Arklow Bank Wind Park 2

Environmental Impact Assessment Report

Volume III, Appendix 12.1: Offshore Ornithology Technical Report - Overview

SSE Renewables

MacArthur Green

Arkload Bank Wind Park 2

Technical Appendix 12.01 Offshore Ornithology

Overview

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Glossary

Term	Meaning
Arklow Bank Wind Park 1 (ABWP1)	Arklow Bank Wind Park 1 consists of seven wind turbines, offshore export cable and inter-array cables. Arklow Bank Wind Park 1 has a capacity of 25.2 MW. Arklow Bank Wind Park 1 was constructed in 2003/04 and is owned and operated by Arklow Energy Limited. It remains the first and only operational offshore windfarm in Ireland.
Arklow Bank Wind Park 2 – Offshore Infrastructure	"The Proposed Development", Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements under the existing Maritime Area Consent.
Arklow Bank Wind Park 2 (ABWP2) (The Proposed Development)	Arklow Bank Wind Park 2 (ABWP2) (The Proposed Development) is the onshore and offshore infrastructure. This EIAR is being prepared for the Offshore Infrastructure. Consents for the Onshore Grid Infrastructure (Planning Reference 310090) and Operational and Maintenance Facility (Planning Reference 211316) has been granted on 26th May 2022 and 20th July 2022, respectively. • Arklow Bank Wind Park 2 Offshore Infrastructure: This includes all elements to be consented in accordance with the Maritime Area Consent. This is the subject of this EIAR and will be referred to as 'the Proposed Development' in the EIAR. • Arklow Bank Wind Park 2 Onshore Grid Infrastructure: This relates to the onshore grid infrastructure for which planning permission has been granted. • Arklow Bank Wind Park 2 Operational and Maintenance Facility (OMF): This includes the onshore and nearshore infrastructure at the OMF, for which planning permission has been granted. • Arklow Bank Wind Park 2 EirGrid Upgrade Works: any non-contestable grid upgrade works, consent to be sought and works to be completed by EirGrid.
Array Area	The Array Area is the area within which the Wind Turbine Generators (WTGs), the Offshore Substation Platforms (OSPs), and associated cables (export, inter- array and interconnector cabling) and foundations will be installed.
Cable Corridor and Working Area	The Cable Corridor and Working Area is the area within which export, inter-array and interconnector cabling will be installed. This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area.
EirGrid	State-owned electric power transmission system operator (TSO) in Ireland and Transmission Asset Owner (TAO) for the Project's transmission assets.

Term	Meaning
Foundation	The load carrying support structure for the wind turbine generator tower or offshore substation platform topside. The foundation is the part of the structure from the interfacing flange with the turbine tower or topside-foundation interface, down to below seabed. This includes any secondary steel items associated with the structure. For the purposes of the EIAR the term 'foundation' includes the structure from the WTG tower or topside interface down to the lower end of the monopile commonly known as the 'substructure' and encompasses monopiles and transition pieces.
Intertidal area	The area between the high water mark (HWM) and the low water mark (LWM).
Landfall	The area in which the offshore export cables make landfall and is the transitional area between the offshore cabling and the onshore cabling.
Maritime Area Consent (MAC)	A consent to occupy a specific part of the maritime area on a non-exclusive basis for the purpose of carrying out a Permitted Maritime Usage strictly in accordance with the conditions attached to the MAC granted on 22nd December 2022 with reference number 2022-MAC-002.
Permitted maritime Usage	The construction and operation of an offshore windfarm and associated infrastructure (including decommissioning and other works required on foot of any permission for such offshore windfarm).
Standard Error	A statistical term that measures the accuracy with which a sample distribution represents a population by using standard deviation. In statistics, a sample mean deviates from the actual mean of a population – this deviation is the Standard Error of the mean.
Transition Piece (TP)	Structural interface between monopile foundation and WTG tower that contains ancillary infrastructure such as boat landings, working platform and j tubes.

Acronyms

Term	Meaning
BBRC	British Birds Rarities Committee
BDMPS	Biologically Defined Minimum Population Scales
BTO	British Trust for Ornithology
CRM	Collision Risk Model/Modelling
EIAR	Environmental Impact Assessment Report
GIS	Geographical Information System
GPS	Global Positioning System
GSD	Ground Sample Distance
JNCC	Joint Natural Conservation Committee
NIS	Nature Impact Statement
PCH	Proportion of birds at collision height
PVA	Population Viability Analysis
QA	Quality Assurance
SE	Standard Error
SNCB	Statutory Nature Conservation Bodies
SPA	Special Protected Area
StUK	Standard for Environmental Impact Assessments
UTM	Universal Transverse Mercator
WGS84	World Geodetic System 84

Units

Unit	Description
birds/km^2	Birds per square kilometre (density)
cm	Centimetre (distance)
°	Degrees
m	Metre (distance)
km^2	Kilometres squared

1 OFFSHORE ORNITHOLOGY TECHNICAL REPORT: OVERVIEW

1.1 Introduction

1. This Technical Report provides full details of the baseline information from the site-specific surveys which have been used to support the offshore ornithology Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS) for the Arklow Bank Wind Park 2 (ABWP2) Offshore Infrastructure (hereafter referred to as 'the Proposed Development').

2. The Proposed Development is comprised of the Array Area (i.e. the area within which the Wind Turbine Generators (WTGs), the Offshore Substation Platforms (OSPs), and associated cables (export, inter- array and interconnector cabling) and foundations will be installed)) and the Cable Corridor and Working Area (the area within which export, inter-array and interconnector cabling will be installed. This area will also facilitate vessel jacking operations associated with installation of WTG structures and associated foundations within the Array Area). Situated on and around Arklow Bank itself, the Array Area is located approximately 6 to 15 km from the shore and covers an area of 63.4 km^2. The Array Area and offshore export cable routes are shown in Figure 12.1.1.

3. The offshore ornithological assessment is informed using baseline site characterisation data collected by digital aerial survey methods, conducted by HiDef Aerial Surveying Limited ('HiDef'). Further details of the survey methods, analysis of the data collected, and the results obtained are provided in relevant sections of this Technical Report. The intertidal ornithological surveys were undertaken by DixonBrosnan and the survey report is presented in Volume III, Appendix 13.11: Arklow Bank Wind Park 2 Onshore Cable Route and Landfall – Baseline Bird Survey.

4. Sections on digital aerial survey methodology (section 1.3) and image analysis (section 1.4.1) were supplied by the aerial survey contractor (HiDef).

5. The Offshore Ornithology Technical Report is comprised of 11 reports. In addition to this overview report, the following appendices contain additional data and analyses used in the assessment:

- **Volume III, Appendix 12.2: Offshore Ornithology Technical Report – Monthly Seabird Density** provides tables of the mean and 95% confidence intervals for seabird density calculated in each calendar month for each species and five high-level species groups recorded (see section 1.4.3). For each species/species group, the density values are presented for all individuals observed (i.e. in flight and on the sea) and also for birds in flight only and on the sea only. For guillemot and razorbill these tables include adjustment for availability bias (birds on the sea multiplied by species-specific correction factors);
- **Volume III, Appendix 12.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance** provides tables of the mean and 95% confidence intervals for seabird abundance calculated from the density in each calendar month for each species and five high-level species groups recorded (see section 1.4.3). For each species/species group, the abundance values are presented for all individuals observed (i.e. in flight and on the sea) and also for birds in flight only and on the sea only. Guillemot and razorbill densities and abundance were also adjusted to account for the proportion of individuals expected to be underwater (see section 1.4.4);

- **Volume III, Appendix 12.4: Offshore Ornithology Technical Report – Collision Risk Model Input Parameters** provides tables of the input parameters used for the Collision Risk Modelling (CRM);
- **Volume III, Appendix 12.5: Offshore Ornithology Technical Report – Seabird Collision Modelling Results** provides the monthly collision mortality predictions (including upper and lower estimates). Collision estimates are those calculated for all three turbine models in the Project Design Envelope;
- **Volume III, Appendix 12.6: Offshore Ornithology Technical Report – Seabird Species Abundance Plots** provides line graphs of seabird population abundance within the Array Area and also within the Array Area and 4 km buffer, both with 95% confidence intervals. These are for all birds observed within the Array Area and 4 km buffer (i.e. both in flight and on the water);
- **Volume III, Appendix 12.7: Offshore Ornithology Technical Report – Migrant Non-Seabird Collision Risk Modelling** provides a collision risk assessment for migrant non-seabird species which are considered to have the potential to cross the Array Area on migration;
- **Volume III, Appendix 12.8: Offshore Ornithology Technical Report – Seabird Spatial Distribution Maps** provides spatial distribution maps illustrating where all birds were recorded within the aerial Survey Area (including Array Area, the Array Area and 2 km buffer, the Array Area and 4 km buffer and wider area);
- **Volume III, Appendix 12.9: Offshore Ornithology Technical Report – Review of Seabird Monitoring Data: 2000 to 2010** provides a review of the seabird monitoring which was conducted for the existing Arklow Bank Wind Park 1 (ABWP1) development;
- **Volume III, Appendix 12.10: Offshore Ornithology Technical Report – Kittiwake Population Viability Analysis** provides a population viability analysis (PVA) for the Wicklow Head Special Protected Area (SPA) kittiwake population; and
- **Volume III, Appendix 12.11: Offshore Ornithology Technical Report - Onshore Cable Route and Landfall – Baseline Bird Survey** provides the results of the intertidal ornithology surveys.

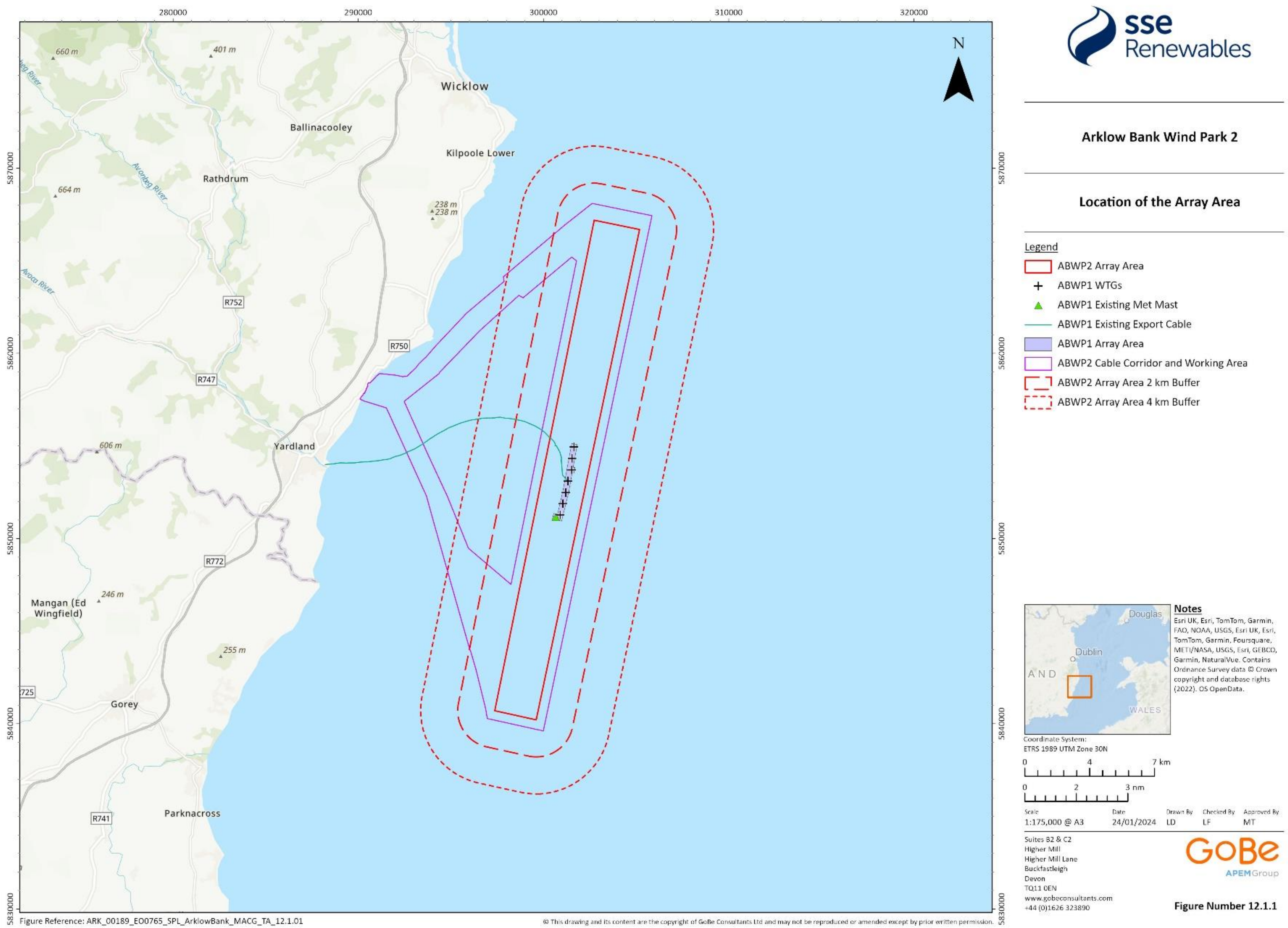

Figure 12.1.1: Location of the Array Area and offshore export cable routes.

1.2 Data Sources

6. HiDef has undertaken digital aerial surveys for the Proposed Development over 25 months as detailed in Table 12.1.1.
7. Surveys began in March 2018 and were completed in April 2020. Two surveys were carried out in each calendar month in total, with the exception of July, for which three surveys were conducted (the additional July survey was conducted because it was not possible to undertake the April 2019 survey due to adverse weather conditions and as a result an extra survey was carried out in July 2019). The second April survey was carried out in 2020 to address the data gap for this month.
8. The analysis presented in this Technical Report used the complete dataset of 25 months.

Table 12.1.1: Months when aerial surveys (X) were conducted for the Proposed Development between March 2018 and April 2020.

Month	2018	2019	2020
Jan		X	X
Feb		X	X
Mar	X	X	
Apr	X		X
May	X	X	
Jun	X	X	
Jul	X	X[a]	
Aug	X	X	
Sep	X	X	
Oct	X	X	
Nov	X	X	
Dec	X	X	

a Two surveys were carried out in July 2019.

9. Dixon Brosnan undertook intertidal surveys at the proposed offshore export cable landfall site in the winter (monthly, November 2019 to March 2020 inclusive) and in the breeding season (July 2020). The surveys were conducted from vantage points on the coastline from which all bird activity was recorded.
10. Boat based surveys of ABWP1 were conducted between 2000 and 2010 and the results have been summarised in Volume III, Appendix 12.9: Offshore Ornithology – Review of Seabird Monitoring Data: 2000 to 2010. Due to the difficulty of integrating these results (collected using boat based methods across a different area than that used for the aerial surveys) into the assessment, the focus for impact assessment is the more recent aerial data. However, the review provides useful background to the seabirds present at the site.

1.3 Survey Methods

11. Digital aerial surveys were undertaken by HiDef using an aircraft equipped with four high-resolution HiDef Gen II digital video cameras with sensors set to a resolution of 2 cm Ground Sample Distance (GSD).

12. Surveys were undertaken using a series of strip transects (20) spaced 2 km apart across the Survey Area, which included a 4 km buffer around the Array Area and also extended to the north of the Array Area to include Wicklow Head and to the west to cover the area inshore of Arklow Bank up to and including the coastline (Figure 12.1.2). Each camera sampled a strip of 125 m width, separated from the next camera by approximately 25 m, thus providing a combined potential sampled width of 500 m within a 575 m overall strip and a maximum of 25% coverage.

13. Position data for the aircraft was captured from a Garmin Global Positioning System (GPS) Map 296 receiver with differential GPS enabled to give 1 m accuracy for the estimated plane locations and recording updates in location at one second intervals for later matching to bird observations.

14. Survey data comprised species, count (number of individual birds), sex (where possible), age (where possible), basic behaviour (whether the bird was sitting on the sea, flying or resting on buoys or other objects), flight height, flight direction, position (longitude and latitude), date and time stamp of image collection.

15. Each bird was assigned to at least a high-level species group (e.g. 'large gulls') and where possible, birds were fully identified to species with a confidence level of 'possible', 'probable' or 'definite'. An average identification rate to species of 92.6% was achieved across the survey programme.

16. Coastal vantage point surveys at the landfall were conducted from headlands which afforded good views of the area of interest. At each vantage point, a 180° scan using a 20x telescope and 8x binoculars was made of the inshore waters and all species of wildfowl, waders and gulls were recorded. All wildfowl, waders and gulls encountered on the water were recorded.

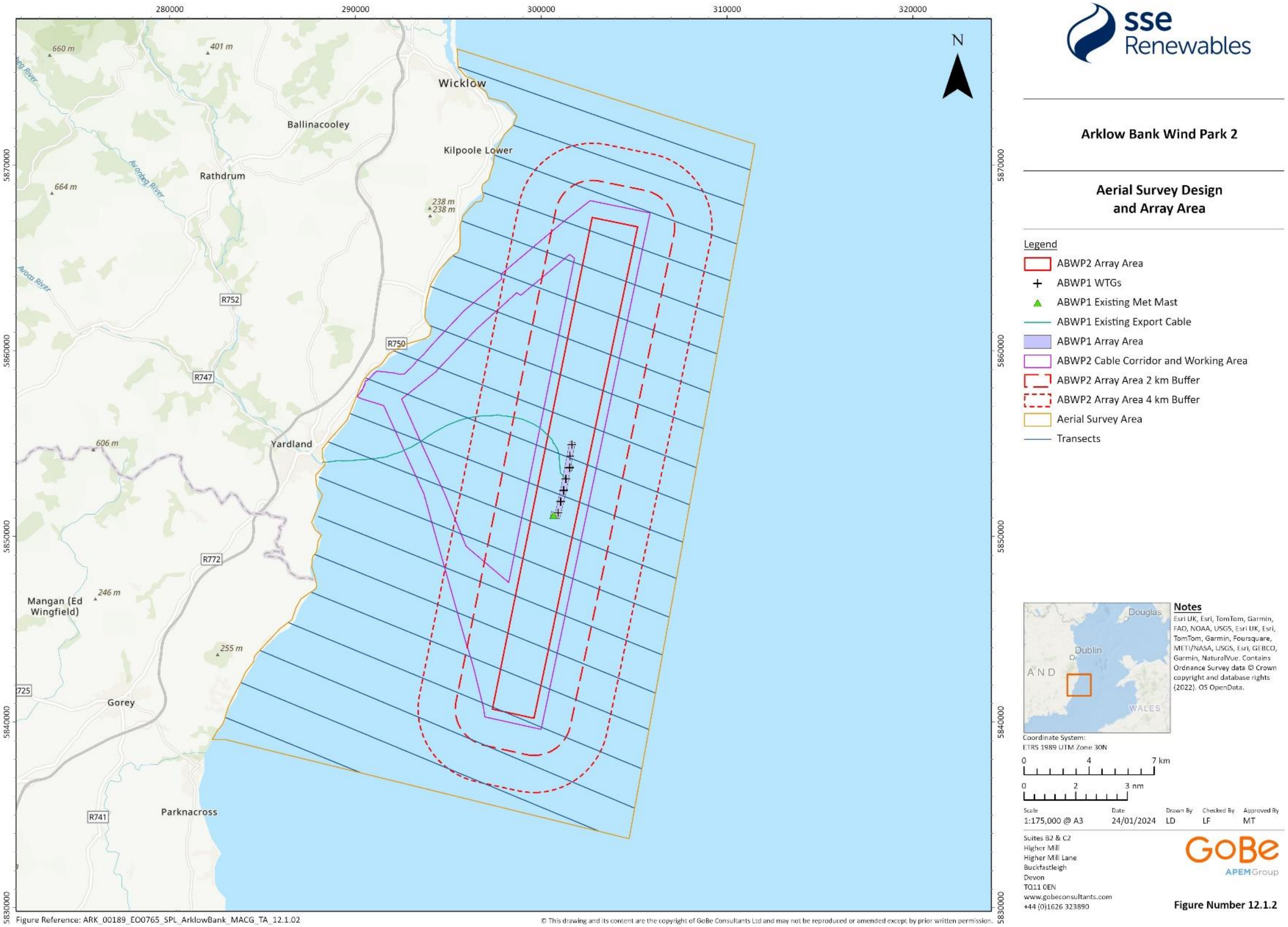

Figure 12.1.2: Aerial survey design showing Survey Area with transects at 2 km spacing and Array Area with 2 km and 4 km buffer.

1.4 Data Analysis

1.4.1 Image Analysis

16. To ensure a survey design with sufficient coverage representative of the region, a total of 10% of the Survey Area was reviewed in the video footage. The Standard for Environmental Impact Assessments (StUK) (BSH, 2013) recommends a 10% sampling figure for a survey area used in offshore aerial surveys and this level of coverage has become the standard in relation to UK surveys. To obtain a 10% coverage distributed evenly over the Survey Area, data were analysed from a 100 m strip width along each transect.

17. Data were viewed by trained reviewers who marked any objects (birds, marine mammals or anthropogenic objects such as ships or buoys) in the video footage as requiring further analysis.

18. Within the video footage, an object was only recorded where it reached a reference line (known as 'the red line') which defined the true transect width for each camera. By excluding objects that did not cross the red line, biases to abundance estimates caused by flux (movement of objects in the video footage relative to the aircraft, such as 'wing wobble') were eliminated.

19. As part of HiDef's Quality Assurance ('QA') process, an additional 'blind' review of 20% of the raw data was carried out and the results compared with those of the original review. If 90% agreement is not attained during the QA process, then corrective action is initiated: the remaining data set is reviewed and where appropriate, the failed reviewer's data discarded and all the data re-reviewed. In addition, additional training is then given to the reviewer to improve performance. However, no re-reviews were required for the current dataset.

20. Images marked as requiring further analysis were reviewed by specialist ornithologists for identification to the lowest taxonomic level possible and for assessment of the approximate age and the sex of each animal, as well as any behaviour traits visible from the imagery.

21. At least 20% of all objects were subjected to an external QA process. If less than 10% disagreement was not attained then corrective action was initiated: if appropriate, the failed reviewer's data was discarded and the data re-reviewed. Any disputed identifications were passed to a third-party expert ornithologist for a final decision.

22. All data were geo-referenced, taking into account the offset from the transect line of the cameras. Object and track data were merged into single datasets in the form of Geographical Information System (GIS) files.

1.4.2 Bird abundance and density estimates

23. Raw data were supplied in ArcGIS shapefile format, using UTM30N projection, WGS84 datum. The GIS files contained details of all objects (birds, marine mammals, vessels, etc.) recorded. All non-bird records were removed prior to analysis. Analysis was conducted for each survey separately. Bird locations were assigned to the Array Area as well as the Array Area plus a 2 km buffer and the Array Area plus a 4 km buffer (note that the buffers also included the Array Area data).

24. Bird abundance and density estimates were calculated for 22 species and/or species groups. An additional eight species were identified within digital aerial survey footage including: British storm petrel (one bird recorded), goldeneye (two birds), great crested grebe (three birds), house martin

(one), pomarine skua (one bird), red-breasted merganser (one bird), Slavonian grebe (one bird) and wigeon (one bird). However, as these species were recorded very infrequently outside of the Array Area, abundance and density were not estimated for these species.

25. For 22 species (and/or species groups), the density (birds/km^2) and abundance were estimated using design-based methods, with the density estimated for the surveyed area (i.e. the sum of the surveyed area, calculated as transect length x width) and multiplied up to the total Survey Area to obtain an abundance estimate. This makes the assumption that the surveyed sample is representative of the un-surveyed region (see paragraph 16), thus the design of survey is important to obtain reliable estimation (hence 'design based').

26. The mean for each month was calculated as the average of the individual monthly mean values (i.e. across two estimates except for July which had three estimates).

27. Confidence intervals for each species in each calendar month were obtained using a bootstrap resampling method. For each survey, images were drawn randomly (with replacement) from the complete dataset for that survey until the same number of images as the original sample was obtained (e.g. if the survey for a particular month comprised 350 images, each resampled datas*et al*so contained 350 images, drawn with replacement from the original dataset). To produce the bootstrap samples, this process was repeated 1,000 times and the density and abundance was calculated for each resampled dataset. These bootstrap samples were then combined for each month (e.g. 1,000 samples for the first January survey and 1,000 samples for the second January survey etc, or for July specifically 1,000 for the first July and 2,000 samples for the second July) from which the overall upper and lower 95% confidence intervals for that month were extracted to estimate sampling variation. This ensured that the distribution of values for each month were derived from all of the available data.

28. The width of the confidence interval obtained using this bootstrap method reflects the degree of aggregation in the species, with highly aggregated species estimated with lower precision (i.e. species observed frequently as individuals will have a small range of estimated densities, while species recorded in occasional large groups will have a wide range of estimated densities).

29. For the displacement and collision risk assessments, the monthly mean values were used.

30. Birds were recorded as either sitting on the sea surface ('sitting') or in flight ('flying'). Analysis was conducted on each subset separately and also combined across both ('all birds'). The combined estimates have been used as the overall densities and abundances required for displacement analysis, while birds in flight have been used for the CRM.

31. All data were analysed using R (R Development Core Team, 2012) to provide the summary outputs (as described above).

1.4.3 High-Level Species Groups

32. It was not possible to fully identify 7.4% of all birds that were recorded within digital aerial survey footage to species level; instead, these birds were assigned to one of 18 high-level species groups including: Arctic/common tern, auk species, cormorant/shag, diver species, small gull, auk/shearwater, auk/small gull, black-backed gull, fulmar/gull, gull species, large auk/diver, large gull, duck species, small bird, swan species, tern/small gull, tern species and wader species.

33. As some of the high-level species groups included different taxa (e.g. 'auk/small gull) and also some species could potentially be assigned to more than one high-level species group (e.g. an unidentified guillemot could be assigned to one of four different high-level species groups), birds assigned to high-level species groups were not proportionally split into different species using the ratios of fully identified birds. In addition, apportioning birds in high-level species groups among their component species has the potential to introduce biases, for example if one species in a group is more often identified to species than others in the same general group, then apportioning may overestimate numbers of the easily identified species and correspondingly underestimate numbers of the less easily identified species.

34. Bird abundance and density were calculated for the following five high-level species groups (each group containing related species within the same family) using the same methods used to calculate abundance and density for fully identified species (see section 1.4.2). A total of 5.7% of birds recorded during the digital aerial surveys were assigned to these five high-level species groups (see Figure 12.1.3 for the number of birds in each group):

- Arctic or common tern species;
- Auk species;
- Cormorant or shag species;
- Diver species; and
- Small gull species.

35. Due to the mixed taxa within the other high-level species groups, abundance and density estimates were not calculated for 1.7% of birds assigned to high-level species groups and these data were not included in the assessment.

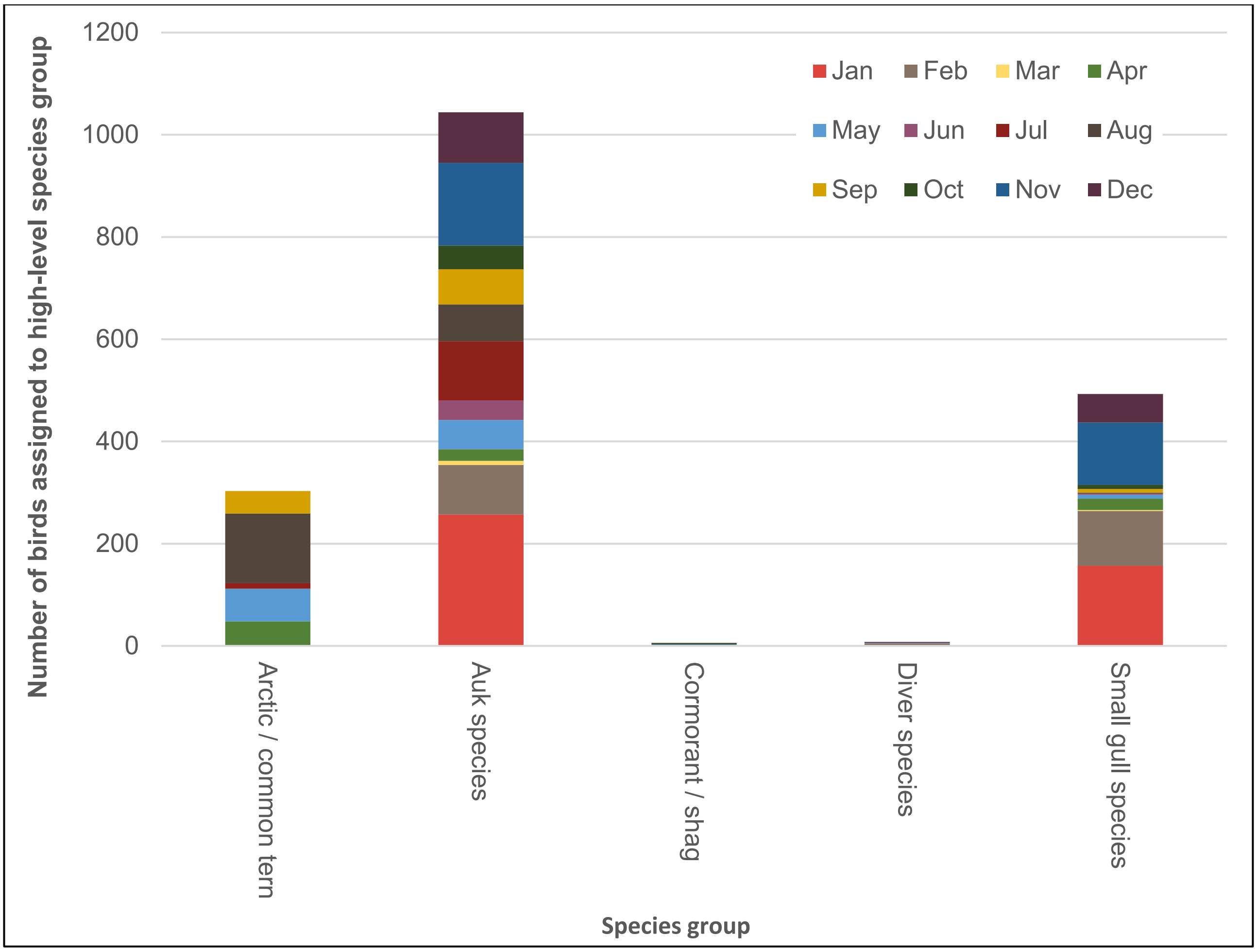

Figure 12.1.3: Number of birds assigned to five high-level species groups.

1.4.4 Availability Bias

36. Guillemots and razorbills spend a proportion of their time foraging beneath the water surface and therefore some individuals present in a given area will not be observable in aerial images. Density and abundance estimates need to be adjusted to allow for these unobserved individuals.

37. Fixed species-specific correction factors were applied to the number of guillemots and razorbills recorded on the sea surface. The values used were those recommended by the Joint Nature Conservation Committee (JNCC) in its submission during the examination phase of East Anglia ONE (Allen, 2013, referred to as Method C), which stated that 24% of guillemots and 17% of razorbills are underwater at any time (these percentages do not include birds in flight).

38. Density and abundance estimates for guillemot and razorbill detailed in Volume III, Appendix 13.2: Offshore Ornithology Technical Report – Monthly Seabird Density and Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance respectively are presented with the application of the availability bias method; these values are used in the assessment.

1.4.5 Spatial Distributions

39. Bird spatial distribution maps are provided for all species and five high-level species groups (see section 1.4.3) in Volume III, Appendix 13.8: Offshore Ornithology Technical Report – Seabird Spatial Distribution Maps. For birds recorded in low numbers, these figures plot observations recorded for related species and high-level species groups that are within the same family (e.g. great northern divers plus diver species) onto one figure, while more commonly recorded species and high level-species groups are plotted with one species/group per map. In addition, for species recorded in low numbers, all observations are plotted while species with higher numbers are combined by season (using the definitions in Furness (2015)). Note that for the latter, where months contain overlapping seasons (e.g. breeding and migration), these have been assigned to breeding since for almost all species the Array Area is located within foraging range of breeding colonies. The exceptions to this are Arctic tern, common tern, Sandwich tern and razorbill colonies which are beyond typical (i.e. mean) foraging distance of Arklow Bank. The seasons used are detailed in Table 12.1.2.

Table 12.1.2: Species specific seasonal definitions have been taken from Furness (2015) unless otherwise stated.

Species	Breeding	Migration – autumn	Winter	Migration – spring	Non-breeding
Arctic skua	May-Jul	Aug-Oct	-	Apr-May	-
Arctic tern	May-Aug	Jul-Sep	-	Apr-May	-
Black-headed gull[a]	May-Aug	-	-		Sep-Apr
Common gull[a]	May-Aug	-	-	-	Sep-Apr
Common scoter[a]	May-Aug	Sep-Dec	-	Feb-May	-
Common tern	May-Aug	Jul-Sep	-	Apr-May	-
Cormorant	Apr-Aug	-	-	-	Sep-Mar
Fulmar	Jan-Aug	Sep-Oct	Nov	Dec-Mar	-
Gannet	Mar-Sep	Sep-Nov	-	Dec-Mar	-
Great black-backed gull	Mar-Aug	Aug-Nov	Dec	Jan-Apr	Sep-Mar
Great northern diver	-	Sep-Nov	Dec-Feb	Mar-May	Sep-May
Guillemot	Mar-Jul	Jul-Oct	Nov	Dec-Feb	Aug-Feb
Herring gull	Mar-Aug	Aug-Nov	Dec	Jan-Apr	Sep-Feb
Kittiwake[b]	Mid-Apr-Aug	Aug-Dec	-	Jan-mid Apr	-
Lesser black-backed gull	Apr-Aug	Aug-Oct	Nov-Feb	Mar-Apr	-
Little gull[a]	Apr-Jul	-	-	-	Aug-Apr
Manx shearwater	Apr-Aug	Aug-early Oct	Nov-Feb	Mar-May	Sept-Mar
Puffin	Apr-Aug	Jul-Aug	Sep-Feb	Mar-Apr	Mid-Aug-Mar

Species	Breeding	Migration – autumn	Winter	Migration – spring	Non-breeding
Razorbill	Apr-Jul	Aug-Oct	Nov-Dec	Jan-Mar	-
Red-throated diver	Mar-Aug	Sep-Nov	Dec-Jan	Feb-Apr	-
Sandwich tern	Apr-Aug	Jul-Sep	-	Mar-May	Sep-Mar
Shag	Feb-Aug	Aug-Oct	Nov	Dec-Feb	Sep-Jan

a Not included in Furness (2015). *Seasons taken from the Birds of the Western Palearctic (Snow and Perrins, 1998).*

b *https://www.nature.scot/sites/default/files/2018-11/Guidance%20-%20Suggested%20seasonal%20definitions%20for%20birds%20in%20the%20Scottish%20Marine%20Environment.pdf*

1.4.6 Collision Risk Modelling

40. Collision estimates were calculated using the Band (2012) CRM. This model incorporates different model options (1 to 4) which correspond to different approaches for estimating the proportion of birds at collision height (PCH) (i.e. the proportion of birds flying at rotor swept heights above the sea). Options 1 and 2 use a single value for PCH, but differ in that the value for option 1 is derived from site specific survey estimates while the value for option 2 is derived from a large dataset collated and analysed by the British Trust for Ornithology (BTO; Johnston *et al.*, 2014a; Johnston *et al.*, 2014b). Options 3 and 4 estimate PCH using flight height distribution curves (also presented in Johnston *et al.*, 2014a; Johnston *et al.*, 2014b), with option 3 using the pooled dataset and option 4 site specific data. Due to concerns about how some of the source data used in Johnston *et al.*, (2014a,) and Johnston *et al.*, (2014b) were collected, the UK Statutory Nature Conservation Bodies (SNCBs) do not advise use of option 3 for UK collision assessments (JNCC *et al.*, 2014). Similarly, digital aerial survey derived flight height estimates were subsequently found to be less reliable than previously thought (APEM, 2018) with the consequence that option 1 and option 4 outputs (which use site specific data) are also considered unreliable. Therefore, collision mortalities used for CRM impact assessment were those calculated using Option 2 of the Band (2012) model, with flight heights obtained from the BTO generic flight height dataset (Johnston *et al.*, 2014a; Johnston *et al.*, 2014b).

41. Uncertainty in seabird density, flight height (derived from the seabird flight height data in Johnston *et al.*, (2014a,) and Johnston *et al.*, (2014b) and avoidance rates was included in the collision mortality estimates. To do this the CRM was calculated using the mean values for each of the above list of parameters as well as using the upper and lower 95% confidence interval values. In addition, it is evident that the values for nocturnal activity used in the Band CRM for most species are a significant over-estimate (e.g. Furness *et al.*, 2018). Therefore, uncertainty in this parameter was also incorporated for gannet and kittiwake (for which empirical nocturnal activity estimates are available).

42. There is increasing evidence that existing nocturnal activity levels, derived from the relative estimates in Garthe and Hüppop (2004), and converted into an absolute scale from 0-100% by Band (2012) overestimate realistic levels of nocturnal activity. Recent advice from Natural England in relation to offshore wind developments has advised that CRM should use upper and lower nocturnal activity rates of 0% and 25% for gannet and 25% and 50% for kittiwake, lesser black-backed gull, great black-backed gull and herring gull (in each case the previous advice was to use the higher rate). In addition, for gannet, a review of empirical evidence from tracking studies has revealed that appropriate (and still precautionary) values for the breeding season and non-

breeding season respectively are 8% (Standard Error (SE) 2.7%) and 3% (SE 0.4%) (Furness *et al.*, 2018). Therefore, as the evidence based seasonal values for gannet represent a significant improvement over the previously categorical values applied, these have been used in the CRM.

43. The input parameters for the collision modelling are provided in Volume III, Appendix 13.4: Offshore Ornithology Technical Report – Collision Risk Model Input Parameters, and the outputs are presented in full in Volume III, Appendix 13.5: Offshore Ornithology Technical Report – Seabird Collision Modelling Tabulated Results.

1.5 Ornithology Baseline

1.5.1 Overview of Bird Species Recorded

44. The following bird species (Table 12.1.3) were recorded during digital aerial surveys within the Array Area as well as within the Array Area 2 km and 4 km buffers only (i.e. the buffers without the Array Area).

Table 12.1.3: Bird species recorded during aerial surveys within the Array Area, the 2 km buffer only and the 4 km buffer only.

Species	Array Area	2 km buffer only	4 km buffer only
Arctic skua			X
Arctic tern	X	X	X
Black-headed gull	X	X	X
Common gull	X	X	X
Common scoter	X		
Common tern	X	X	X
Cormorant	X		
Fulmar	X		
Gannet	X	X	X
Great black-backed gull	X	X	
Great northern diver	X		
Guillemot	X	X	X
Herring gull	X	X	X
Kittiwake	X	X	X
Lesser black-backed gull	X		X
Little gull	X	X	X
Manx shearwater	X	X	X
Puffin	X	X	X
Razorbill	X	X	X
Red-throated diver	X	X	X
Sandwich tern	X	X	X
Shag	X	X	X

1.5.2 Summary Species Accounts

45. The following species accounts are a high-level summary of the estimated abundance values presented in Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance for birds recorded both in flight and on the sea surface. For guillemots and razorbills, the values include adjustment for birds expected to be underwater during the surveys (section 1.4.4). All data figures referenced below are presented in Volume III, Appendix 13.8: Offshore Ornithology Technical Report – Seabird Spatial Distribution Maps.

Arctic Skua

46. Two Arctic skuas were recorded in the 4 km buffer surrounding the Array Area in September 2018. The estimated mean peak population was ten in September (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.1a). No individuals were recorded in the Array Area itself. Figure 13.8.1 provides locations of Arctic skuas recorded.

Arctic Tern

47. Arctic terns were recorded in April and May, and August to October within the Array Area. The estimated mean peak population was 3,230 in August (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.2a). Birds allocated to the Arctic/common tern high-level species group were also recorded in April, May, August and September within the Array Area as well as in July within the Array Area 4 km buffer. The estimated mean peak population of Arctic/common terns within the Array Area was 540 in August (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.3a). Figure 13.8.2 provides locations of Arctic terns and the Arctic/common terns high-level species group.

Black-headed Gull

48. Black-headed gulls were recorded in January, February, July, August, and October to December within the Array Area. The estimated mean peak population was 600 in February (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.5a). Birds allocated to the small gull high-level species group were recorded in all calendar months except May, July and August within the Array Area, although they were recorded within the Array Area 2 km buffer in May. The estimated mean peak population of small gulls in the Array Area was 535 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.27a). Figure 13.8.4 provides locations of black-headed gulls. Figure 13.8.23 provides locations of birds allocated to the small gull high-level species group.

Common Gull

49. Common gulls were recorded in January to April, June and November to December within the Array Area as well as May and July within the Array Area 2 km buffer. The estimated mean peak population in the Array Area was 2,230 in February (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.6a). Birds allocated to the small gull high-level species group were recorded in all calendar months except May, July and August within the Array Area, although they were recorded within the Array Area 2 km buffer in May. The estimated mean peak population of small gulls in the Array Area was 535 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance,

Table 13.3.27a). Figure 13.8.5 provides locations of all common gulls. Figure 13.8.23 provides locations of birds allocated to the small gull high-level species group.

Common Scoter

50. Common scoters were recorded in January, June and December within the Array Area as well as May and October within the Array Area 4 km buffer. The estimated mean peak population was 20 in December (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.7a). Figure 13.8.6 provides locations of common scoter.

Common Tern

51. Common terns were recorded in April, August and September within the Array Area as well as May and July within the Array Area 4 km buffer. The estimated mean peak population in the Array Area was 870 in August (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.8a). Birds allocated to the Arctic/common tern high-level species group were recorded in April, May, August and September within the Array Area as well as in July within the Array Area 4 km buffer. The estimated mean peak population of Arctic/common terns within the Array Area was 540 in August (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.3a). Figure 13.8.7 provides locations of common terns and the Arctic/common terns high-level species group.

Cormorant

52. Cormorants were recorded in January, September and October within the Array Area as well as February within the Array Area 2 km buffer and June within the Array Area 4 km buffer. The estimated mean peak population in the Array Area was ten in October (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.9a). Birds allocated to the cormorant/shag high-level species group were recorded in March, May, and December within the Array Area and in April within the Array Area 4 km buffer. The estimated mean peak population in the Array Area was ten in March, May and December (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.10a). Figure 13.8.8 provides locations of all cormorants, shags and birds allocated to the cormorant/shag high-level species group.

Fulmar

53. Fulmars were recorded in April and September within the Array Area as well as July and August within the Array Area 2 km buffer and January and June within the Array Area 4 km buffer. The estimated mean peak population in the Array Area was ten in September (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.12a). Figure 13.8.9 provides locations of all fulmars recorded.

Gannet

54. Gannets were recorded within the Array Area in all months except February, April, and May; this species was recorded within the Array Area 2 km buffer in April and May. The estimated mean peak population in the Array Area was 35 in October (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.13a). Figure 13.8.10 provides locations of all gannets recorded.

Great Black-backed Gull

55. Great black-backed gulls were recorded in January, September, November and December within the Array Area as well as March within the Array Area 2 km buffer and July and October within the 4 km buffer. The estimated mean peak population in the Array Area was 20 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.14a). Figure 13.8.11 provides locations of all great black-backed gulls.

Great Northern Diver

56. Great northern divers were recorded in January and December within the Array Area. The estimated mean peak population was ten in January and December (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.15a). Birds allocated to the diver high-level species group were recorded in February within the Array Area with an estimated mean peak population of 20 (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.11a). Figure 13.8.12 provides locations of great northern divers and birds allocated to the diver high-level species group.

Guillemot

57. Guillemots were recorded in all calendar months within the Array Area. The estimated mean peak population was 4,197 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report Monthly Seabird Abundance, Table 13.3.16a). Birds allocated to the auk high-level species group were also recorded in all calendar months within the Array Area with an estimated mean peak population of 975 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.4a). Figure 13.8.13 provides locations of all guillemots recorded. Figure 13.8.3 provides locations of birds allocated to the auk high-level species group.

Herring Gull

58. Herring gulls were recorded in February and November within the Array Area as well as March, June and July within the Array Area 2 km buffer and January within the Array Area 4 km buffer. The estimated mean peak population in the Array Area was 15 in November (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.17a). Figure 13.8.14 provides locations of all herring gulls recorded.

Kittiwake

59. Kittiwakes were recorded in all calendar months within the Array Area. The estimated mean peak population was 7,390 in February (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.18a). Birds allocated to the small gull high-level species group were recorded in all calendar months except May, July and August within the Array Area, although they were recorded within the Array Area 2 km buffer in May. The estimated mean peak population of small gulls in the Array Area was 535 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.27a). Figure 13.8.15 provides locations of all kittiwakes recorded. Figure 13.8.23 provides locations of birds allocated to the small gull high-level species group.

Lesser Black-backed Gull

60. Lesser black-baked gulls were recorded in March within the Array Area. The estimated mean peak population was five in March (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.19a). Figure 13.8.16 provides locations of all lesser black-backed gulls.

Little Gull

61. Little gulls were recorded in January to March and August to December within the Array Area, this species was also recorded in July with the Array Area 2 km buffer. The estimated mean peak population in the Array Area was 1,045 in December (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.20a). Figure 13.8.17 provides locations of all little gulls.

Little Tern

62. Three little terns were recorded flying in the wider area during aerial surveys in July 2019, but no individuals were recorded in the Array Area or the Array Area 2 km or 4 km buffers. Figure 13.8.22 provides locations of all little terns and Sandwich terns recorded.

Manx Shearwater

63. Manx shearwaters were recorded in April to September within the Array Area. The estimated mean peak population was 1,015 in August (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.21a). Figure 13.8.18 provides locations of all Manx shearwaters recorded.

Puffin

64. Puffins were recorded in February, March, June, July and August within the Array Area as well as November within the Array Area 2 km buffer and April, May, and September within the Array Area 4 km buffer. The estimated mean peak population in the Array Area was 20 in March (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.22a). Birds allocated to the auk high-level species group were recorded in all calendar months within the Array Area with an estimated mean peak population of 975 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.4a). Figure 13.8.19 provides locations of all puffins recorded. Figure 13.8.3 provides locations of birds allocated to the auk high-level species group.

Razorbill

65. Razorbills were recorded in all calendar months within the Array Area. The estimated mean peak population was 3,313 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.23a). Birds allocated to the auk high-level species group were also recorded in all calendar months within the Array Area with an estimated mean peak population of 975 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.4a). Figure 13.8.20 provides locations of all razorbills recorded. Figure 13.8.3 provides locations of birds allocated to the auk high-level species group.

Red-throated Diver

66. Red-throated divers were recorded in January to May and October to December within the Array Area. The estimated mean peak population was 115 in January (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.24a). Birds allocated to the diver high-level species group were recorded in February within the Array Area with an estimated mean peak population of 20 (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.11a). Figure 13.8.21 provides locations for all red-throated divers recorded and birds allocated to the diver high-level species group.

Sandwich Tern

67. Sandwich terns were recorded in May, August and September within the Array Area as well as April within the Array Area 2 km buffer. The estimated mean peak population in the Array Area was 15 in September (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.25a). Figure 13.8.22 provides locations of all Sandwich terns and little terns recorded.

Shag

68. Shags were recorded in January to March and October to December within the Array Area as well as May and August within the Array Area 4 km buffer. The estimated mean peak population in the Array Area was 35 in February (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.26a). Birds allocated to the cormorant/shag high-level species group were recorded in March, May and December within the Array Area and in April within the Array Area 4 km buffer. The estimated mean peak population of cormorant/shag in the Array Area was ten in March, May and December (Volume III, Appendix 13.3: Offshore Ornithology Technical Report – Monthly Seabird Abundance, Table 13.3.10a). Figure 13.8.8 provides locations of shags, cormorants and birds allocated to the cormorant/shag high-level species group.

1.6 References

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