-	-	-	-	-
S23 March (I) 2023	-	-	-	-	-	-
S24 March (II) 2023	-	-	-	-	-	-
Mean	**3**	**19**	**3**	**56**	**0.45**	**0.002**
Spring average (March, April, May)						**0.00**

Survey	Raw count	Abundance				Density
		Abundance	95% CI lower	95% CI upper	Precision (CV)	
Summer average (June, July, August)						**0.00**
Autumn average (September, October, November)						**0.005**
Winter average (December, January, February)						**0.004**

Management unit

5.1.5.6 The population estimate for Risso's dolphin in the CGNS MU is 12,262 individuals (95% CI: 5,227 to 28,764; CV: 0.46; IAMMWG, 2022). The UK portion of this MU is 8,687 (95% CI: 2,810 to 26,852; CV: 0.63) individuals (IAMMWG, 2022).

SCANS surveys

SCANS-IV

5.1.5.7 The Project is partially located in the SCANS-IV survey block NS-D, where there were no Risso's dolphin recorded; however, in the other overlapped block NS-E there was a reported estimated abundance of 4,589 individuals (95% CI: 31 to 16,458) and a density estimate of 0.0702 individuals/km^2 (CV: 0.974; Gilles *et al.,* 2023).

SCANS-IV surface densities

5.1.5.8 Gilles *et al.* (2025) did not provide a modelled density surface for Risso's dolphin.

SCANS-III

5.1.5.9 The Project is located within the SCANS-III survey blocks R and T, where there were no Risso's dolphin recorded (Hammond *et al.,* 2021).

SCANS-III surface densities

5.1.5.10 Lacey *et al.* (2022) did not provide a modelled density surface for Risso's dolphin.

Other offshore wind farms

Caledonia

5.1.5.11 Risso's dolphins were recorded in three of the Caledonia Offshore Wind Farm site-specific surveys, June, August and September 2022, with sightings occurring throughout the extent of the survey area. Risso's dolphin sighting peak was recorded in August and September 2022, at five individuals, and peak density estimate of 0.05 individuals/km^2. The average density estimate across the two years of surveys was 0.002 individuals/km^2 (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.1.5.12 Only a single Risso's dolphin was sighted during the Green Volt Offshore Wind Farm site-specific surveys, and hence no density estimates were calculated (Royal HaskoningDHV, 2023).

Moray East

5.1.5.13 A single Risso's dolphin was sighted during the Moray East Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Moray Offshore Renewables Ltd, 2012).

Moray West

5.1.5.14 There were no Risso's dolphins observed during the Moray West Offshore Wind Farm site-specific survey; therefore, no density estimates were calculated (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.1.5.15 The Muir Mhòr Offshore Wind Farm site-specific surveys recorded Risso's dolphin, with the highest densities during March (2022) and February (2023) surveys. The average absolute density estimate over the 24 months was 0.002 individuals/km^2, with the peak density recorded in March (2022) and February (2023) at 0.02 individuals/km^2 (Stevens and Sinclair, 2023).

Salamander

5.1.5.16 There were no Risso's dolphins observed during the Salamander Offshore Wind Farm site-specific survey, therefore no density estimates were calculated (Klementisová *et al.,* 2023).

Risso's dolphin summary

5.1.5.17 Risso's dolphin have been observed sporadically around the east coast of Scotland. During the Project site-specific surveys there were eight Risso's dolphin observed, resulting in an average absolute density of 0.002 individuals/km^2. This species has also been observed in low densities during other survey data reviewed and analysed (**Table 5.8**). The site-specific density estimate is lower than the SCANS-IV density estimate and is only relevant to the survey area and should not be extrapolated beyond this. Therefore, it is recommended that the SCANS-IV, block NS-E density (0.0702 individuals/km^2; Gilles *et al.,* 2023) is brought forward to the quantitative impact assessment.

Table 5.8 Summary of publicly available density estimates for Risso's dolphin within sites surrounding the Project

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Site-specific survey	April 2021 to March 2023.	OAA + 4km buffer.	0.002	APEM (2024a).
SCANS-III	Summer 2016.	Block T	0	

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
		Block R	0	Hammond *et al.* (2021).
SCANS-III surface density	Summer 2016.	Grid cell specific average density within OAA.	Not provided	Lacey *et al.* (2022).
SCANS-IV	Summer 2022.	Block NS-E	0.0702	Gilles *et al.* (2023).
		Block NS-D	0	
SCANS-IV surface density	Summer 2022.	Grid cell specific average density within OAA.	Not provided	Gilles *et al.* (2025).
Caledonia	May 2021 to April 2023.	Caledonia site + 4km buffer.	0.002	Caledonia Offshore Wind Farm Ltd (2024).
Green Volt	May 2020 to April 2022.	Green Volt site + 4km buffer.	0	Royal HaskoningDHV (2023).
Moray East	April 2010 to March 2012.	Moray East site + wider Moray Firth.	0	Moray Offshore Renewables Ltd (2012).
Moray West	April 2016 to March 2017.	Moray West site + 4km buffer.	0	Moray Offshore Windfarm (West) Limited (2018).
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0.002	Stevens and Sinclair (2023).
Salamander	March 2021 to February 2023.	Salamander site + 4km buffer.	0	Klementisová *et al.* (2023).

5.1.6 Minke whale

Overview

5.1.6.1 Minke whales are the most common baleen whale species in Scottish waters and are regularly observed across north-east Scotland (Robinson *et al.*, 2009), although no calving has been recorded in these waters. This species is listed as Least Concern on the IUCN Red List (Cooke, 2018). Their UK conservation status remains unknown due to insufficient data (JNCC, 2019f). Two MPAs within the CGNS MU are designated for minke whale: the Southern Trench MPA and the Sea of the Hebrides MPA.

5.1.6.2 Minke whales are present year-round in UK coastal waters, mainly within continental shelf areas shallower than 200m (Reid *et al.*, 2003). Sightings peak between June and August, when whales move closer inshore, particularly in the Moray Firth, which serves as a key feeding area. Here, they show a preference for depths between 20m to 50m. A shift to offshore waters in Autumn may be linked to breeding behaviour. They are typically seen

alone or in pairs, but minke whales occasionally form feeding groups of ten to 15 individuals (Reid *et al.*, 2003). Their diet includes a range of fish species, such as herring, cod, capelin, haddock, saithe, and sandeel, as well as euphausiids and pteropods (Haug *et al.*, 1995; Nordøy *et al.*, 1995; Pierce *et al.*, 2004).

5.1.6.3 SCANS survey data show stable distribution patterns, with recent density estimates in Scottish waters ranging from 0 (block CS-G) to 0.0419 individuals/km² (block NS-D; Hammond *et al.*, 2013; Gilles *et al.*, 2023).

Site-specific surveys

5.1.6.4 No minke whales were observed during the two years of site-specific surveys.

Management unit

5.1.6.5 The population estimate for minke whale in the CGNS MU is 20,118 individuals (95% CI: 14,061 to 28,786; CV: 0.18; IAMMWG, 2022), of which 10,288 (95% CI: 6,210 to 17,042; CV: 0.26) are estimated within the UK Exclusive Economic Zone (EEZ) (IAMMWG, 2022).

SCANS surveys

SCANS-IV

5.1.6.6 The Project is located in the SCANS-IV survey blocks NS-D and NS-E. Within block NS-D there was an estimated block-wide abundance of 2,702 individuals (95% CI: 547 to 7,357) and an estimated density of 0.0419 individuals/km^2 (CV: 594). Block NS-E had an estimated abundance of 795 (95% CI: 3 to 2,673) and a density estimate of 0.0121 individuals/km^2 (CV: 0.724; Gilles *et al.,* 2023).

SCANS-IV surface densities

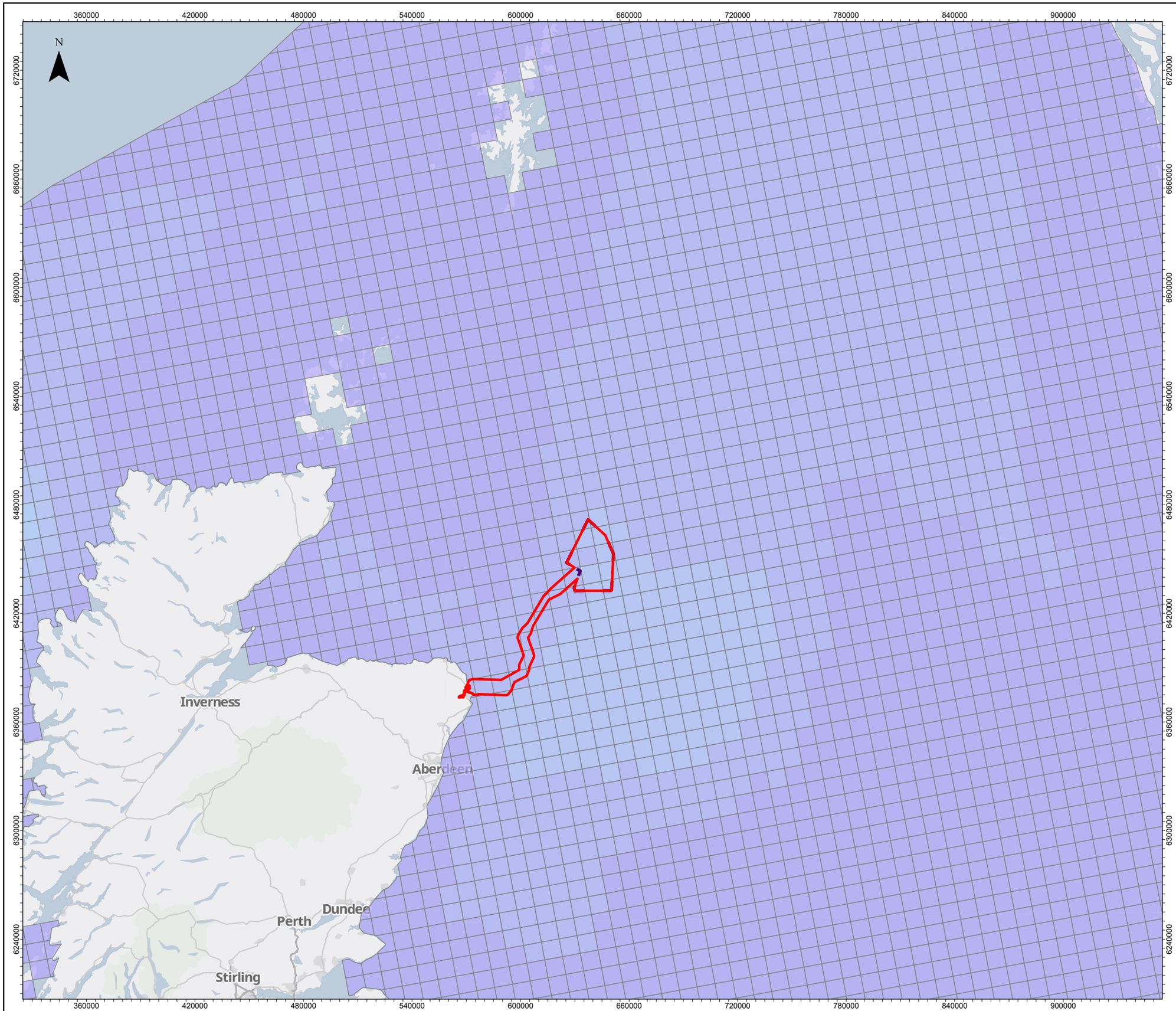
5.1.6.7 Around Scotland the highest densities for minke whale were located around the east and north-east of Scotland. Density estimates within the site-specific study area, extracted from the modelling by Gilles *et al.* (2025) using SCANS-IV data, indicate a range of 0.032 to 0.063 individuals/km^2 and an average of 0.05 individuals/km^2 within the site-specific study area (**Table 5.9**). Compared to the regional study area of the CGNS, the densities of minke whale around the site-specific study area are moderate to high (**Figure 9**; Gilles *et al.,* 2025).

SCANS-III

5.1.6.8 The Project is located within the SCANS-III survey blocks R and T. Within block R there was an estimated block-wide abundance of 2,498 individuals (95% CI: 604 to 6,791) and an estimated density of 0.0387 individuals/km^2 (CV: 0.614). Block T had an estimated abundance of 2,068 individuals (95% CI: 290 to 6,960) and a density estimate of 0.0316 individuals/km^2 (CV: 0.805) (Hammond *et al.,* 2021).

SCANS-III surface densities

5.1.6.9 Density estimates within the site-specific study area, extracted from the modelling by Lacey *et al.* (2022) using SCANS-III data, indicate a range of 0.026 to 0.035 individuals/km^2 and an average of 0.03 individuals/km^2 within the site-specific study area. Compared to the regional study area of the CGNS, the densities of minke whale around the site-specific study area are moderate (Lacey *et al.,* 2022).



Red Line Boundary

Option Agreement Area

Minke Whale Density (ind./km²)

- 0 - 0.025
- 0.025 - 0.05
- 0.05 - 0.1
- 0.1 - 0.015
- 0.15 - 0.2
- 0.2 - 0.25
- 0.25 - 0.3
- 0.3 - 0.35
- 0.35 - 0.4
- 0.4 - 0.45
- 0.45 - 0.5
- 0.5 - 0.55
- 0.55 - 0.6
- 0.6 - 0.65
- 0.65 - 0.7
- 0.7 - 0.75
- 0.75 - 0.8
- 0.8 - 0.85
- 0.85 - 0.9
- 0.9 - 1
- >1

0 50 100 Kilometres

	dd/mm/yyyy	--	--	--	--
2	16/10/2025	EH	LT	MR	NC
1	04/09/2025	EH	LT	MR	NC
REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER

WSP DRAWING NUMBER	808368-WEIS-IA-E5-FG-M8-11589
MarramWind DRAWING NUMBER	MAR-GEN-ENV-MAP-WSP-000387
DATUM	ETRS 89
PROJECTION	UTM Zone 30N
SCALE	1:2,000,000
PAGE SIZE	A3

PROJECT TITLE

MarramWind Offshore Wind Farm

DRAWING TITLE

Figure 9 Minke whale surface density (Gilles et al. 2025)

Environmental Impact Assessment Report
Appendix 11.1

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NOT TO BE USED FOR NAVIGATION

wsp MarramWind

Other offshore windfarms

Caledonia

5.1.6.10 Minke whales were observed in four out of 24 surveys for the Caledonia Offshore Wind Farm, with a total of 12 individuals recorded. The highest uncorrected abundance estimate was 36 whales (95% CI: 8 to 78), in July 2021. Across the two-year survey period, the average uncorrected relative density was 0.003 individuals/km² (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.1.6.11 No minke whales were observed during the Green Volt Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Royal HaskoningDHV, 2023).

Moray East

5.1.6.12 Minke whales were recorded between the months of April and October during the Moray East Offshore Wind Farm site-specific surveys. A total of 49 minke whales were recorded between April 2010 and March 2012, and the peak in sightings occurred in August. No minke whales were observed between November and March. The average density reported across all surveys was 0.01 individuals/km^2 (95% CI: 0.007 to 0.02) within the site (Moray Offshore Renewables Ltd, 2012).

Moray West

5.1.6.13 There were five minke whales observed during the Moray West Offshore Wind Farm site-specific surveys. However, all sightings were recorded during one survey (June 2016) and no density estimates were provided (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.1.6.14 The Muir Mhòr Offshore Wind Farm site-specific surveys recorded minke whales on seven occasions, during Spring, Summer and Autumn months (from April to October), with no sightings in Winter months (November to March). The average absolute density estimate over the 24 months was 0.004 individuals/km^2, with the peak density recorded in April (2021) at 0.03 individuals/km^2 (Stevens and Sinclair, 2023).

Salamander

5.1.6.15 The Salamander Offshore Wind Farm site-specific surveys recorded three minke whales throughout the entire survey period, in June, October and December 2021. The average relative density estimate over the survey months was 0.02 individuals/km^2, with the peak relative density recorded in June (2021) at 0.26 individuals/km^2 (Klementisová *et al.,* 2023).

Minke whale summary

5.1.6.16 Minke whale density estimates collated from various data sources range from 0 individuals/km^2 to 0.0419 individuals/km^2 (**Table 5.9**). The Project site-specific surveys did not record any minke whales and therefore an average relative density within the site-specific area was not produced. It is recommended that the SCANS-IV block NS-D density (0.0419 individuals/km^2; Gilles *et al.,* 2023) and SCANS-IV modelled density surface (0.05 individuals/km^2; Gilles *et al.,* 2025) for minke whale are brought forward to the quantitative impact assessment.

Table 5.9 Summary of publicly available density estimates for minke whale within sites surrounding the Project

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Site-specific survey	April 2021 to March 2023.	OAA + 4km buffer.	0	APEM (2024a).
SCANS-III	Summer 2016.	Block T	0.0316	Hammond *et al.* (2021).
		Block R	0.0387	
SCANS-III surface density	Summer 2016.	Grid cell specific average density within OAA.	0.03	Lacey *et al.* (2022).
SCANS-IV	Summer 2022.	Block NS-E	0.0121	Gilles *et al.* (2023).
		Block NS-D	0.0419	
SCANS-IV surface density	Summer 2022.	Grid cell specific average density within OAA.	0.05	Gilles *et al.* (2025).
Caledonia	May 2021 to April 2023.	Caledonia site + 4km buffer.	0.003	Caledonia Offshore Wind Farm Ltd (2024).
Green Volt	May 2020 to April 2022.	Green Volt site + 4km buffer.	0	Royal HaskoningDHV (2023).
Moray East	April 2010 to March 2012.	Moray East site + wider Moray Firth.	0.01	Moray Offshore Renewables Ltd (2012).
Moray West	April 2016 to March 2017.	Moray West site + 4km buffer.	0	Moray Offshore Windfarm (West) Limited (2018).
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0.03	Stevens and Sinclair (2023).
Salamander	March 2021 to February 2023.	Salamander site + 4km buffer.	0.02	Klementisová *et al.* (2023).

5.1.7 Atlantic white-sided dolphin

Overview

5.1.7.1 Atlantic white-sided dolphins are present year-round in UK waters, with most sightings recorded along the north and north-west coasts of Scotland during Summer (Paxton *et al.*, 2016). Occasional sightings have also been reported in the east and north-east (Scottish Government, 2011). The species is listed as Least Concern on the IUCN Red List (Braulik, 2019), but its UK conservation status remains unknown due to limited data (JNCC, 2019g). There are currently no designated conservation sites for this species within the CGNS MU.

5.1.7.2 Atlantic white-sided dolphins are often seen in large groups, sometimes totalling up to 1,000 individuals (Reeves *et al.*, 1999). Within these aggregations, smaller subgroups of two to 15 are common. They may also form mixed groups with white-beaked dolphins, making identification challenging (Marine Scotland, 2022). Their diet includes poor cod, pouting (*Trisopterus* spp.), blue whiting, Atlantic mackerel, myctophids, and silvery pout (*Gadiculus argentus*) (Hernandez-Milian *et al.*, 2016). These dolphins prefer cool waters (7°C to 12°C) and are typically found along the outer continental shelf and slope at depths of 100m to 500m, though they may also occur in deeper oceanic waters (Leopold and Couperus, 1995; Pollock *et al.*, 2000).

5.1.7.3 The latest SCANS survey estimated densities in Scottish waters ranging from 0 (blocks CS-F, CS-I, CS-K, NS-D) to 0.0279 individuals/km² (block CS-H; Gilles *et al.*, 2023).

Site-specific surveys

5.1.7.4 No Atlantic white-sided dolphins were observed during the two years of site-specific surveys.

Management unit

5.1.7.5 The relevant MU for Atlantic white-sided dolphin is the CGNS MU which has an estimated population size of 18,128 individuals (95% CI: 6,049 to 54,323; CV: 0.61) of which 12,293 (95% CI: 3,891 to 38,841; CV: 0.64) are estimated within the UK EEZ (IAMMWG, 2022).

SCANS surveys

SCANS-IV

5.1.7.6 The Project is located in the SCANS-IV survey blocks NS-D and NS-E. No Atlantic white-sided dolphins were recorded within block NS-D; however, in block NS-E an estimated abundance of 958 individuals (95% CI: 5 to 4,583) and a density estimate of 0.0146 individuals/km^2 (CV: 1.028; Gilles *et al.,* 2023) were reported.

SCANS-IV surface densities

5.1.7.7 Gilles *et al.* (2025) did not provide a modelled density surface for Atlantic white-sided dolphin.

SCANS-III

5.1.7.8 The Project is located within the SCANS-III survey blocks R and T. Within block R, there is an estimated abundance of 644 individuals (95% CI: 0 to 2,069), with a density estimate of 0.0100 individuals/km^2 (CV: 0.994; Gilles *et al.,* 2023). Block T has an estimated abundance

of 1,366 individuals (95% CI: 0 to 5,031), and a density estimate of 0.0209 individuals/km^2 (CV: 0.984; Gilles *et al.,* 2023).

SCANS-III surface densities

5.1.7.9 Lacey *et al.* (2022) did not provide a modelled density surface for Atlantic white-sided dolphin.

Other offshore windfarms

Caledonia

5.1.7.10 No Atlantic white-sided dolphins were observed during the Caledonia Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.1.7.11 No Atlantic white-sided dolphins were observed during the Green Volt site-specific surveys; therefore, no density estimates were calculated (Royal HaskoningDHV, 2023).

Moray East

5.1.7.12 No white-sided dolphins were observed during the Moray East Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated. There were however some *Lagenorhynchus* species recorded, where confirmation between Atlantic white-sided and white-beaked dolphin was not possible (Moray Offshore Renewables Ltd, 2012).

Moray West

5.1.7.13 No Atlantic white-sided dolphins were observed during the Moray West Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.1.7.14 No Atlantic white-sided dolphins were observed during the Muir Mhòr Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Stevens and Sinclair, 2023).

Salamander

5.1.7.15 No Atlantic white-sided dolphins were observed during the Salamander Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Klementisová *et al.,* 2023).

Atlantic white-sided dolphin summary

5.1.7.16 Atlantic white-sided dolphin have been observed sporadically around the east coast of Scotland, and during the site-specific surveys this species was not recorded. Atlantic white-sided dolphin have also not been observed during other survey data reviewed and analysed (**Table 5.10**). It is recommended that the latest density estimate from the SCANS-IV survey is used in the quantitative assessment for Atlantic white-sided dolphin (block NS-E 0.0146 individuals/km^2; Gilles *et al.,* 2023).

Table 5.10 Summary of publicly available density estimates for Atlantic white-sided dolphin within sites surrounding the Project

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Site-specific survey	April 2021 to March 2023.	OAA + 4km buffer.	0	APEM (2024a).
SCANS-III	Summer 2016.	Block T	0.0209	Hammond *et al.* (2021).
		Block R	0.0100	
SCANS-III surface density	Summer 2016.	Grid cell specific average density within OAA.	Not provided	Lacey *et al.* (2022).
SCANS-IV	Summer 2022.	Block NS-E	0.0146	Gilles *et al.* (2023).
		Block NS-D	0	
SCANS-IV surface density	Summer 2022.	Grid cell specific average density within OAA.	Not provided	Gilles *et al.* (2025).
Caledonia	May 2021 to April 2023.	Caledonia site + 4km buffer.	0	Caledonia Offshore Wind Farm Ltd (2024).
Green Volt	May 2020 to April 2022.	Green Volt site + 4km buffer.	0	Royal HaskoningDHV (2023).
Moray East	April 2010 to March 2012.	Moray East site + wider Moray Firth.	0	Moray Offshore Renewables Ltd (2012).
Moray West	April 2016 to March 2017.	Moray West site + 4km buffer.	0	Moray Offshore Windfarm (West) Limited (2018).
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0	Stevens and Sinclair (2023).
Salamander	March 2021 to February 2023.	Salamander site + 4km buffer.	0	Klementisová *et al.* (2023).

5.1.8 Humpback whale

Overview

5.1.8.1 Humpback whales are occasionally seen in UK waters during their migration between breeding grounds off Africa and feeding areas near Iceland (Sea Watch Foundation, 2012b). Sightings in the UK have steadily increased since the mid-1980s, likely due to the population recovery following the ban on commercial whaling (JNCC, 2019h). In Scotland, they are most commonly observed around the Shetland Isles and Hebrides, with growing numbers reported in the northern North Sea, including from the Firth of Forth to Shetland (Hague *et al.*, 2020; Marine Scotland, 2022). The species is listed as Least Concern on the IUCN Red List (Cooke, 2018), but its UK conservation status remains unknown due to limited data (JNCC, 2019h). There are currently no designated sites or defined MUs for this species in the UK.

5.1.8.2 Globally distributed across tropical, temperate, and polar seas, humpback whales favour continental shelf waters and areas around oceanic islands (Winn and Reichley, 1985). Their presence is closely tied to prey availability. In UK waters, they primarily feed on small schooling fish such as sandeels, herring, mackerel, capelin, cod, and European anchovy (*Engraulis encrasicolus*), along with large zooplankton. Humpback whales are usually seen alone or in mother-calf pairs, though small feeding or breeding groups of up to five individuals may occur (Reid *et al.*, 2003).

5.1.8.3 No humpback whales were recorded in the SCANS-III or IV surveys (Hammond *et al.*, 2021; Gilles *et al.*, 2023). However, at least four individuals were observed in the Firth of Forth during Winter 2017 and 2018 (O'Neil *et al.*, 2019).

Site-specific surveys

5.1.8.4 No humpback whales were observed during the two years of site-specific surveys.

Management unit

5.1.8.5 Humpback whales have no defined management unit from IAMMWG (2023).

SCANS surveys

SCANS-IV

5.1.8.6 The Project is located within the SCANS-IV survey blocks NS-D and NS-E, where there were no humpback whales recorded (Gilles *et al.,* 2023).

SCANS-IV surface densities

5.1.8.7 Gilles *et al.* (2025) did not provide a modelled density surface for humpback whales.

SCANS-III

5.1.8.8 The Project is located within the SCANS-III survey blocks T and R, where there were no humpback whales recorded.

SCANS-III surface densities

5.1.8.9 Lacey *et al. (*2022) did not provide a modelled density surface for humpback whales.

Other offshore windfarms

Caledonia

5.1.8.10 No humpback whales were observed during the Caledonia Offshore Wind Farm site-specific surveys (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.1.8.11 No humpback whales were observed during the Green Volt Offshore Wind Farm site-specific surveys (Royal HaskoningDHV, 2023).

Moray East

5.1.8.12 No humpback whales were observed during the Moray Offshore Wind Farm East site-specific surveys (Moray Offshore Renewables Ltd, 2012).

Moray West

5.1.8.13 No humpback whales were observed during the Moray West Offshore Wind Farm site-specific survey (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.1.8.14 No humpback whales were observed during the Muir Mhòr Offshore Wind Farm site-specific surveys (Stevens and Sinclair, 2023).

Salamander

5.1.8.15 No humpback whales were observed during the Salamander Offshore Wind Farm site-specific surveys (Klementisová *et al.,* 2023).

Humpback whale summary

5.1.8.16 Humpback whales have been observed sporadically around the east coast of Scotland, and during the site-specific surveys this species was not recorded. Humpback whales have also not been observed during other survey data reviewed and analysed. Therefore, humpback whales was assessed qualitatively due to a lack of density estimates.

5.2 Pinnipeds

5.2.1.1 Two pinniped species, harbour and grey seal, are resident to the UK. Both species are regularly seen in Scottish waters and occur regularly along the east coast of Scotland (SCOS, 2024; Carter *et al.,* 2022).

5.2.2 Grey seal

Overview

5.2.2.1 Grey seals are present year-round along Scotland's east coast and are the more numerous seal species in this region (Hague *et al.,* 2020). They are listed as Least Concern on the IUCN Red List (Bowen, 2016), and their UK conservation status is assessed as Favourable with an improving trend (JNCC, 2019i).

5.2.2.2 Grey seals regularly haul out on land to rest, breed, and moult. They are known to exhibit seasonal redistribution at broader spatial scales and use different areas for breeding and foraging (Carter *et al.,* 2022). Breeding in Scotland occurs from September to December, and the moulting period occurs from December to April (SCOS, 2022). While grey seals can forage up to 448km from haul-out sites, most trips are much shorter, with 88% occur within 65km (McConnell *et al.,* 1999). Carter *et al.* (2022) reported that grey seals in east Scotland had a more coastal distribution compared to other areas, and that telemetry data indicated that individuals predominantly remain within 100km of their haul-out sites. During the breeding season, however, this distance reduces further, and breeding individuals are thought to remain within 20km of their haul-out. Grey seals typically forage in waters up to 100m deep, with trips lasting from one to 30 days (SCOS, 2019).

5.2.2.3 At-sea distribution of grey seals is closely linked to sandy or gravelly sediments, which support sandeel populations, their primary prey in the central and northern North Sea (McConnell *et al.,* 1999; Hammond and Wilson, 2016). However, grey seals have a broad, adaptable diet that includes gadids (such as cod, saithe, ling (*Molva molva*)), flatfish, scorpion fish, pelagic fish species, and cephalopods.

5.2.2.4 Between 2021 and 2023, August counts in East Scotland SMA recorded 1,584 grey seals at haul-out sites, down from an annual average of 3,683 between 2016 and 2019 (SCOS, 2024). As for the North Coast and Orkney SMA, the August counts recorded 8,599 individuals between 2016 and 2019, which is the most recent count for this area (SCOS, 2024). These regions include three SACs for grey seals: the Isle of May and the Berwickshire and North Northumberland Coast SACs (East Scotland SMA) and Faray and Holm of Faray SAC (North Coast and Orkney SMA). There is also one designated seal haul-out that supports grey seals and is within 20km of the Project's Offshore Red Line Boundary, namely the Ythan Estuary, which is located in the East Scotland SMA.

Site-specific survey

5.2.2.5 Across the two years of site-specific surveys conducted from April 2021 to March 2023, grey seal were the only pinniped species recorded, with a total of three sightings in year one (April 2021 to April 2022) and four sightings in year two (May 2022 to March 2023), and a peak of two grey seals observed in December 2021 and July (I) 2022 (for further details refer to APEM (2024a)). Density estimates ranged from 0 individuals/km^2 to 0.01 individuals/km^2 (CV: 0.71; **Table 5.11**; for further details refer to APEM (2024a)).

5.2.2.6 Grey seal had an average density estimate over the two years of site-specific surveys of 0.0021 individuals/km^2. This species appeared to show some extent of seasonality within the site-specific survey area, with a maximum estimated density of 0.007 individuals/km^2 during Summer surveys (June, July, and August), compared to a lowest estimated density of 0.00 individuals/km^2 during Spring (March, April, and May) and Autumn surveys (September, October, and November; **Table 5.11**). There was no clear spatial variation in grey seal across the survey area, with surveys indicating a widespread distribution (for further details refer to APEM (2024a)).

Table 5.11 Monthly density and abundance estimates for grey seal in the site-specific survey area between April 2021 and March 2023 (data from APEM, 2024a)

SurveyP_	Raw count	Abundance				Density
		Abundance	95% CI lower	95% CI upper	Precision (CV)	
S1 April 2021	-	-	-	-	-	-
S2 May 2021	-	-	-	-	-	-
S3 June 2021	-	-	-	-	-	-
S4 July 2021	-	-	-	-	-	-
S5 August 2021	1	8	1	24	<1	0.01
S6 September 2021	-	-	-	-	-	-
S7 October 2021	-	-	-	-	-	-
S8 December 2021	2	16	2	49	0.71	0.01
S9 January 2022	-	-	-	-	-	-
S10 March 2022	-	-	-	-	-	-
S11 April 2022	-	-	-	-	-	-
S12 May 2022	-	-	-	-	-	-
S13 July (I) 2022	2	16	2	40	0.71	0.01
S14 July (II) 2022	1	8	1	24	<1	0.01
S15 August 2022	1	8	1	23	<1	0.01
S16 September 2022	-	-	-	-	-	-
S17 October 2022	-	-	-	-	-	-
S18 November (I) 2022	-	-	-	-	-	-
S19 November (II) 2022	-	-	-	-	-	-
S20 February (I) 2023	-	-	-	-	-	-
S21 February (II) 2023	-	-	-	-	-	-
S22 February (III) 2023	-	-	-	-	-	-
S23 March (I) 2023	-	-	-	-	-	-
S24 March (II) 2023	-	-	-	-	-	-
Mean	**1.4**	**11.2**	**1.4**	**32**	**0.71**	**0.0021**
Spring average (March, April, May)						**0.00**

SurveyP_	Raw count	Abundance				Density
		Abundance	95% CI lower	95% CI upper	Precision (CV)	
Summer average (June, July, August)						**0.007**
Autumn average (September, October, November)						**0.00**
Winter average (December, January, February)						**0.002**

Management unit

5.2.2.7 The Project is located within both the East Scotland SMA and North Coast and Orkney SMA. The most recent grey seal count for the East Scotland MU is 1,584, for the period 2016 to 2023 (SCOS, 2024). When applying the scalar of 25.15% to account for the number of animals not hauled out during the August surveys, this is converted to a population estimate of 6,298 individuals. To note, the count for the period 2016 to 2023 is a notable decline compared to the count of 3,683 individuals in 2016 to 2019 (SCOS, 2023). Though, the latest single count in 2021 comprised 2,707 individuals (SCOS, 2024). Despite this potentially negative trend, the grey seal pup production in the SMA is increasing, with the latest (2021) pup production estimate a 4.9% (95% CI: 3.1 to 6.8) increase upon the previous year.

5.2.2.8 Regarding the North Coast and Orkney SMA, the most recent grey seal count is 8,599, for the period 2016 to 2019 (SCOS, 2024). When applying the scalar of 25.15% to account for the number of animals not hauled out during the August surveys, this is converted to a population estimate of 34,266 individuals. The grey seal counts in the North Coast and Orkney SMA have been consistently between 8,000 to 9,000 since 2007, indicating that the current population trend is stable. The latest grey seal pup production estimate for the region, of 20,506 pups in 2022, is also stable when considering the trend over the last one and six years (SCOS, 2024).

5.2.2.9 Telemetry data of grey seals has shown connectivity of the Moray Firth SMA with the East Scotland and North Coast and Orkney SMAs (Carter *et al.,* 2025). The Moray Firth SMA has a population estimate of 5,384 individuals, based on the latest August count of 1,354 for the period 2016 to 2023 and the correction factor (SCOS, 2024).

Other offshore windfarms

Caledonia

5.2.2.10 Grey seals were observed in 16 out of 24 surveys for the Caledonia Offshore Wind Farm, with a total of 26 individuals recorded. The peak number of sightings was four grey seals in October 2022. Across the two-year survey period, the average relative density was 0.01 individuals/km^2 (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.2.2.11 Grey seals were observed during the Green Volt Offshore Wind Farm site-specific surveys. A total of five grey seals were recorded: three in year one during the August 2020, December 2020, and March 2021 surveys, and two in year two during the October 2021 and March 2022 surveys. However, due to the low number of sightings, density estimates were not created (Royal HaskoningDHV, 2023).

Moray East

5.2.2.12 Grey seals were recorded throughout the Moray East Offshore Wind Farm site-specific surveys. A total of 305 seals were recorded, of which 178 were identified as grey seals. Peaks in sightings occurred in Spring (April) and late Summer (August and September). The average density reported across all surveys was 0.05 individuals/km^2 (95% CI: 0.03 to 0.07) within the site (Moray Offshore Renewables Ltd, 2012).

Moray West

5.2.2.13 There were no grey seals identified during the Moray West Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.2.2.14 Grey seals were identified during the Muir Mhòr Offshore Wind Farm site-specific surveys, being the second most frequently sighted marine mammal. A total of 46 grey seals were recorded, 33 in year one and 13 in year two. The maximum apportioned density estimate of grey seals across the 24 surveys was 0.05 individuals/km^2 (Stevens and Sinclair, 2023).

Salamander

5.2.2.15 There were no grey seals identified during the Salamander Offshore Wind Farm site-specific surveys, hence there are no density estimates available. However, there was a total of three sightings of unidentified seals over the site-specific surveys (Klementisová *et al.,* 2023).

August haul-out count

5.2.2.16 The latest haul-out counts for grey seal within the East Scotland SMA are from 2021 and 2023, recording 1,584 individuals. As for the North Coast and Orkney SMA, the most recent haul-out counts are from 2016 to 2019 recording 8,599 individuals (SCOS, 2024).

5.2.2.17 North Coast and Orkney SMA has seen an increase in the grey seal population when compared to 1992, of 57.4% (95% CI: 23.3 to 101.5; SCOS 2024); however, over the last six years the population has remained stable (SCOS, 2024). It is noted that, despite a similarly positively long-term trend in the Faray and Holm of Faray SAC (which is located in the SMA), a decline and level of depletion has been observed the past six years; the last count in 2019 of 228 individuals reflected a decline of -38.2% (95% CI: -58.7 to -8.2; SCOS 2024) compared to the count six years prior (SCOS, 2024).

5.2.2.18 SCOS (2024) does not provide an indication of the short- or long-term trends for the grey seal count for the East Scotland SMA, or the SACs located therein.

Pup production count

5.2.2.19 There are five grey seal breeding colonies within the East Scotland SMA, all of which have been surveyed and some of which include long-term monitoring. These are Craigleith (west of Edinburgh), Fast Castle (Berwickshire) and the islands of Inchcolm, Inchkeith and May (all in the Firth of Forth; SCOS, 2024). Across the East Scotland SMA the most recent pup count was conducted between 2019 and 2023 recording a total of 7,413 grey seal pups (SCOS, 2024). Fast Castle has seen a drastic increase in the number of pups recorded in surveys; a total 236 pups were recorded in 1997 compared to the 2021 survey recording 4,483 pups, with of the latest annual increase of 5.4%. As for the SACs in the East Scotland SMA, the Berwickshire and North Northumberland Coast SAC recent 2021 grey seal pup

production count recorded 2,669 individuals, which is a 231% (95% CI:170.5 to 304.7) increase since 2012 (SCOS, 2024). In contrast, the Isle of May SAC recorded an estimated 2,005 pups in 2021, and while this represents a 26.7% increase since 1992 (95% CI: 10.8–44.9), since 2004 there has been a decline of 19.5% (95% CI: -29.1 to -8.7) in the number of pups recorded (SCOS, 2024).

5.2.2.20 There are a further 35 pupping sites within the North Coast and Orkney SMA. Across this SMA the most recent pup count was conducted between 2010 and 2022 recording a total of 21,161 grey seal pups, of which 20,526 were recorded around Orkney (SCOS, 2024). The overall pup production in this SMA has been stable, with the latest annual trend of -0.1% change (95% CI: -2.1 to 1.9; SCOS, 2024). However, the change observed in the Faray & Holm of Faray SAC is notably more drastic, with the most recent 2022 count estimating 1,915 pups, which is a 46.3% (95% CI: -53.8 to -37.5) decline since 1992 (SCOS, 2024).

Seal at-sea distribution

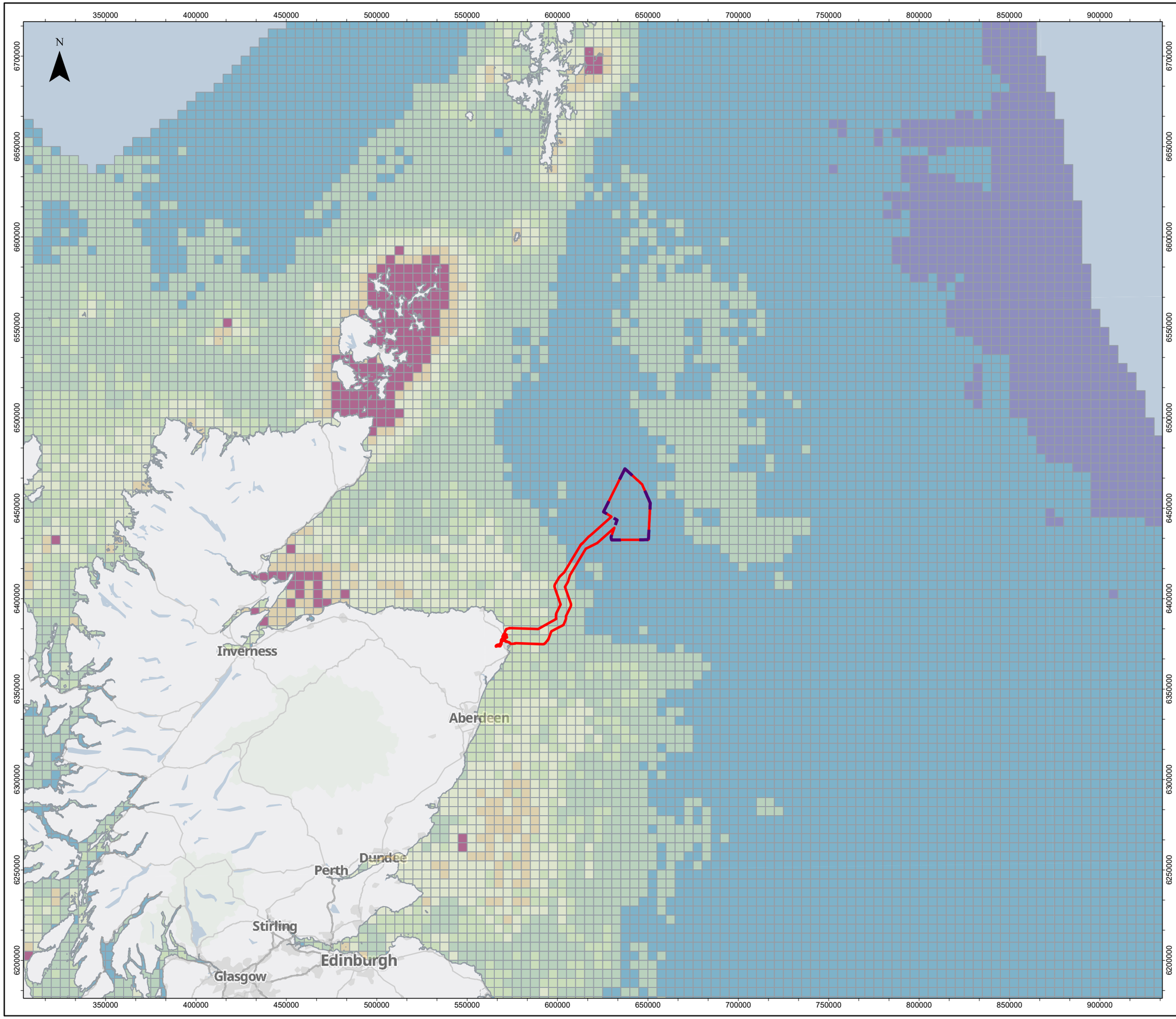
5.2.2.21 Grey seals are broadly distributed in the seas around Scotland, with higher densities of at-sea grey seals being predicted around Orkney and the Firth of Forth, relevant to the SMAs. There are however reduced density estimates in parts of the Hebrides and the Moray Firth (**Figure 10**). When using the Carter *et al.* (2022) data, the at-sea densities within the Project's Offshore Red Line Boundary are low. The expected grey seal density within the site-specific study area is an average of 0.075 individuals/km^2. The more recent Carter *et al.* (2025) also predicted very low at-sea grey seal densities within the Project's Offshore Red Line Boundary, specifically predicting grey seal density within the site-specific study area as 0.01 individuals/km^2.

Grey seal summary

5.2.2.22 The Project is located in the East Scotland SMA, though there is also connectivity to the North Coast and Orkney SMA. The predicted at-sea densities of grey seals in the vicinity of the Project are low (as shown by Carter *et al.* 2025, for example). For the quantitative impact assessment, the East Scotland SMA population (6,298 grey seals) and the North Coast and Orkney SMA population (34,266 grey seals), are the relevant populations which impacts are assessed against. Further, where impact contours extend into the Moray Firth SMA (5,384 grey seals), this population was also utilised in the impact assessment. To quantify the number of grey seals potentially impacted by the Project, the Carter *et al.* (2025) modelled distribution in the habitat preference maps was used, as well as the site-specific DAS density (0.0021 individuals/km^2; **Table 5.12**).

Table 5.12 Summary of publicly available density estimates for grey seal within sites surrounding the Project

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Site-specific survey	April 2021 to March 2023.	OAA + 4km buffer.	0.0021	APEM (2024a).
Seal at-sea distribution	-	Grid-cell specific.	0.01	Carter *et al.* (2025).
Seal at-sea distribution	-	Grid-cell specific.	0.075	Carter *et al.* (2022).
Caledonia	May 2021 to April 2023.	Caledonia site + 4km buffer.	0.01	Caledonia Offshore Wind Farm Ltd, 2024.
Green Volt	May 2020 to April 2022.	Green Volt site + 4km buffer.	0	Royal HaskoningDHV (2023).
Moray East	April 2010 to March 2012.	Moray East site + wider Moray Firth.	0.05	Moray Offshore Renewables Ltd, 2012.
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0.05	Stevens and Sinclair, 2023.
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0	Stevens and Sinclair (2023).
Salamander	March 2021 to February 2023.	Salamander site + 4km buffer.	0	Klementisová *et al.* (2023).



Red Line Boundary

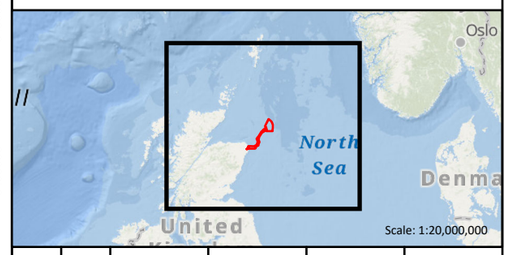
Option Agreement Area

Relative Population Density of Grey Seal

% At-sea Population Per Cell

- 0
- 0 - 0.001
- 0.001 - 0.005
- 0.005 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- >0.05

0 25 50 Kilometres



REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER
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2	16/10/2025	EH	LT	MR	NC
1	29/08/2025	EH	LT	MR	NC

WSP DRAWING NUMBER	808368-WEIS-IA-E5-FG-M8-94568
MarramWind DRAWING NUMBER	MAR-GEN-ENV-MAP-WSP-000390

DATUM	ETRS 89	PROJECTION	UTM Zone 30N
SCALE	1:2,000,000	PAGE SIZE	A3

PROJECT TITLE

MarramWind Offshore Wind Farm

DRAWING TITLE

Figure 10 Grey Seal at-sea density habitat preference map (Carter *et al.*, 2025)

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5.2.3 Harbour seal

Overview

5.2.3.1 Harbour seals are present year-round in Scottish waters, including the east coast. They are less abundant than grey seals in this region (Hague *et al.,* 2020). They are listed as Least Concern on the IUCN Red List (Lowry, 2016), but their UK conservation status is assessed as Unfavourable-Inadequate (JNCC, 2019j).

5.2.3.2 Harbour seals haul out to give birth in June and July, and moult in August, but they also haul out regularly throughout the rest of year to rest. While some individuals forage up to 273km from haul-out sites, most remain within 50km, favouring shallow waters (<50m) and showing strong site fidelity (Bailey *et al.,* 2014; Carter *et al.,* 2022). Foraging behaviour varies between individuals and may be regionally specialised (Sharples *et al.*, 2012). Harbour seals have a generalist diet, feeding on a wide range of prey including gadids (such as poor cod, pouting), sandeel, pelagic fish, flatfish, and cephalopods. The prey species of particularly importance for harbour seals on Scotland's east coast are sandeel and flatfish (Hammond and Wilson, 2016).

5.2.3.3 Recent counts (2021 and 2023) recorded 276 harbour seals at haul-out sites in the East Scotland SMA, lower than the count in 2016 to 2019 of 343 individuals (SCOS, 2024). The region includes one SAC for harbour seals: the Firth of Tay and Eden Estuary SAC. The most recent count (2016 to 2019) from the North Coast and Orkney SMA recorded 1,405 harbour seals, which is lower than the previous count in 2011 to 2015 of 1,938 harbour seals. This region also includes one SAC: the Sanday SAC. There is also one designated seal haul-out within 50km of the Project's Offshore Red Line Boundary, namely the Ythan Estuary, which is located in the East Scotland SMA. Whilst this site is designated for grey seals, harbour seals are also known to use the site.

Site-specific survey

5.2.3.4 No harbour seals were observed during the two years of site-specific surveys.

Management unit

5.2.3.5 The Project is located in the East Scotland SMA, though there is also connectivity to the North Coast and Orkney SMA. The latest population estimate of harbour seals in the East Scotland SMA is 383 individuals (95% CI: 314 to 522), with the latest trend in the population estimate comprising a decline of -4.93% (compared to the year leading up to the latest count; 95% CI:-7.09 to -2.62; SCOS 2023). For the North Coast and Orkney SMA, the latest harbour seal population estimate is 1,951 individuals, with the latest trend in the population estimate comprising a decline of -8.63% (95% CI: -9.98 to -7.28; SCOS, 2023).

5.2.3.6 Telemetry data of harbour seals has shown connectivity of the Moray Firth SMA with the East Scotland and North Coast and Orkney SMAs (Carter *et al.,* 2025). The Moray Firth SMA's latest population estimate is 1,365 individuals (SCOS, 2024).

Other offshore windfarms

Caledonia

5.2.3.7 There were no harbour seals identified during the Caledonia Offshore Wind Farm site-specific surveys, therefore no density estimates were calculated. However, there was a total

of 13 sightings of unidentified seals over the site-specific survey period (Caledonia Offshore Wind Farm Ltd, 2024).

Green Volt

5.2.3.8 There were no harbour seals identified during the Green Volt Offshore Wind Farm site-specific surveys, hence there are no density estimates available. However, there was a total of nine sightings of unidentified seals over the site-specific survey period (Royal HaskoningDHV, 2023).

Moray East

5.2.3.9 During the Moray East Offshore Wind Farm site-specific surveys there was a total of 305 seals recorded, of which six were identified as harbour seals, with the peak in sightings occurred in Spring and Summer. There were however, not enough sightings to provide density estimates (Moray Offshore Renewables Ltd, 2012).

Moray West

5.2.3.10 There were no harbour seals identified during the Moray West Offshore Wind Farm site-specific surveys; therefore, no density estimates were calculated (Moray Offshore Windfarm (West) Limited, 2018).

Muir Mhòr

5.2.3.11 Harbour seals were identified during the Muir Mhòr Offshore Wind Farm site-specific surveys. A total of four harbour seals were recorded, three in year one and one in year two. The maximum apportioned density estimate of harbour seals across the 24 surveys was 0.02 individuals/km^2 (Stevens and Sinclair, 2023).

Salamander

5.2.3.12 There were no harbour seals identified during the Salamander Offshore Wind Farm site-specific surveys, hence there are no density estimates available. However, there was a total of three sightings of unidentified seals over the site-specific survey period (Klementisová *et al.,* 2023).

August haul-out count

5.2.3.13 The latest haul-out counts for harbour seal within the East Scotland SMA are from 2021 and 2023 recording 276 individuals, resulting in a latest population estimate of 383 harbour seals. For the North Coast and Orkney SMA, the most recent haul-out counts are from 2016 to 2019 recording 1,405 individuals, resulting in a latest population estimate of 1,951 harbour seals (SCOS, 2024).

5.2.3.14 The population of harbour seals within the East Scotland SMA has varied significantly over time; however, the trend has shown decline in the count of harbour seals, of -70.3% (95% CI: -82.9 to -48.2) since 1997 (SCOS, 2024). The population used to be concentrated in the Firth of Tay and Eden Estuary area, leading to the designation of the SAC in 2005 when approximately 600 adult harbour seals would use the haul-out site to rest, pup and moult. However, the Firth of Tay and Eden Estuary SAC August haul-out counts have declined by 93.5% (95% CI: -95.4 to -90.9) since 1997, and the latest count was 55 animals in August 2023 (SCOS, 2024). In recent years, the majority of the East Scotland SMA now haul-out within the Firth of Forth area.

5.2.3.15 North Coast and Orkney SMA has also seen a decline in the count of harbour seals, of -85.5% (95% CI: -87.6 to -82.9) since 2002 (SCOS, 2024). Further, the rate of decline and level of depletion are more severe in the Sanday SAC than the SMA. At the time of the latest count in 2019, the SAC represented ~5% of the SMA total compared to around 19% in 1993 (SCOS, 2023). The August count in the SAC, of 77 individuals, comprises a decline of -96% (95% CI: -97.6 to -93.5) since 2002 (SCOS, 2024).

Seal at-sea distribution

5.2.3.16 The highest at-sea densities of harbour seals in Scotland are mainly around the West of Scotland where the majority of the Scottish population are found. On the east coast of Scotland, higher density areas include the Moray Firth, the Firth of Forth and the Orkney Islands (**Figure 11**). Across the SMAs, harbour seal at-sea distribution is highly coastal typically remaining within 30km of the shore (Jones *et al.,* 2017). When using Carter *et al.* (2022), the at-sea densities within the Project are very low. The expected harbour seal density within the site-specific study area is 0.0000011 individuals/km^2. Further, Carter *et al.* (2025) estimated that there would be no harbour seals within the Project's Offshore Red Line Boundary.

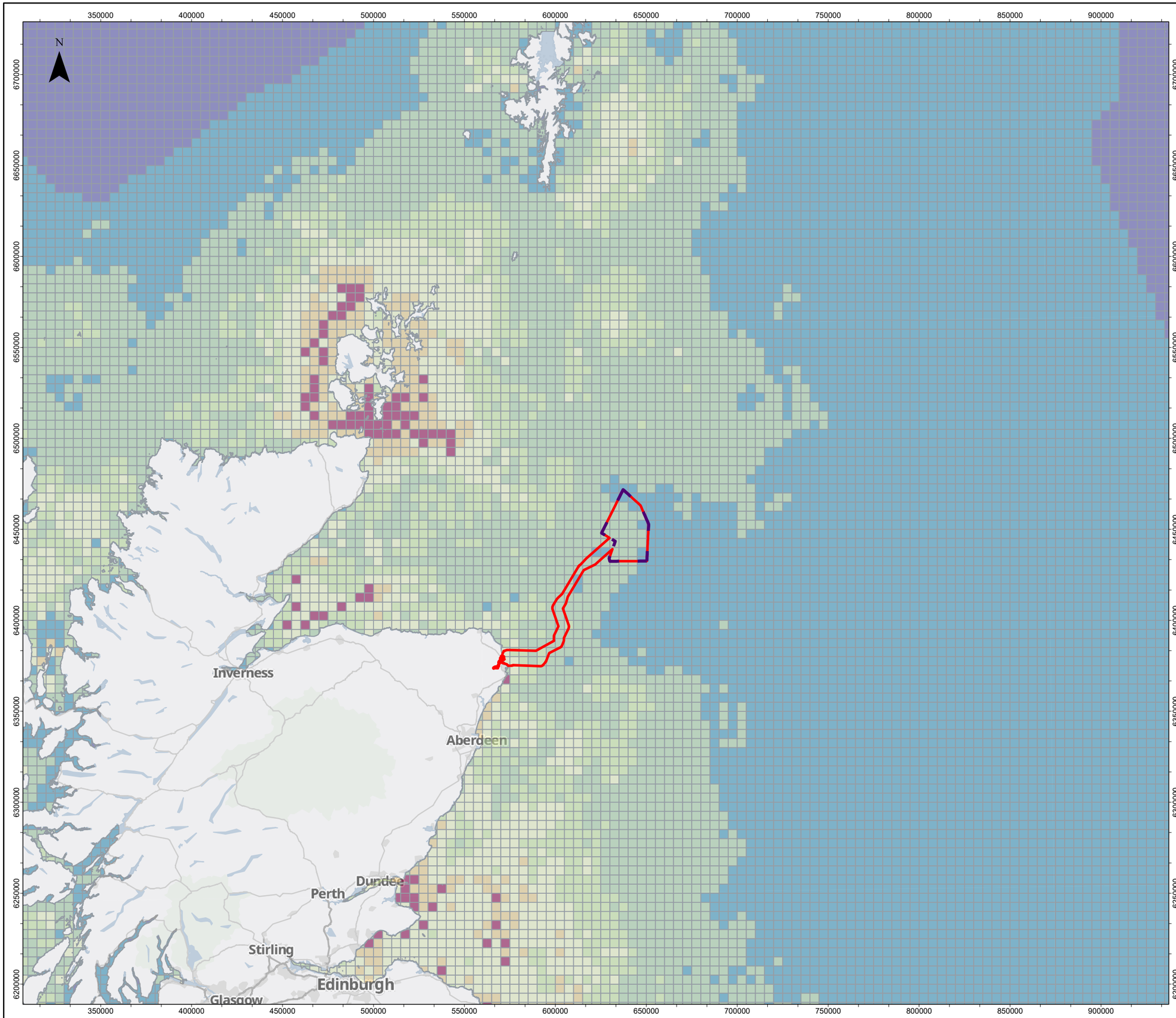
Harbour seal summary

5.2.3.17 The Project is located in the East Scotland SMA, though there is also connectivity to the North Coast and Orkney SMA. The predict at-sea densities of harbour seals in the vicinity of the Project are very low (for example, 0.0000011 individuals/km^2; Carter *et al.* 2022). For the quantitative impact assessment, the East Scotland SMA population (383 harbour seals) and the North Coast and Orkney SMA population (1,951 harbour seals), are the relevant populations that impacts are assessed against. Further, where impact contours extend into the Moray Firth SMA (1,365 harbour seals), this population was utilised in the impact assessment. To quantify the number of harbour seals potentially impacted by the Project, the Carter *et al.* (2022) modelled distribution in the habitat preference maps was used (**Table 5.13**).

Table 5.13 Summary of publicly available density estimates for harbour seal within sites surrounding the Project

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Site-specific survey	April 2021 to March 2023.	OAA + 4km buffer.	0	APEM (2024a).
Seal at-sea distribution	-	Grid-cell specific.	0	Carter *et al.* (2025).
Seal at-sea distribution	-	Grid-cell specific.	0.0000011	Carter *et al.* (2022).
Caledonia	May 2021 to April 2023.	Caledonia site + 4km buffer.	0	Caledonia Offshore Wind Farm Ltd (2024).
Green Volt	May 2020 to April 2022.	Green Volt site + 4km buffer.	0	Royal HaskoningDHV (2023).

Source	Survey dates	Detail	Density estimate (individuals/km^2)	Reference
Moray East	April 2010 to March 2012.	Moray East site + 4km buffer.	0.02	Moray Offshore Renewables Ltd, 2012.
Moray West	April 2016 to March 2017.	Moray West site + 4km buffer.	0	Moray Offshore Windfarm (West) Limited (2018).
Muir Mhòr	April 2021 to March 2023.	Muir Mhòr site + 4km buffer.	0	Stevens and Sinclair (2023).
Salamander	March 2021 to February 2023.	Salamander site + 4km buffer.	0	Klementisová *et al.* (2023).



Red Line Boundary

Option Agreement Area

Relative Population Density of Harbour Seal

% At-sea Population Per Cell

- 0
- 0 - 0.001
- 0.001 - 0.005
- 0.005 - 0.01
- 0.01 - 0.025
- 0.025 - 0.05
- >0.05

0 50 100 Kilometres

REV	REV DATE	GIS CREATOR	GIS REVIEWER	TECHNICAL CHECKER	TECHNICAL APPROVER
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2	16/10/2025	EH	LT	MR	NC
1	29/08/2025	EH	LT	MR	NC

WSP DRAWING NUMBER	808368-WEIS-IA-E5-FG-M8-11931		
MarramWind DRAWING NUMBER	MAR-GEN-ENV-MAP-WSP-000392		
DATUM	ETRS 89	PROJECTION	UTM Zone 30N
SCALE	1:2,000,000	PAGE SIZE	A3

PROJECT TITLE

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Figure 11 Harbour Seal at-sea density habitat preference map (Carter *et al.*, 2022)

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Summary

5.2.3.18 The site-specific surveys combined with a review of other available data sources indicate that ten marine mammal species may be present within the area of the Project; therefore, these species are taken forward to the impact assessment. This includes the species which have only been sighted sporadically and / or in low densities. Whilst there are no density estimates available for humpback whale, they could be present and so were assessed qualitatively within the impact assessment. **Table 5.14** outlines each species reviewed within this Technical Report, alongside the most relevant density estimates available for each species.

Table 5.14 Species, management unit size and density estimate recommended for use in the quantitative impact assessment for the Project

Species	MU	MU refence population	UK MU reference population	Density (individuals/km^2)	Reference
Harbour porpoise	NS	346,601	159,632	0.752	Derived from SCANS-IV density surfaces (Gilles *et al.,* 2025).
				0.5985	SCANS-IV survey block NS-D (Gilles *et al.,* 2023).
				0.087	Site-specific DAS.
Bottlenose dolphin	CES	226		0.116 (within 2km of the coast).	Calculated from Cheney *et al.* (2024).
				0.0298 (beyond 2km of the coast).	SCANS-III survey block R (Hammond *et al.,* 2021).
	GNS	2,022	1,885	0.001	Derived from SCANS-IV density surfaces (Gilles *et al.,* 2025).
				0.0298	SCANS-III survey block R (Hammond *et al.,* 2021).
Short-beaked common dolphin	CGNS	102,656	57,417	0.017	Derived from SCANS-IV density surfaces (Gilles *et al.,* 2025).
White-beaked dolphin		43,951	34,025	0.416	Derived from SCANS-IV density surfaces (Gilles *et al.,* 2025).
				0.1775	SCANS-IV survey block NS-E (Gilles *et al.,* 2023).
				0.023	Site-specific DAS.
Risso's dolphin		12,262	8,687	0.0702	SCANS-IV survey block NS-E (Gilles *et al.,* 2023).

Species	MU	MU refence population	UK MU reference population	Density (individuals/km^2)	Reference
				0.002	Site-specific DAS.
Minke whale		20,118	10,288	0.05	Derived from SCANS-IV density surfaces (Gilles *et al.,* 2025).
				0.0419	SCANS-IV survey block NS-D (Gilles *et al.,* 2023).
Atlantic white-sided dolphin		18,128	12,293	0.0146	SCANS-IV survey block NS-E (Gilles *et al.,* 2023).
Humpback whale	Qualitative assessment				
Grey seal	East Scotland SMA.	6,298		0.01 (grid-cell specific).	Carter *et al.* (2025).
	North Coast and Orkney SMA.	34,266		0.0021	Site-specific DAS.
	Moray Firth SMA.	5,384			
Harbour seal	East Scotland SMA.	383		0.0000011 (Grid-cell specific).	Carter *et al.* (2022).
	North Coast and Orkney SMA.	1,951			
	Moray Firth SMA.	1,365			

6. Other Data Sources Examined

6.1.1.1 This Section lists other data sources that were examined. These data sources were identified as not being suitable to take forward to detailed examination and are not suitable to inform the quantitative impact assessment in the EIA Report.

6.2 JCP Phase III analysis

6.2.1.1 The JCP Phase III integrated data from 38 sources, including the SCANS-I and SCANS-II surveys, collected between 1994 and 2010. This extensive dataset spans over 1.05 million kilometres of survey effort (Paxton *et al.*, 2016). The primary objective was to evaluate spatial and temporal trends in the abundance of seven cetacean species: bottlenose dolphin, common dolphin, harbour porpoise, minke whale, Risso's dolphin, white-beaked dolphin, and Atlantic white-sided dolphin.

6.2.1.2 The analysis produced seasonal abundance estimates to support marine spatial planning and inform offshore industry assessments. Using density surface modelling, species densities were predicted on a 25km² grid for a representative day in each season of every survey year. To capture seasonal variability, the data were categorised into four periods: Winter (January to March), Spring (April to June), Summer (July to September), and Autumn (October to December).

6.2.1.3 Due to the age of the JCP Phase III dataset and changes in cetacean population dynamics over time, the data are now considered outdated and less reliable. Furthermore, given the availability of more recent and reliable data from the latest SCANS surveys (as highlighted by the authors of Paxton *et al.* (2016): "*Surveys specifically designed for large-scale abundance estimation, such as SCANS, should produce more reliable estimates of abundance over a wide area for a particular time than those given here, and should be used in preference where possible*," the JCP Phase III data was not be considered further in this baseline report.

6.2.2 JCP data analysis product

6.2.2.1 The JCP Phase III data analysis product (JNCC, 2016), released by the JNCC, provided a tool for extracting cetacean abundance estimates from Summer surveys conducted between 2007 and 2010. Originally developed by Charles Paxton and later adapted by JNCC, the tool allows users to generate abundance estimates for user-defined spatial areas. JNCC's modifications also incorporated scaling adjustments to align the estimates with results from the SCANS-III survey (undertaken in 2016).

6.2.2.2 While the tool offers some analytical value, it is constrained by several significant limitations. Most notably, the underlying data are between nine and 28 years old, making them outdated and unreflective of current cetacean distributions or abundance. The estimates are based solely on Summer data, which do not capture seasonal variability and are therefore not representative of density changes throughout the year. Additionally, the JCP dataset suffers from limited spatial and temporal coverage, and the authors themselves caution that the outputs should be interpreted as indicative trends rather than precise estimates. Confidence in the results is further reduced by inconsistencies in survey effort, temporal gaps, and variable data quality. The tool is also unsuitable for fine-scale or short-term assessments, particularly in areas smaller than 1,000km^2, due to methodological inconsistencies, such as uncorrected detection biases and assumptions made to standardise data across different survey techniques.

6.2.2.3 In conclusion, given the dataset's age, methodological constraints, and the availability of more current and reliable sources, the JCP Data Analysis Tool was not used in this baseline report.

6.2.3 Porpoise high density areas

6.2.3.1 Heinänen and Skov (2015) conducted a comprehensive analysis of harbour porpoise data spanning 18 years (1994 to 2011) from the JCP database, with the aim of identifying regions of consistently high porpoise density to support conservation planning, including the designation of SACs. To address variability in survey effort and seasonal distribution, the data were organized into three temporal blocks, 1994 to 1999, 2000 to 2005, and 2006 to 2011, and further divided into two seasonal categories: Summer (April to September) and Winter (October to March)

6.2.3.2 Limitations to these data include the age of the data and that "*due to the uneven survey effort over the modelled period, the uncertainty in modelled distributions vary to a large extent*", as noted by Heinänen and Skov (2015). The authors also note that the modelling uncertainties are higher during the Winter analysis (Heinänen and Skov, 2015). As a result, with the availability of more reliable and recent data available, this data source was not considered further in this Technical Report.

6.2.4 Spatially indexed adjusted densities

6.2.4.1 Following the enactment of the Marine (Scotland) Act 2010, the Marine Directorate launched the Scottish MPA project to establish a cohesive network of MPAs across Scottish waters. A key objective of this initiative was to identify ecologically significant areas that consistently support high concentrations of four priority marine megafauna species: Risso's dolphin, white-beaked dolphin, minke whale, and basking shark (Paxton *et al.*, 2014).

6.2.4.2 To inform the selection of candidate MPA sites, Paxton *et al.* (2014) compiled survey data collected between 1994 and 2012 to generate spatially explicit, seasonally averaged density maps. These modelled surfaces were designed to identify areas of persistent high density for the target species, providing a quantitative basis for conservation planning. The dataset included absolute seasonal density estimates, averaged across all seasons to reflect long-term habitat use patterns; however, the dataset is subject to notable limitations due to uneven spatial and temporal survey coverage. Several regions were poorly surveyed or not surveyed at all, and the timing and frequency of data collection varied significantly across seasons and years. Additionally, limited overlap in space and time among the contributing datasets undermines the consistency of the results. Availability bias corrections were based on sparse data, and for most species the resulting models were considered to have limited reliability.

6.2.4.3 Given these limitations, the outputs from this analysis are regarded as less robust than other available spatio-temporal models for the region. Consequently, this dataset was not used further in this Technical Report.

6.2.5 MERP distribution maps

6.2.5.1 The MERP was developed to produce high-resolution, monthly distribution maps of cetaceans and seabirds to support conservation planning at both regional and national levels. Drawing on approximately 2.68 million kilometres of standardised survey effort conducted between 1980 and 2019, the initiative compiled data from aerial and vessel-based surveys across the north-east Atlantic. Only datasets with consistent methodologies, clearly defined survey areas, and reliable effort metrics were included. The study by Waggitt

et al. (2019) encompassed a broad geographic range, from Norway to the Iberian Peninsula (north to south) and from Rockall to the Skagerrak (west to east).

6.2.5.2 Using advanced statistical modelling, Waggitt *et al.* (2019) generated monthly density estimates (individuals/km²) for 12 cetacean species at a spatial resolution of 10km². Species presence was modelled using a binomial framework, while density estimates were derived using a Poisson model. However, the analysis did not clarify whether more recent observations were given greater weight than older records, raising concerns about the maps' relevance to current distribution patterns. As a result, while the maps provide a useful indication of relative density across UK waters, they are not considered sufficiently robust for quantitative impact assessments. This limitation is particularly evident in species such as the harbour porpoise, whose distribution in the southern NS has shifted southward in recent years, as shown by newer SCANS survey data.

6.2.5.3 For these reasons, the MERP Distribution Maps are not considered further in this baseline report as there are other more recent and reliable data sources available.

6.3 Production of seabird and marine mammal distribution models for the east of Scotland

6.3.1.1 Paxton *et al.* (2022) presents findings from aerial surveys conducted by APEM for Marine Scotland across offshore waters east of Scotland between February 2020 and March 2021. The surveys aimed to model seabird and marine mammal distributions to estimate abundance and density in the region. Four cetacean species were the main focus: harbour porpoise, white-beaked dolphin, common dolphin and minke whale. While other species such as killer whale, Risso's dolphin and humpback whale were recorded, sightings were too infrequent for density modelling. Data were gathered using continuous digital still imagery with a 2cm GSD along ten transects, each covering a 960m swathe and totalling 16,882.47km^2, with the survey areas ranging from Crail to the east coast of Orkney. However, the image sea surface area covered was 194km^2, representing 1.5% coverage of the wider surface area. Surveys were restricted to sea states below Beaufort Scale 4.

6.3.1.2 Where density estimates were made, corrections for surface availability were applied, but associated uncertainties were not factored in. Further, recent studies have since refined some availability bias estimates. Due to data limitations, the robustness of the models were affected. For example, only 35 minke whale sightings led to the use of binomial presence-absence model rather than density model. A similar approach was taken for common dolphins, observed just 18 times between March and July. These modelling methods were not considered an ideal modelling approach (Paxton *et al.,* 2022).

6.3.1.3 Certain transects focused on offshore areas beyond 12nm and inadequately sampled habitats within the 50m isobath. Several of the species within the region have predominantly coastal distributions, and therefore, these species would not have been effectively sampled during these surveys. Additionally, imagery was captured at a higher altitude of 2,000ft to maximise area coverage, but this reduced image resolution, affecting species identification. Early surveys lacked species-level identification, with all small cetaceans recorded as porpoise / dolphin. Finally, due to COVID-19 restrictions there was patchy temporal coverage, with only eight surveys completed over 13 months. As marine mammals are highly mobile, these data offer a limited temporal snapshot; therefore, due to these limitations the density estimates from this study have been excluded from this baseline report, with access to more up to date and reliable data sources.

6.4 East Coast Marine Mammal Acoustic Study

6.4.1.1 The ECOMMAS project, a Scottish Government funded project, used click detectors (C-PODs; Chelonia Ltd, 2014), at 30 locations off the east coast of Scotland, to detect echolocation clicks produced by dolphin species and harbour porpoise. C-POD data are presented in detection-positive days and detection-positive hours. At 10 of these locations, a broadband acoustic recorder was also deployed, which could capture a wider spectrum of underwater sounds, including ambient noise, and dolphin and whale vocalisations.

6.4.1.2 In 2022, ScotMER decided to broaden the study scope of ECOMMAS to include additional monitoring locations on the western and northern coasts, where fewer data are currently available. Original mooring locations have continued to use the C-PODs; however, all new moorings have upgraded to the successor, the F-POD. In addition to collecting fine-scale temporal data on marine mammals, the SPAN moorings can also detect fish tagged through other monitoring projects, such as PrePared and SeaMonitor.

6.4.1.3 The acoustic data gathered by these programmes provide insights into the relative occurrence and behavioural activity of dolphins and porpoises in proximity to the monitoring locations. These data have been used in numerous outputs, including peer reviewed publications and EIAs for major infrastructure projects on the east coast of Scotland. These data will also contribute to the UK's reporting under the UK Marine Strategy. However, the approach used within these programmes does not allow for direct estimation of species absolute density. Analysis of these data are available up until 2016; however, the data has not since been analysed and need to be requested should any party wish to analyse these data. This can be time intensive with regards to analysis of the broadband data, and since C-PODs / F-PODs lack the capability to differentiate between dolphin species, this restricts the dataset's value for species-specific evaluations. Given these limitations, the ECOMMAS and SPAN datasets are not considered suitable for inclusion in this baseline assessment and was not used further in this Technical Report.

6.5 Existing offshore wind data

6.5.1 Aspen

6.5.1.1 The Aspen Offshore Wind Farm is located approximately 25km south of the Project. Site-specific DAS were conducted monthly by HiDef Aerial Surveying Limited between April 2023 and March 2025. However, at the time of writing, the only DAS information available for this site are from the Scoping Report, which is limited to April to September 2023 (GoBe, 2025). There were four marine mammal species identified during the surveys: harbour porpoise (n=93), white-beaked dolphin (n=4), minke whale (n=2) and grey seal (n=4). However, these are preliminary findings and no density estimates were provided, therefore they was not used within this Technical Report.

6.5.2 Ayre

6.5.2.1 The Ayre Offshore Wind Farm is an offshore wind development found east of Orkney, Scotland, and is located approximately 92km north-north-west of the Project. Site-specific DAS were conducted by APEM Ltd between March 2022 and February 2024, covering an area of 345km^2 (RPS, 2024).

6.5.2.2 At the time of writing this Technical Report, the first 21 months (March 2022 to November 2023) are publicly available within the Scoping report. The surveys identified eight marine mammal species: grey seal (n=721), harbour porpoise (n=522), white-beaked dolphin (n=203), Risso's dolphin (n=39), minke whale (n=7), common dolphin (n=6), killer whale

(n=3), and a humpback whale (n=1). However, these are preliminary findings and no density estimates are provided, therefore they was not used within this Technical Report.

6.5.3 Broadshore

6.5.3.1 The Broadshore Offshore Wind Farm, part of the Broadshore Hub, is a floating development in the outer Moray Firth located approximately 46km from the Project. Site-specific DAS were conducted by HiDef Aerial Surveying Limited between March 2022 and February 2024. The surveys consisted of 14, 2km spaced transects over the OAA plus a 4km buffer, totalling 367km^2 (Royal HaskoningDHV, 2024).

6.5.3.2 To date, the only information available for this site are from the Scoping Report (Royal HaskoningDHV, 2024). Three species of marine mammal were identified between the March 2022 and February 2023 surveys: harbour porpoise (n=51), white-beaked dolphin (n=27), and grey seal (n=1), as well as unidentified seal species (n=7). However, the data have yet to be processed and so are not available to include here.

6.5.4 Buchan

6.5.4.1 The Buchan Offshore Wind Farm is a floating development in the outer Moray Firth located approximately 24km north-west from the Project. Site-specific DAS were conducted between March 2022 and February 2024. The surveys covered the OAA and consisted of 26 south-west to north-east orientated transects spaced 2.5km apart, plus a 4km buffer (Natural Power, 2023).

6.5.4.2 There were two species of marine mammal identified during the first year of Buchan Offshore Wind Farm DAS; harbour porpoise and grey seal. However, the second year of DAS are not available publicly at the time of writing this Technical Report and therefore was not included.

6.5.5 Scaraben / Sinclair

6.5.5.1 The Scaraben and Sinclair Offshore Wind Farms are both part of the Broadshore Hub and are floating developments in the outer Moray Firth located approximately 43km from the Project. The site-specific DAS were conducted by HiDef Aerial Surveying Limited between March 2022 and February 2024. The surveys consisted of 14, 2km spaced transects which covered both development sites as well as a 4km buffer, totalling 396km^2 (Royal HaskoningDHV, 2024).

6.5.5.2 To date, the only information available for this site are from the Scoping Report (Royal HaskoningDHV, 2024). Three species of marine mammal were identified between the March 2022 and February 2023 surveys: harbour porpoise (n=42), white-beaked dolphin (n=17), and grey seal (n=2), as well as unidentified seal species (n=2), dolphin species (n=1) and seal / small cetacean species (n=1). However, the data have yet to be processed and so are not available to include in this Technical Report.

6.5.6 Stromar

6.5.6.1 The Stromar Offshore Wind Farm is located approximately 50km eastwards from Wick in the outer Moray Firth, situated approximately 73km from the Project site. HiDef Aerial Surveying Limited carried out dedicated DAS between March 2022 and March 2024 (GoBe, 2024). During the first 12 months (March 2022 to February 2023) of DAS, six marine mammal species were recorded: harbour porpoise (n=73), white-beaked dolphin (n=19), common dolphin (n=1), Risso's dolphin (n=2), harbour seal (n=10) and grey seal (n=1).

However, at the time of writing this Technical Report, the only information available for this site are from the offshore Scoping Report (GoBe, 2024), with only half of the DAS completed and no density estimates available. Therefore, this data source was not considered further in this Technical Report.

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8. Glossary of Terms and Abbreviations

8.1 Abbreviations

Acronym	Definition
CES	Coastal East Scotland
CGNS	Celtic and Greater North Seas
CI	Confidence Interval
C-POD	Continuous Porpoise monitoring Detector
CS	Celtic Sea
cm	centimetres
CV	Coefficient of Variation
DAS	Digital Aerial Surveys
ECOMMAS	East Coast Scotland Marine Mammal Acoustic Survey
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
F-POD	Full Waveform Capture POD
GNS	Greater North Sea
GSD	Ground Sampling Distance
IAMMWG	Inter-Agency Marine Mammal Working Group
IUCN	International Union for Conservation of Nature
JCP	Joint Cetacean Protocol
JNCC	Joint Nature Conservation Committee
km^2	kilometre squared
km	Kilometre
Ltd	Limited
m	metre
MERP	Marine Ecosystems Research Programme
MPA	Marine Protected Area
MU	Management Unit

Acronym	Definition
NERC	Natural Environment Research Council
NS	North Sea
nm	nautical mile
OAA	Option Agreement Area
PAM	Passive Acoustic Monitoring
Photo-ID	Photo-identification
PrePARED	Predators and Prey Around Renewable Energy Developments
QA	Quality Assurance
SAC	Special Area of Conservation
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCOS	Special Committee on Seals
SMA	Seal Management Area
SMRU	Sea Mammal Research Unit
SPAN	Scottish Passive Acoustic Network
UK	United Kingdom
%	percent
°C	degrees Celsius

8.2 Glossary of terms

Term	Definition
Baleen whales	Marine mammals of the Mysteceti parvorder, characterised by keratin-based baleen places for filter-feeding, as opposed to true teeth.
Beaufort Scale	An empirical (for instance, based on observation or experience) measure for wind intensity and speed based on how such conditions affect observed sea conditions or ‘sea states’. The scale measures from 1 (calm) to 12 (hurricane).
Cetacean	Marine mammals of the order Cetacea. Includes whales, dolphins and porpoise species.
Cephalopod	Predatory, free-swimming molluscs includes squid, octopus and cuttlefish
Digital Aerial Surveys	Digital photography surveys carried out by aeroplane.

Term	Definition
Ecotype	Organisms that belong to the same species but that can be geographically and genetically differentiated from others of the same species by phenotypical features that have varied as a result of environmental conditions.
Euphausiid	Zooplankton that are typically shrimp-like crustacea including krill.
Haul-out	Used in reference to pinniped behaviour of exiting the water to spend time on land. Also used to refer to the terrestrial and intertidal location of this behaviour (i.e haul-out site).
Isobath	A line on a map or chart connecting points of equal depth below the surface of a water body.
Mark-recapture analysis	A survey technique involving the capture and tagging or marking of animals, without causing them injury, and releasing them back into their natural environment such that they can be identified if later recaptured.
Passive Acoustic Monitoring	A survey technique using acoustic recording devices to identify and analyse sounds in the marine environment.
Pinniped	Carnivorous, aquatic mammals of the order Pinnipedia, including seals and walruses.
Pteropod	Small, free-swimming marine gastropod molluscs.

MarramWind