Project Environmental Monitoring Plan

KINCARDINE OFFSHORE WINDFARM PROJECT

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Revision History

Date	Rev. Status	Purpose of Issue*	Remarks	Initials
29-06-2017	00	For Review	First Issue of Draft PEMP	AHP
19-03-2018	A1	For Review	Second Issue of Draft PEMP	AC
23-03-2018	B1	External Review	Issued for External Review	JD
01-05-2018	C1	For Information		AHP
19-04-2019	C2	External Review	Issued for External Review	JD
09-10-2019	C3	External Review	Re-Issued for External Review	JD
09/06/21	C4	For Review	First issue of Revised PEMP (2021)	IB
02/07/21	C5	For Review	Second issue of Revised PEMP (2021)	IB
08/10/21	C6	For review	First Issue of C6 2021 Revised PEMP	IB
08/11/21	C6	For External Review	Second Issue of 2021 Revised PEMP	IB
03/07/23	C7	For External Review	First issue of 2023 Revised PEMP	IB
27/01/25	C8	For Internal Review	First issue of 2025 Revised PEMP	IB
14/03/25	C9	For External Review	Issued for External Review	IB
26/3/25	C10	For External Review	Issued for External Review	IB

*Purpose of Issue: for information, for review, for approval

Detailed Change Log

Date	Rev. Status	References	Description of changes	Initials
23-03-2018	A1	CRS	See CRS for Comments	JD
01-05-2018	C1		Logo and minor text updates following consultation	AHP
19-04-2019	C2		Updated project information. Reformatted body of text into tabular format	AF
09-10-2019	C3	Appendix C	Updated Field Layout	JD
09/06/21	C4		Updated Purpose of Document and Project Information. Updated Principal Components, Bird monitoring approach, objectives, and methods; new Diadromous fish sections and contact information.	IB
29/06/21	C5		Amendments post AW review – load cells, DTBird Specifications and visualisations updated	IB
06/10/21	C6		Amendments post meeting with NS, MSS, MD-LOT and RSPB. Updates to Introduction to include description of document structure, installed components, bird monitoring plan, marine mammals monitoring plan including reference to SUPERGEN/FORTUNE project, diadromous fish monitoring plan and new section on UXO clearance included. Methods and Objectives sections 4.2, 5.2 and 6.2 have been restructured.	IB
08/10/21	C6		Additional amendments to SUPERGEN/FORTUNE project section	IB
03/07/23	C7		Updates to ornithology monitoring approaches and data collection. Revised section on marine mammals including approach to ROV surveys and entanglement, and outcomes of noise monitoring projects. Revised sections on diadromous fish research, UXO clearance and noise monitoring.	IB
27/1/25	C8		Updates to reflect Gap analysis sent to MD-LOT on ornithology monitoring, marine mammals including approach to ROV surveys based on stakeholder discussions. Diadromous fish section updated to reflect commencement of KOWL-funded PhD study.	IB
16/3/25	C9		Addition of Section 8 (overall summary)	IB
26/3/25	C10		Minor revisions to address MD-LOT comments on version C9	IB

Table of Contents

ACRONYMS, ABBREVIATIONS AND DEFINITIONS

CRM	Collision Risk Modelling
dB	Decibel
ECoW	Ecological Clerk of Works
ECT	KOWL Environment and Consents Team
EIA	Environmental Impact Assessment
EOWDC	European Offshore Wind Deployment Centre
EMP	Environmental Management Plan
ES	Environmental Statement
FTRAG	Forth and Tay Regional Advisory Group
GIS	Geographic Information Systems
GLS	Global Location Sensor
GPS	Global Positioning System
HAT	Highest Astronomical Tide
HRA	Habitats Regulation Assessment
Hz	Hertz
KOWL	Kincardine Offshore Wind Ltd
LAT	Lowest Astronomical Tide
LMP	Lighting and Marking Plan
MHWS	Mean High Water Springs
MMO	Marine Mammal Observer
MD-LOT	Marine Directorate Licensing and Operations Team (formerly MS-LOT)
MSS	Marine Scotland Science
MW	MegaWatt
NRMSD	National Research and Monitoring Strategy for Diadromous Fish
NS	NatureScot (previously Scottish Natural Heritage)
PEMP	Project Environmental Monitoring Plan
ROV	Remotely Operated Vehicle
RSPB	The Royal Society for the Protection of Birds
SAMS	Scottish Association for Marine Science

ScotMER	Scottish Marine Energy Research
SPA	Special Protection Area
SpORRAn	Scottish Offshore Renewables Research Framework
SSMEG	Scottish Strategic Marine Environment Group
Supergen/FORTUNE	Supergen Floating Offshore Wind Turbine Noise project
TBC	To be confirmed
UXO	Unexploded Ordnance
WTG	Wind Turbine Generator
µPa	Pascal

1. INTRODUCTION

1.1. Purpose and Structure of the Document

This document has been created to satisfy Condition 22 of the Section 36 Consent originally issued by Marine Scotland Licensing Operations Team (MS-LOT, now MD-LOT) to Kincardine Offshore Wind Ltd (KOWL) for the Kincardine Offshore Windfarm (the Project).

Condition 22 requires the production of a Project Environmental Monitoring Plan (PEMP). The overall aim of the PEMP is to outline and define the approach KOWL, its survey contractors and advisors will take with respect to the environmental monitoring of the Project required under the consent conditions.

The PEMP is designed to provide guidance to those involved in the Project, on the monitoring of potential environmental impacts associated with the installation, post-construction and operational phases of the wind farm.

This iteration of the PEMP (revision C10) has been adapted from that originally prepared for the initial stages of the Project, in order to build upon learnings during the data collected during operation of the 2MW turbine and to refine the monitoring objectives and methodologies subsequent to the installation and operation of five 9.5MW turbines at the site.

The document is structured into 8 main sections plus Appendices:

Section 1 Introduction: This section sets out the purpose, structure, scope of the document as well as the approach to updating it, and compliance with consent conditions

Section 2 Project Overview: This section summarises the main features of the Kincardine project, turbine locations, its principal and currently installed components, the project design life, and an overview of the construction programme.

Section 3 Consent Conditions: This section describes the main consent conditions for the Kincardine project, and highlights where each consent condition is addressed in the relevant sections of this document.

Section 4 Birds Monitoring Plan: This section focuses on the monitoring plan for birds at the site. It starts with a summary of meetings held to-date with stakeholders, and the key outcomes and agreements from each of these meetings. The overarching approach to bird monitoring is summarised, and the various objectives of the bird monitoring studies and methods to be employed at the site are then discussed in turn. The reporting requirements are described, and this is followed by a summary table of the main activities that have been carried out and are planned for bird monitoring at the site.

Section 5 Marine Mammals Monitoring Plan: This section focuses on the monitoring plan for marine mammals at the site. It starts with a summary of meetings held to-date with stakeholders, and the resultant key outcomes and agreements. The overarching approach to marine mammal monitoring is summarised, and the various objectives of the marine mammal monitoring studies and methods to be employed at the site are then discussed in turn, along with details of activities carried out to-date. The reporting requirements are described, and this is followed by a summary of the activities that have been carried out and are planned for monitoring the potential effects upon marine mammals at the site.

Section 6 Diadromous Fish Monitoring Plan: This section focuses on the monitoring plan for diadromous fish at the site. It starts with a summary of meetings held to-date with stakeholders, and the key outcomes and agreements from each of these meetings. The overarching approach to diadromous fish monitoring is summarised, and the various objectives of these monitoring studies and methods to be employed at the site are discussed. The reporting requirements are described, and this is followed by a summary of the main activities that are currently being carried out.

Section 7 Unexploded Ordnance (UXO) Clearance: This section describes the approaches that KOWL will undertake and references the guidance documents that KOWL will consult, should any UXO clearance activities be required at the site in the future.

Finally, Section 8 presents an overall summary of the key monitoring activities and recent reporting outputs at Kincardine as of March 2025.

Appendix A presents technical details and specifications of the DTBird video camera systems that are installed at the site to monitor bird collisions.

Appendix B contains details of KOWL's key contractors and advisors.

Appendix C illustrates the field layout and locations of each WTG at the KOWL site.

1.2. Scope of the Document

This PEMP is not intended to present the full detail of the monitoring proposals, but to summarise the agreed approach. The PEMP:

- Describes the objectives and methodologies for monitoring surveys
- Describes the proposed programmes for monitoring and reporting on:
  - Birds (Kittiwake and Puffin);
  - Diadromous fish;
  - Marine mammals;
- The objectives and methodologies for the monitoring surveys;
- Provides evidence of consultation on and approval of the monitoring approach and survey methodology;

1.3. Approach to Amending and Updating this PEMP

The nature of the construction process proposed for the Project means that updates to this document may be required as the project progresses.

Where the need for an update or amendment to this document is identified following approval from Marine Directorate Licensing Operations Team (MD-LOT), either through a consultation response, or due to practicalities arising as the project progresses, KOWL will communicate the suggested update/amendment to MD-LOT prior to editing the approved document.

1.4. Compliance

Compliance with the various consent conditions is documented in the Commitments Register and where applicable throughout the PEMP.

2. PROJECT OVERVIEW

2.1. Summary

The Project is considered a commercial demonstrator site, which utilises floating foundation technology, and is one of the world's first arrays of floating wind turbines. It was included within the Survey, Deploy and Monitoring scheme for offshore renewable systems (similar to wave and tidal devices).

The Project is located south-east of Aberdeen approximately 8nm (15km) from the Scottish coastline, in a location that provides suitable water depth for a floating offshore wind demonstrator development (approximately 60-80m).

The project is split into the following areas:

- The Development Area – the wind farm area including the Wind Turbine Generators (WTG) and inter-array cables.
- The Offshore Export Cable Corridor – the area within which the proposed export cables will be laid, from the perimeter of the Development Area to the onshore area at Mean High Water Spring (MHWS).
- The Onshore Area – the onshore area above MHWS including the underground cables connecting to the onshore substation at Redmoss.

This PEMP focuses on the offshore elements only as per Section 36 Consent and Marine Licences granted. The onshore area is subject to a separate planning permission granted by Aberdeen City Council

2.2. Turbine Locations

The project originally consisted of 8 locations. This has been reduced to 6 locations with 5 operating turbines and hence the designations have now changed as follows;

Table 2-1 Turbine Designations

Location designation Pre-2019	New location designation post 2019
KIN-01	KIN-01
KIN-02	KIN-02
KIN-03	KIN-03
KIN-04	n/a
KIN-05	n/a
KIN-06	KIN-04
KIN-07	KIN-05
KIN-08	KIN-06 (vacant)

The position of the locations 'KIN-01' through to 'KIN-06' together with the key project boundaries are detailed in Appendix C in drawing KOWL-DR-0001-015.

This drawing is a controlled document and shall form the approved source for all coordinates in both UTM and Latitude/Longitude positions.

It must be stressed that the locations are the centre of the turbine and not the centre of the substructure.

2.3. Principal Components

The maximum generation capacity of the windfarm is capped at 50MW, the main difference between the various stages of the applications have been the number, size and power rating of the turbines, together with the substructure type.

The Project now consists of the following offshore components:

- 1 x 2MW WTG (currently offsite; operated September 2018 to July 2020)
- 5 x 9.5MW WTGs (installed in 2021 and are operational)
- 5 x 33kv inter-array cables (installed 2021)
- 2 x export cables
- All turbine substructures are the semi-submersible Principle Power Windfloat™ design.

2.4. Installed Components

The onshore sub-station has been completed.

The first deployment was a 2MW WTG and associated substructure, anchors and mooring lines in 2018 on location 'KIN-01'. One export cable was also installed, through a Horizontal Directional Drilling (HDD) hole from landfall to circa 20m water depth and then along the export cable corridor to 'KIN-01' location. Five 9.5MW WTGs and associated substructures, anchors, mooring lines and inter-array cables were installed in 2021 at the locations KIN-01, KIN-02, KIN-03, KIN-04 and KIN-05. The 2MW WTG is currently offsite awaiting decommissioning and the KIN -06 slot is currently vacant.

A condition in the existing marine licence requires Third Party Certification or Verification (or suitable alternative as agreed, in writing, with the Licensing Authority) for all WTGs, mooring systems and WTG substructures prior to the commencement of the works.

2.5. Project Design Life

The design life for the windfarm is 25 years.

2.6. Construction Programme Overview

The construction of the project is in two 'Tranches' in-line with the Programme outlined in the document ''Construction Programme'', KOWL-REP-0004-001.

Both tranches have now been completed; the Construction Programme for the second tranche was provided to Scottish Ministers prior to commencement of the construction as a requirement of the consent conditions.

3. CONSENT CONDITIONS

Table 3-1 below summarises the consent conditions for the project and highlights the sections of the PEMP where each condition is addressed.

Table 3-1 Summary of consent conditions and relevant sections where condition is addressed in this PEMP document

Licence	Condition Number	Name	Wording in licence	Where Addressed in this PEMP document
S36	22	Project Environmental Monitoring Programme	The Company must, no later than 6 months, or at such a time as agreed with the Scottish Ministers, prior to the Commencement of the Development, submit a Project Environmental Monitoring Programme (“PEMP”), in writing. The PEMP must cover, but not be limited to, the following matters: a. pre-construction, construction (if considered appropriate by the Scottish Ministers) and post-construction monitoring or data collection as relevant in terms of the ES and ES Addendum and any subsequent monitoring or data collection for: i) birds. This should include, but not be limited to, a detailed entanglement monitoring and reporting schedule, as well as a post-consent monitoring plan for bird strike; ii) marine mammals. This should include, but not be limited to, a detailed entanglement monitoring and reporting schedule, particularly of load on the moorings from derelict fishing gear; and iii) diadromous fish; b. the methodology to record and report noise levels from construction and sound profiles from operational floating turbines to be carried out in relation to marine mammals; and	a. Monitoring plans are outlined in Sections 4, 5, 6 and 7 i. Detailed in Section 4 ii. Detailed in Section 5 iii. Detailed in Section 6 b. Detailed in Sections 5 and 7

			c. the participation and contribution to be made by the Company to data collection or monitoring of wider strategic relevance, identified and agreed by the Scottish Ministers, and may include but not necessarily be limited to: i) the avoidance behaviour of breeding seabirds around turbines; ii) flight height distributions of seabirds at wind farm sites; and iii) effects on survival and productivity at relevant breeding colonies. The Company must submit written reports and associated raw data of such monitoring or data collection to the Scottish Ministers at timescales to be determined by them.	c. Detailed in Section 4. Reporting timelines of data collected are detailed in Section 4, 5 and 6.
S36	23	Regional Advisory Group	The Company must participate in any Regional Advisory Group, or any successor group, established by the Scottish Ministers for the purpose of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, ornithology, marine mammals, and diadromous fish. The extent and nature of the Company's participation is to be agreed by the Scottish Ministers.	At the time of writing this PEMP there have been no active groups that are appropriate for KOWL to participate in, although KOWL has attended the Forth and Tay Regional Advisory Group when invited to do so. KOWL will participate in appropriate groups that may be formed as the number of proposed offshore wind projects off the Aberdeenshire coast increases in the near future.
S36	28	SpORRAn (Scottish Offshore Renewables Research Framework)	The Company must, to the satisfaction of the Scottish Ministers, participate in the monitoring requirements as laid out in the 'SpORRAn' (Scottish Offshore Renewables Research Framework) for Diadromous Fish'. The extent and nature of the Company's participation is to be agreed by the Scottish Ministers.	The SpORRAn framework has been replaced by ScotMER. KOWL have attended meetings of the Forth and Tay Commercial Fisheries Working Group as well as the 2023 and 2024 ScotMER Symposia.
S36	29	Marine Mammal Observer	Prior to the Commencement of the development, the Company must confirm the appointment of a Marine Mammal Observer ("MMO"). When appointed, the	MMO's have been appointed as and when required and have provided reports as appropriate.

			MMO must, as a minimum, maintain a record of any sightings of marine mammals and maintain a record of the action taken to avoid any disturbance being caused to marine mammals during pre-construction and geophysical surveys and construction activities.	The geophysical site investigations and construction undertaken to date were carried out under an EPS licence specifically for the surveys. The reports from these surveys have been provided in accordance with the conditions of the licence.
S36	30	Scottish Strategic Marine Environment Group	The Company must participate in any Scottish Strategic Marine Environment Group ("SSMEG") established by the Scottish Ministers for the purposes of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, ornithology, diadromous fish, marine mammals and commercial fish.	KOWL attended a Scoping Workshop on 06/03/2018 'Sectoral Marine Plan for Offshore Wind Energy' organised by Marine Scotland Planning and the Scottish Crown Estate to input into the next round of offshore wind developments in Scotland. An element of this workshop was a discussion research and monitoring programmes. More recently, KOWL attended the 2023 and 2024 ScotMER symposia. KOWL will continue to participate in future meetings, or any other groups established by the Scottish Ministers as appropriate.

4. BIRDS MONITORING PLAN

4.1. Monitoring Approach - Birds

Table 4-1 summarises the outcomes of meetings and dialogue to discuss the approaches to bird monitoring between KOWL and NatureScot, MD-LOT, MSS and RSPB. Table 4-2 describes the key questions that will be addressed by the bird monitoring studies.

Table 4-1 Summary of bird monitoring discussions in PEMP meetings held between KOWL and NS, RSPB, MD-LOT and MSS

Meeting Date	Summary of key discussions and agreements
05/05/2017	**Kittiwake:** Agreed that focus of monitoring for Kittiwake was regarding collision risk **Puffin:** Agreed that focus of monitoring for Puffin was displacement **Bird Tagging:** Agreed that tagging Kittiwake would not provide data specific to assessing collision risk and therefore was not considered necessary.

	Agreed that tagging of Puffins could offer some benefit and should be considered as part of the PEMP from 2018 onwards (tagging in 2017 was not possible). **Collision sensors in WTG blades:** It was agreed that installing collision sensors in the blades of the WTGs would be the most appropriate way to monitor collision risk. However, it was agreed that due to the timescales involved before construction of Unit 1 KOWL would not be able to install sensors in the first unit, but that they will be included for consideration in the PEMP for the larger turbines. **Cameras/Radar:** It was agreed that installation of cameras would also be beneficial for detecting bird collisions and species identification. It was discussed that KOWL would explore available 'off the shelf' camera systems for Unit 1 and work with the manufacturer to develop a more sophisticated system for Units 2-6, including radar if possible. **Aerial Surveys:** A discussion was had as to the cost/benefit of aerial surveys in terms of what the results can provide i.e. presence/absence rather than flight path etc. It was concluded that tagging is more useful and flight data from cameras/radars from the turbine and monitoring focus should be on these instead of aerial surveys. Agreed that Aerial Surveys will be included in the PEMP to start with as a potential option which could be taken forward or removed from the scope as other methods are developed over the next two years of construction. **Adaptive PEMP:** All parties agreed to KOWL taking an Adaptive approach to the PEMP to reflect the Tranches in overall Project programme. The first iteration of the PEMP will present the overarching principles of the monitoring as agreed above and all likely technologies that may be considered for each tranche of WTG installation and once the whole farm is operational. Over time, the PEMP will then be revised at times to be agreed going forward.
19/03/20	**A meeting was held on 19th March 2020 between KOWL, MD-LOT, MSS, NS and RSPB to discuss data from the first 12 months of operation of the 2 MW turbine (March 2019-March 2020).** **Key findings from first 12 months:** During the first year of deployment, the DTBirdV8 unit operated 86.9% of the days with 8 cameras and an additional 9.32% of days with 4 cameras. From final commissioning in June 2019 to March 2020 it operated 91.36% of days with 8 cameras and 6.14% with 4 cameras. A flight is defined as an event which the control unit identifies as a bird and it starts to record the output from all cameras, until it can no longer identify a bird in any of the cameras. From March 2019 to March 2020, the system recorded more than 11,000 flights on the daylight cameras and 379 flights on the thermal cameras.

	The flights corresponded to 44,000 individual birds on the daylight cameras and 6,000 birds on the thermal cameras. Of these flights, DTBird analysts determined that 191 flights were "High Collision Risk Flights" either near to or passing through the rotor swept area. The daylight cameras detected 187 of these, and a further 4 High Collision Risk Flights were detected using the thermal cameras. Amongst these High Collision Risk Flights, 169 were identified as large gulls (Herring Gull or Lesser Black-backed Gull). Five High Collision Risk Flights involved Black-legged Kittiwakes, and a further 3 involved unidentified small gulls. Four Swallows and one Great Black-backed Gull were observed, and the remaining nine flights involved six big sized birds (wingspan 120-180cm) and three very small sized birds (wingspan 10-30cm). Only one collision was observed during these initial 12 months, with a small gull species at 1746hrs on 14th October 2019. The collision was recorded by the thermal cameras. Stakeholders agreed that the purpose of KOWL's PEMP studies should be considered further to identify how best to deploy resources and get the most out of the PEMP studies. Key research questions remain around a) Quantifying the number of collisions for all birds at the development site (micro avoidance) b) Quantifying the number of collisions for Kittiwake alone (as key PEMP requirement) (micro avoidance) c) Compare actual collision data to CRM modelling output. KOWL agreed that these research questions should be central to the objectives of the ornithological PEMP studies. **Atlantic Puffin Tracking Studies** It was suggested by NS that it may be more useful for KOWL to contribute to funding the ongoing works led by UKCEH on Puffin and other auk species (coordinated by the Forth and Tay Regional Advisory Group) rather than KOWL commissioning a separate study. The understanding of puffin movements on the east coast would then not be reliant on the results of several different projects. This suggestion was supported by MSS, and KOWL agreed that this would be a suitable way forward. Data on Puffin displacement will also be gathered as part of the post-deployment aerial survey that KOWL will carry out. **Technical Questions on DTBird system** Stakeholders had several questions around the technical specifications and capabilities of the DTBird systems. The specifications of the DTBird systems are detailed in Appendix A. The stakeholders asked for clarification of the data storage arrangements in the next iteration of the PEMP. These arrangements are detailed in Table 4.3 below. Stakeholders requested further details of proposed ornithological reporting to be provided in this revised PEMP, which are described in the following sections (4.2).

	KOWL committed to providing the reports to MSS as soon as they are available from DTBird.
01/09/21	A meeting was held with KOWL, MD-LOT, MSS, NatureScot and RSPB to review additional data analysis from the 2MW turbine, and to discuss monitoring approaches and the PEMP for the 5 9.5MW turbines. KOWL have analysed further data from the DTBird system on the 2MW turbine from the period March-July 2020 (in addition to the previously-analysed period from March 2019-March 2020) and reported that they have detected no further bird collisions during this period when the turbine was operational. Key actions include an additional technical seminar to be held with DTBird to review the capabilities of the new video camera systems following analysis of one month's data from these systems starting in late 2021. Other topics at the technical seminar are to include potential for flux determination, QA processes for data review, and the use of discouragement triggers. KOWL also advised that collision sensors could not be installed on the 9.5MW turbines (as suggested for consideration on 5/5/17 above) as the turbine manufacturer did not supply them for this turbine model. KOWL proposed developing a log for O+M boats to record absence/presence of gulls on turbine substructures along with times of visits and weather conditions during regular O+M visits. A series of post-construction aerial surveys was agreed – the timing and schedule of these surveys is still to be finalised but they will employ the same methodologies and transects as the original aerial surveys conducted prior to construction. MD-LOT also agreed to organise a separate meeting with UKCEH/RSPB to discuss Puffin studies in the light of stakeholder opinions that tagging studies are of limited value at the Kincardine site, although KOWL remain open to contributing towards wider Puffin tagging studies. Aerial surveys will be used to compare pre- and post-construction Puffin numbers at the site to assess potential displacement.
01/06/22	A technical meeting with DTBird was held with MSS, RSPB and NatureScot to highlight the capabilities of the new systems on the 9.5MW turbines – see Section 4.2.2 below.
08/09/22	A meeting was held with MSS, RSPB and NatureScot together with representatives of HiDef Aerial Surveying to discuss the approach to aerial survey analysis. The data have been collected in a series of monthly surveys from April 2021 to September 2022 which covers two breeding seasons and the intervening non-breeding season. Proposals for the analysis of this data were discussed and agreed – see Section 4.2.3 below. A KOWL proposal to contribute to GLS tagging studies was also discussed although this was felt by stakeholders to be premature as technological hurdles still remain with Puffins which are being currently investigated by a joint RSPB/Crown Estate project – see Section 4.2.1 below.
29/11/22	KOWL sought further clarification from MD-LOT regarding consent condition 22ciii (iii) effects on survival and productivity at relevant breeding colonies. Following internal discussion at MD-LOT, and in consultation with NatureScot, MD-LOT have deemed that there is no time limit on meeting consent condition 22ciii and are content for this to be considered again in the future. MD-LOT

	propose that options to address consent condition 22ciii are reviewed with MD-LOT on an annual basis.
24/10/23	PEMP version C7 was put to consultation in September 2023. Comments from NS, RSPB and MSS were received on various aspects of the bird monitoring programme. KOWL subsequently generated a Gap analysis (submitted to MD-LOT) to address each of the comments and propose next stages for ornithological data collection and analysis.
12/2/24	KOWL and HiDef issued a proposal to consultees to address the comments received during the PEMP C7 consultation. These included a comparative analysis of aerial survey data in 2013/14 with 2021/22 (before and after construction of the Kincardine project together with an associated power analysis, and an analysis of Kittiwake flight heights.
2/4/24	Following the proposal from KOWL and HiDef regarding analysis of digital aerial survey data, NS issued a response to indicate that they generally supported the approach and methodologies proposed, and comments from NS were considered in the final reporting. This included methods for comparing pre- and post-construction digital aerial survey data alongside the power analysis, plus flight height data analysis.
1/11/24 – 13/12/24	HiDef Reports 1a (density modelling), 1b (power analysis) and 2 (flight height analysis) were submitted by KOWL to MD-LOT.
20/1/25	KOWL confirmed to MD-LOT that the report on collision studies using the DTBird technology was nearing completion and would be submitted to MD-LOT in Q1 2025. The analysis covers the 2022, 2023 and 2024 breeding seasons as well as the intervening non-breeding season. The report was submitted on 25/2/25.

Table 4-2 Monitoring approach to birds

Bird Monitoring Approach	**Post-Construction:** The objectives of the bird monitoring post-construction are to improve understanding of seabird interactions with offshore windfarms, and particularly floating offshore windfarms which are located further offshore than fixed foundations windfarms, and validate the assumptions made in the Original ES, ES Addendum and Variation ES. With regards to a 'detailed entanglement monitoring plan' for birds as outlined within the S36 Condition 22, following consultation with MD-LOT it has been agreed that an entanglement plan for marine mammals is sufficient and an entanglement plan for birds is not required. The key seabird concerns identified in the Original ES and HRA were collision risk for Black-Legged Kittiwake from Fowlsheugh Special Protection Area (SPA) and displacement risk for Puffins from Forth Island SPA. The aim of the monitoring surveys is to address these key questions: 1. In relation to Atlantic Puffin; is there connectivity between Forth Island SPA and the Project? 2. In relation to Black-legged Kittiwake; are there detectable effects of collisions occurring at the Project site?

	3. Are the impacts sufficiently large to influence the populations of kittiwake?

4.2. Objectives and Methods of the Bird Monitoring Programme

This section provides details on methods for bird monitoring and how they are being used to achieve objectives of the Bird Monitoring Programme at the Kincardine site to monitor potential impacts on birds in the post-construction and O+M phases.

4.2.1 GPS/GLS Tagging Studies.

Consent condition 22(c iii) requires the company to participate in and/or collect data regarding “effects on survival and productivity at relevant breeding colonies”.

The original objectives of the GPS tagging studies were to use foraging distribution data obtained through tag deployment to investigate the extent of connectivity between the Project and Forth Island SPA Atlantic Puffin populations and potentially finer scale movements in relation to the turbines; and to build on the previous tagging work conducted by RSPB.

However, subsequent to the original iteration of the PEMP and as noted in Section 4.1 above, stakeholders agreed that it may be more useful for KOWL to contribute to funding the ongoing works led by UKCEH on Puffin and other auk species (coordinated by the Forth and Tay Regional Advisory Group) rather than KOWL commissioning a separate study.

At the December 2020 FTRAG meeting, stakeholders stated that they consider that the KOWL project impacts on Puffins from the Forth Islands SPA are unlikely during the breeding season, due to the distance from the KOWL project to the SPA and known foraging distances of Puffins. Therefore FTRAG consider that there is potential that the existing breeding Puffin work on the Isle of May undertaken by UKCEH might not be the most appropriate for KOWL, and any studies should focus on displacement during the non-breeding season to identify extent of connectivity between the Project and other SPAs. There may be appetite amongst stakeholders for a geolocator or global location sensor (GLS) study at UK scale to determine proportion of population in the region and KOWL have approached stakeholders with a proposal to contribute to such a study (e.g. involving a feasibility study of deploying Motus technology at the stie). However, at the 8th September 2022 meeting, stakeholders felt that this would be premature given the current technical challenges in using GLS tags with Puffins, and stakeholders advised that KOWL should await outcomes of ongoing research to evaluate these technologies.

Taking into account this feedback from stakeholders and MD-LOT, and the technological challenges in deploying GLS technology at present, KOWL proposed that the revised aim of Puffin studies at the KOWL site would be to understand possible displacement effects upon Puffins post-deployment of the Project. Aerial survey data has been analysed to compare pre- and post-construction Puffin numbers and distributions at the site, with an associated power analysis (see Aerial Surveys section below). This analysis was completed in Q4 2024 and reports have been provided to MD-LOT (HiDef Reports 1a and 1b).

RSPB highlighted at the 8th September 2022 meeting that Kittiwake tagging data had been gathered by RSPB during the 2021 breeding season at Fowlsheugh, and it was agreed that KOWL will seek access to this data via MD-LOT in order to analyse the usage of the KOWL site by Fowlsheugh-tagged Kittiwakes. These data have not yet been provided to KOWL, but BTO data from satellite-tagged Kittiwakes from the Buchan Ness to and Collieston Coast SPA have recently been published (October 2024). No current Kittiwake tagging studies are planned by KOWL.

KOWL will continue to engage with all stakeholders to identify the most appropriate research design and methodologies to address the monitoring requirements for Puffin and effects of the project on relevant seabird breeding colonies. Following correspondence with MD-LOT and consultation with stakeholders, MD-LOT have deemed that there is no time limit on meeting consent condition 22ciii and are content for this to be considered again in the future. Scientific understanding of seabird behaviour including effects on their survival and productivity are evolving and our ability to understand this is constantly changing through evolving methodologies and technologies. It may be that at some point in the future there are techniques more suited to enable KOWL to discharge this condition than are currently available. MD-LOT therefore propose that options to address consent condition 22ciii are reviewed with MD-LOT on an annual basis.

4.2.2 Video Cameras and Collision Detection Studies.

Consent condition 22 (a i) requires KOWL to provide a post-consent monitoring plan for bird strike. Additionally, consent condition 22 (c i) requires KOWL to collect data or monitoring regarding the avoidance behaviour of breeding seabirds around turbines. The objectives for the collision detection studies with video cameras are to provide data on real time detection of birds in the vicinity of the windfarm; to provide video and audio recordings of bird collisions; and to enable species identification of bird collisions.

Eight HD cameras were installed on the 2MW turbine which have continuously recorded video and sounds of every flying bird that was detected within the vicinity of the turbine. The system deployed was DTBird V8, which is a self-working system that monitors bird activity in real-time and detects any bird species flying during the day or night, all year round. The system uploads video and audio recordings of every bird flight detected to DTBird online Data Analysis Platform, to which access is protected with a username and password. Recorded data can include location, flight ID, flight time data, flight video records with embedded audio. This system enables bird identification based on bird shape, flight pattern and wing beat frequency from both the video and the audio files, although in practice audio has not been used to identify birds in the reports provided by KOWL. In addition, the system takes HD camera snapshots every hour. There are environmental sensors on the DTBird units to collect information on light, temperature, humidity, rain, fog, wind speed and direction.

The daylight cameras have limited capability during hours of darkness as they operate in a lux >50, however, two thermal cameras were mounted on the 2MW turbine to ensure night detection of bird activity.

Six of the daylight cameras look forward from the base of the turbine tower and together they cover the full 360° circumference of the turbine. The remaining two cameras point upwards towards the rotor swept area. The two thermal cameras are located on opposite sides of the turbine tower and point forwards, covering 45x33°.

The DTBird V8N2 systems on the 5x 9.5MW turbines have a different configuration of cameras, with four forward-facing and four vertical cameras to cover the larger rotor swept zone, as well as two thermal cameras.

Full technical details and specifications of the DTBird systems are presented in Appendix A.

The analysis of the data has been conducted initially by trained ornithologists at DTBird who reviewed the videos and sound recordings and provided identifications and numbers for any birds encountered, as well as details of any collisions. Identifications and counts of birds have been carried out via a visual assessment of the images (and aural assessment of sound recordings if available), and potential high-collision risk flights are identified by the ornithologists via visual assessment of the flight paths observed as birds pass one or more of the cameras. Similarly any collisions were identified via a visual assessment of birds either hitting the blades in view of the cameras or falling debris passing the cameras.

Further analysis of the data from the 2MW machine was conducted by KOWL ornithological advisors to determine:

- Availability of data for key species / species groups
- Proportion of unidentified records
- Camera operation times and downtime
- Visual assessment via review by a trained DTBird ornithologist and graphical analysis of data for key species / species groups to include:
- Data for key species/species groups (e.g. Black-legged Kittiwake/small gulls, Herring Gull, large gulls, Gannet)
- Checks on extent of unidentified records (for key species / species groups) and any systematic biases in their occurrence
- Graphical presentation of seasonal and diurnal patterns of occurrence for key species / species groups and potential interactions in these (i.e. variation in diurnal patterns with season), flock number and sizes.

Full tabular and graphical summaries from the analyses above have been provided to consultees with associated annotated explanation from KOWL ornithological advisors in a Royal Haskoning DHV report[1]. The report highlights that *"Over the period of the monitoring (i.e. March 2019 to July 2020), only one actual confirmed collision was recorded with this involving a 'small gull' (at 17:46h on 14th October 2019). On another occasion (at 08:17h on 21st May 2020), a medium-sized bird (for which species or species group was not determined) was recorded narrowly missing the turbine blades but it recovered a normal flight pattern after initially falling."*

Similar analysis has been carried out on data from the 9.5MW turbines from January 2022 to September 2024 i.e. 33 months of post-installation data from the DTBird systems. It is KOWL's intention (subject to review of these results) to cease collision monitoring data collection in September 2024 now that 33 months of data have been collected, covering three seabird breeding seasons and two intervening non-breeding seasons. A report covering this analysis was submitted to MD-LOT on 25th February 2025

All collisions detected by the DTBird systems have been reported to MD-LOT and this empirical collision data has been compared with CRM predictions specifically for Black-legged Kittiwake; however the numbers of collisions recorded have been extremely low (just one Kittiwake collision at the original 2MW turbine, with one Kittiwake collision and one large gull collision in the 33 months of data collection at the five 9.5MW turbines). This rate of observed collisions is significantly lower than the original HRA CRM predictions at the Kincardine site.

DTBird have recently been able to add information on approximate bird detection distances to the data collected, and this information has been added to all videos from Q3 2022. This will help to understand micro-avoidance behaviour of birds at the turbines. Results from this technique have been analysed and reported to MD-LOT.

Data management from the DTBird systems is challenging given the large sizes and numbers of videos generated, necessitating contractual arrangements between KOWL and DTBird whereby the video and sound recordings are currently stored by DTBird on behalf of KOWL for 3 years but specific videos (principally those showing collisions) can be downloaded and stored for longer if required. The associated analytical data (including dates, times, rotor status, lux, anemometer data, species, numbers, rotor crosses, collisions, video length and any other comments by the DTBird analysts) are stored for 10 years on the DTBird Data Analysis Platform (DAP) located in a Data Center classified

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[1] Kincardine Offshore Wind Farm DTBird data analyses: Seasonal and diurnal variation in occurrence of key seabird species and groups. Royal Haskoning DHV Report, November 2021

Tier 3, up to 100 Gb per year per DTBird Unit. Access codes for the DAP have been provided to MSS. Only videos with confirmed false positives (e.g. sky artifacts, turbine structures and blades) will be periodically deleted from the system, and the actual data points showing that a video was determined to be a false positive will be retained in the DAP.

4.2.3 Aerial Video Surveys for Bird Abundance and Distribution Studies.

Consent condition 22 (c i) requires KOWL to collect data or monitoring regarding the avoidance behaviour of breeding seabirds around turbines, and the aerial video surveys are designed to address issues of macro-avoidance and displacement. The aerial surveys are also capable of collecting information on flight height distributions as required in Consent condition 22 (c ii), as well as informing potential connectivity with neighbouring relevant breeding colonies as required in Consent condition 22 (c iii).

The objectives of the aerial video surveys are to collect seabird distribution and estimation of abundance to compare against baseline survey collected pre-construction to estimate displacement resulting from avoidance of the windfarm.

A series of monthly aerial surveys was undertaken post installation of the 9.5MW turbines, incorporating the same flight paths from pre-construction survey detailed in the ES, in addition to extra transects extended towards Fowlsheugh during the breeding season.

The aerial surveys began in April 2021 and continued until the final survey in September 2022, covering the 2021 and 2022 breeding season as well as the intervening non-breeding season.

The data from the post-construction surveys has been compared to the pre-construction surveys to estimate displacement of key species, including Black-legged Kittiwake and Atlantic Puffin. Analysis of the survey data also examines displacement of these key species during the non-breeding season. At the meeting with stakeholders and the aerial survey provider (HiDef Aerial Surveying) in September 2022, the approach to aerial survey data analysis was discussed and agreed; this was refined following a stakeholder review of PEMP version C7 and further comments from NS in April 2024.

The data analysis from the aerial surveys covers:

- Details of survey transects flown (dates, timings, completeness) via maps and tables
- Analysis of bird species (identification, numbers, density and distribution) via density and distribution maps, tables and histograms as appropriate
- Comparison of 2021-22 dataset with 2013-2014 for selected species (Kittiwake, Puffin, Guillemot, Razorbill, Gannet) via maps, tables and histograms as appropriate – changes in density and distribution were analysed via density surface modelling, using the Marine Renewables Strategic Environmental Assessment tool (MRSea) in R (Scott-Hayward et al., 2014)[2].
- Flight height analysis for selected species (Kittiwake) via HiDef's flight height tool, which uses a bootstrap resampling method to compare sample body lengths to body lengths of birds identified as flying at the sea surface, and estimates the difference in size between the two.
- Comparison of Kittiwake flight heights with published datasets/models via histograms and tables as appropriate

[2] Scott-Hayward, L.A.S., Walker, C.G. and M.L. Mackenzie (2021). Vignette for the MRSea Package v1.3: Statistical Modelling of bird and cetacean distributions in offshore renewables development areas. Centre for Research into Ecological and Environmental Modelling, University of St Andrews.

Flight direction analysis was originally proposed for Kittiwake, but MD-LOT and stakeholders clarified in correspondence on 29th November 2022 that this method would not be suitable for addressing consent condition 22ciii, and as with the proposed tagging studies, MD-LOT proposed that options to address consent condition 22ciii are reviewed on an annual basis as required. HiDef Report 1a (aerial survey analysis), Report 1b (power analysis) and Report 2 (Kittiwake flight height analysis) have been provided to MD-LOT in Q4 2024 for review by consultees.

4.2.4 Visual Surveys for gulls utilising the turbine substructures.

As stated previously, consent condition 22 (c i) required KOWL to collect data regarding the avoidance behaviour of breeding seabirds around turbines.

The objectives of the visual surveys are to collect basic data on the presence and numbers of gulls perching on the turbine substructures at different times of the year, as the presence of the substructures may prove attractive to birds which could potentially act as a driver for collision risk.

These data were collected during regular O+M visits to the site, and KOWL developed a logsheet that was filled in by maintenance boat personnel to record the approximate numbers of birds resting on each turbine during the visit, along with dates and times of each visit. The visual surveys started in November 2021 for a period of 12 months. A summary report of the data collected during November 2021-October 2022 has been provided to stakeholders, showing the total numbers of gulls recorded on the turbine structures at different times of the year.

4.2.5 Additional methods considered: Collision Sensors and Radar

During previous iterations of the PEMP, it was stated that two additional methods for bird monitoring would be considered at the project post-construction, namely collision sensors and radar.

The original PEMP described that collision sensors would be considered for installation in the blades of turbines KIN-01-to KIN-05, with an objective to collect direct measurements of collisions with WTG blades to assess number of collisions per year and compare to estimates used in collision risk modelling.

The original PEMP also stated that the decision to install such sensors was to have been made following the initial twelve months of site data collected from the cameras on the 2MW turbine. However, the turbine manufacturer for the 9.5 MW WTG’s does not supply collision sensors for the model installed at the Project. Furthermore, as the objective to record collisions and compare with CRM was being addressed by the DTBird system (see Section 4.2.2 above), it was decided not to pursue the installation of collision sensors in the blades for the remaining WTG’s.

The original PEMP also stated that radar was to be considered (provided that suitable deck space was available and engineering parameters could be met). The objective of these radar studies was to provide accurate bird flight and behaviour monitoring around the windfarm.

Monitoring by radar would provide accurate bird flight and behaviour monitoring around structures. This would provide real-time data (day and night) on any macro-avoidance around the turbines. However, the original PEMP stated that due to the size and power requirements of such radar devices, any decision on installing such units on later turbines would be deferred until the initial 12 months of monitoring has been collated from the DTBird video camera systems.

Following subsequent discussions with KOWL engineers regarding the feasibility of installing radar systems, and analysis of the initial 12 months of data, KOWL informed stakeholders in July 2021 that the installation of radar systems would not be feasible at the Project, and the Bird Monitoring Programme would be completed using a combination of the methods in sections 4.2.1-4.2.4 above.

4.3 Reporting – Bird Monitoring Programme

In accordance with the provisions of Consent condition 22, KOWL will submit survey reports and raw data to MD-LOT on behalf of the Scottish Ministers in support of the discharge of conditions within three months of receiving the data from survey contractors or equivalent.

Raw data and monthly reports from the HiDef aerial surveys have been provided to MD-LOT in June 2023; the comparison between 2013/14 and 2021/22 aerial survey data was completed in Q4 2024 along with an associated power analysis. Flight height analysis of the data was completed in Q4 2024. MD-LOT and stakeholders have been provided access to the DTBird Data Analysis Platform to view raw data at any time. A report on the results of the DTBird collision monitoring at the original 2MW turbine was submitted to MD-LOT in 2021, and a second report on the outcomes of the DTBird analysis at the five 9.5MW turbines was submitted in February 2025. Meetings will also be held with statutory consultees before iterations to PEMP are due to review any available data and agree any amendments to the strategy. A PEMP review meeting was held in September 2022, and comments on the PEMP version C7 by NS, RSPB and MSS were received by KOWL in Q4 2023. Subsequently a Gap analysis was provided by KOWL to MD-LOT to respond to the comments raised by stakeholders on the PEMP version C7; this has been reviewed on a regular basis by KOWL and MD-LOT with meetings in September and November 2024, January and March 2025, and has resulted in amendments to the PEMP that are incorporated in this version C10.

4.4 Summary of Bird Monitoring Programme

The bird monitoring programme described in Section 4.2 is summarised in Table 4-3 below and will be reviewed at subsequent intervals.

Table 4-3 Summary of Bird Monitoring Programme phases, activities and purpose

Project Phase/Reviews	Proposed Activity	Purpose
2MW turbine March 2019-July 2020	Video Camera study (DTBird) mounted on 2MW turbine	Detection of collisions and micro-avoidance around the 2MW turbine (Consent conditions 22 a i and 22 c i)
2MW Data Review and PEMP Update	Meeting with MSS, MD-LOT, NS and RSPB	To discuss data collected from Tranche 1 and agree any amendments to PEMP – held on 19/3/20 to review first 12 months data (Consent conditions 22 a i and 22 c i).
Post construction/O+M – 5x 9.5MW turbines	Meetings with MSS, MD-LOT, NS and RSPB (held in September 2021 and September 2022). Additional meetings with MD-LOT in September and November 2024, January and March 2025	Meetings were held with stakeholders in September 2021 and September 2022 to agree approaches to discuss data collected to date and agree PEMP for post-construction monitoring.(Consent conditions 22 a i and 22 c i).
Post construction/O+M – 5x 9.5MW turbines	Tagging/Geolocator studies	Contribution of KOWL to wider tagging/geolocator studies is still under review to determine if alternative technologies (e.g.

		Motus) would be a more suitable alternative – see Section 4.2.1 above (Consent condition 22c iii)
Post construction/O+M – 5x 9.5MW turbines	Video Camera study (DTBird) mounted on 9.5MW turbines	Collisions and micro-avoidance behaviour around the 9.5MW turbines – see Section 4.2.2. above (Consent conditions 22 a i and 22 c i).
Post construction/O+M – 5x 9.5MW turbines	Aerial video surveys: series of aerial video surveys and associated power analysis.	Seabird distribution and estimation of abundance to compare against baseline survey collected pre-construction to estimate displacement, macro-avoidance and potential connectivity to Fowlsheugh and Forth SPA's – see 4.2.3 above (Consent conditions 22 a i,22 c i, c ii and c iii).
Post construction/O+M – 5x 9.5MW turbines	Visual surveys during O+M visits	To collect basic data on numbers of gulls utilising the substructures as a potential driver of collision risk – see 4.2.4 above (Consent condition 22 c i).
O+M phase	Meeting with MD-LOT and consultees – to be held in mid-2025 following analysis of DTBird and HiDef survey data	To review data following post-construction period and review any further modifications to final PEMP version C10 for O+M phase (Consent conditions 22 a i,22 c i, c ii and c iii).

5. MARINE MAMMALS MONITORING PLAN

5.1. Monitoring Approach – Marine Mammals

Table 5-1 summarises the outcomes of meetings to discuss the approach to marine mammal monitoring that have been held to date between KOWL and NatureScot, MD-LOT, MSS and RSPB. Table 5-2 describes the key questions that will be addressed by the marine mammal monitoring studies.

Table 5-1 Summary of marine mammals monitoring discussions in PEMP meetings held with NS, RSPB, MD-LOT and MSS

Date	Summary of key discussions and agreements
05/05/2017	**Noise Profiling:** Noise Profile – all parties agreed that any data on the noise profile of floating offshore windfarms will be invaluable as this data does not currently exist. **Entanglement:** All parties agreed that load cells and ROV surveys were sufficient methods for monitoring impacts to marine mammals, however, it was suggested that ROV survey frequency may need to be increased in the purpose of marine mammals monitoring to start with, and then over time, the frequency could be reduced. **Adaptive PEMP:** All parties agreed to KOWL taking an Adaptive approach to the PEMP to reflect the Tranches in overall Project programme. The First Iteration of the PEMP will present the overarching principles of the monitoring as agreed above and all likely technologies that may be considered for each tranche of WTG installation and once the whole farm is operational. Over time, the PEMP will then be revised at times to be agreed going forward.
19/6/2023	Following submission of the completed Supergen FORTUNE project report and Drifting Ear reports to MD-LOT and stakeholders, NS have advised that they consider that the noise profiling aspects of consent condition 22b as being satisfactorily met by KOWL. MSS required further clarifications to the information provided, which are included in subsequent sections of this PEMP document. MD-LOT also requested further details from KOWL on its approach to entanglement of sea mammals via “ghost nets”.

Table 5-2 Monitoring Approach to marine mammals

Monitoring Approach	Pre-Construction: Pre-construction noise profiling has been agreed with NS and MD-LOT. The purpose of the measurements is to provide good quality, reliable measurements of the baseline underwater noise to determine the pre-existing acoustic environment prior to the installation of the 2MW turbine. Construction: The construction of the substructures was undertaken in ports, and therefore the activities on site will be limited to installation of the units (substructures and WTGs) including towing, hook up and

	commissioning only. Installation of the units on site is expected to take less than one week (tow to sites, hook up to moorings and export cables), and therefore, monitoring during construction and installation of the units is not considered necessary as agreed during consultation with the key stakeholders. Post-Construction: As part of the project HRA no marine mammal impacts were identified from the proposed construction approach (no piling being the main reduction factor), therefore, the primary aim of the monitoring is to improve the understanding of the noise profile from floating windfarms. The aim of the monitoring surveys is to address these key questions: 1. What is the noise profile of floating offshore wind turbines? 2. Does the presence of the mooring lines cause a potential hazard to marine mammals in the vicinity of the Project?

5.2. Objectives and Methods of the Marine Mammal Monitoring Programme

This section provides details on methods for marine mammal monitoring and how they are being used to achieve objectives of the Marine Mammal Monitoring Programme at the Kincardine site to monitor potential impacts on marine mammals in the post-construction phase. The following sections also contain outlines of studies that have been carried out to-date at the 2MW and 9.5MW turbines.

5.2.1 Noise profiling studies – pre- and post-construction

Consent condition 22 b requires KOWL to present “the methodology to record and report noise levels from construction and sound profiles from operational floating turbines to be carried out in relation to marine mammals”. The overarching objectives of the noise profiling studies were to collect data on noise emitted into the water column from a floating turbine, and determine the noise profile around the structure.

The purpose of noise profiling pre-construction is to provide good quality, reliable measurements of the baseline underwater noise to determine the pre-existing acoustic environment prior to the installation of the 2MW turbine.

It was agreed with NS and MS that a one-day (eight hours of survey data) boat-based survey would be sufficient to provide information for both background noise (pre-installation) and baseline information, to be repeated as exactly as possible during operation.

Noise monitoring was undertaken using the Scottish Association for Marine Science (SAMS) own designed Drifting Ear. The Drifting Ear deployment methodology was specifically designed by SAMS for noise measurements in high flow tidal sites. The basic principle of the Drifting Ear design is to keep a free-floating drogue mounted hydrophone fixed to a moving body of water rather than the seabed. The devices are connected to a surface float which contains an Iridium based satellite communication system for field-based tracking, as well as a GPS unit to record precise location information. The recorded satellite and GPS data monitor the tracks and drift rate of each Drifting Ear unit for subsequent analysis. Hydrophones are suspended within the drogues approximately six meters below the surface and connected near the recorder to reduce the introduction of cable-related noise.

The drifter mounted hydrophones (RESON TC4014-5) are broadband omnidirectional units characterized by low internal noise and high sensitivity (180 dB ±3 dB re 1V/µPa) with a frequency response of 25 Hz – 250 kHz ± 3 dB. Acoustic data is recorded using a compact digital underwater recorder (EA-SDA14), with resulting sound files stored internally on SD cards.

The recorders are set up to sample at 312.5 kHz with 32-bit resolution to cover a broad frequency band and allow interpretation of all likely noise sources without aliasing risks. The Drifting Ear method does not require any license as the equipment will not be deposited on the seabed.

The pre-construction Drifting Ear noise survey was carried out by SAMS Research Services Ltd. on Thursday 17th May 2018, with approximately eight hours' worth of data collected throughout the day. A full report on the findings of the pre-construction noise profiling survey has been submitted to MD-LOT.

The purpose of noise profiling post-construction is to provide good quality, reliable measurements of the acoustic environment following the installation of the 2MW turbine. Post construction monitoring was commissioned by KOWL to collect data on noise emitted into the water column from a floating turbine, to determine the noise profile around the structure. The survey was carried out by SAMS Research Services Ltd. on 5th June 2019 whilst the 2MW turbine was operational, using the same "Drifting Ear" methodology that had been employed during the pre-construction survey. A full report on the findings of the post-construction noise profiling survey has been submitted to MD-LOT.

Post construction noise profiling (after installation of the five 9.5MW WTGs) has subsequently been carried out at the KOWL site as part of the Supergen/FORTUNE (Floating Offshore Wind Turbine Noise) project carried out by SAMS. Three noise monitoring devices were placed on the seabed (containing a combination of SoundTrap full-bandwidth recorders and F-POD porpoise click detectors) at locations near the windfarm site, for a period of approximately one month in commencing on 2nd November 2021. The aim of the Supergen/FORTUNE project is to obtain systematic long-term measurements of underwater noise and the acoustic signatures generated by floating offshore wind turbines under different environmental conditions at multiple locations. Participation by KOWL in this project allows comparison of noise profiling of the KOWL wind turbine design with different turbine types used at other project locations in the UK.

The final Supergen/FORTUNE report has been submitted to MD-LOT and has been reviewed by stakeholders. In correspondence from MD-LOT in June 2023, NS have stated that the provision of these reports support NS's conclusion that the condition relating to construction and operational noise monitoring and implications for marine mammals has been met and can now be discharged.

MSS also advised that the Consent Condition 22b in the PEMP relating to post-construction noise profiling and marine mammals has been generally met. However, MSS note that the modelling in the report excluded a number of impulsive transients recorded (2000-6000 per day). Furthermore, MSS, note that the relatively short deployment period of both broadband recorders (maximum single device deployment of 44 days) and cetacean click detectors (maximum single deployment of 84 days) is not sufficient to determine the variation in sound-scapes and porpoise detection rates through the suite of conditions that might be represented throughout a typical year. Further, the deployments' focus on winter months may not reflect the elevated noise imparted by increased shipping traffic as a result of maintenance vessel presence.

In response to these comments and queries highlighted by MSS, the report authors at SAMS acknowledge that the transients were not considered in the noise modelling of this project as they were interested in the floating turbine-generated noise signature to compare this with outputs from fixed wind turbines. It was outside the scope of this project to model the contribution of transients to overall noise levels. However, it was clearly stated in the report that transients created by the mooring system are contributing considerably to the noise signature of floating offshore wind turbines, and cannot be ignored in noise impact assessments.

The report authors also highlight that the FORTUNE project was a one-year pilot research project funded by the Supergen programme (without financial contribution by either developers or regulators) to obtain some of the first noise signature and noise level measurements aver collected around FOW turbines. The aim of the project was to obtain as much data as possible from two different types of turbines (i.e. spar-buoy and semi-submersible platforms) in a range of sea states and tidal conditions. 'Long-term' in this context meant the recording of data over several weeks, rather than a few days as is sometimes done when describing device signatures. The constraints of the project, which had to be carried out and delivered within one year in line with Supergen regulations, dictated the length of the deployment periods. It is recognised in the report that longer-term recordings over a full year would be beneficial to capture further environmental conditions. However, a range of sea states and tidal conditions has already been captured even with these short deployment times, and this is also stated in the report.

It is also worth noting that the F-PODs were an add-on to the project, the main focus of which was to understand the underwater noise produced by the turbines, rather than study porpoise detection rates. The subsequent analysis of porpoise presence at the site, was thus preliminary (as stated in the report) and needs to be expanded to fully understand porpoise behaviour in the site over time. This was outside the scope of the project, but the porpoise data collected at Kincardine are currently being examined through an ongoing PhD project.

The SAMS report authors agree that there are other factors that might influence porpoise behaviour at floating offshore wind sites, and that maintenance vessel noise will contribute to porpoise presence and behaviour. However, assessment of these other influences was outside the scope of this research project. As mentioned previously, the aim of the project was not to assess noise impacts associated with floating offshore farms on marine mammals. Porpoise presence data presented in the report were collected opportunistically, whilst the main aim of the project was the description of the noise signature of floating turbines. A more in-depth investigation of porpoise behaviour around FOW arrays would be designed very differently and would require additional funding and longer-term monitoring. More data (notably passive acoustic monitoring [PAM] data as well as auxiliary information such as VMS and AIS vessel tracks) would be necessary to comment on how vessel traffic in this particular site might impact porpoise behaviour. However, this was not the aim of the FORTUNE project.

KOWL will continue to engage with the ScotMER framework, SAMS and other partners to identify additional opportunities to address the research gaps around inter-year and seasonal variability, and KOWL remains open to hosting similar research projects to Supergen/FORTUNE at the site in future. Indeed, a further 3-month deployment of floating ear technology was carried out by SAMS in Spring 2024 at the project site (including an analysis of transient noise signals), and reporting will be provided to MD-LOT on the completion of this project.

5.2.2 Entanglement – ROV studies and monitoring for strains on mooring lines

Consent condition 22 (aii) requires KOWL to provide "a detailed entanglement monitoring and reporting schedule, particularly of load on the moorings from derelict fishing gear".

During the construction works it was not possible to install load cells to the mooring lines for continuous monitoring of mooring line loads. There are many variables affecting the load on the mooring lines and there is doubt as to whether the load from entangled fishing nets would be detectable by load cells. Furthermore, due to the steep angle (less than 40 degrees to the vertical when at their static position) and nature of the material of the mooring lines it is expected that any entangled fishing nets would slide to the bottom of the lines towards the touch-down point of the moorings at the seabed further preventing detection of any additional load due to entanglement.

There is a position monitoring system installed on each structure which will indicate if a mooring line load has changed over a period based on observing a change in the offset of the structure. This can be used to compare each structures' position with reference to their installed nominal position. This system provides continuous reports and logs can be obtained and provided if necessary. Should a permanent anomalous significant shift in the position of any of the turbines occur, this will be reported to MD-LOT. However, KOWL consider that this technology would not be sufficiently sensitive to detect entanglement of fishing gear or other debris around the Kincardine substructures and cabling.

Periodic maintenance ROV surveys are primarily to be used for monitoring the integrity of the inter-array cables, export cables, mooring lines and anchors, however, the surveys also offer the opportunity to monitor the presence of ghost fishing nets lodged on the mooring system. These surveys are part of class surveys under American Bureau of Shipping (ABS) rules and will be inspected according to these standards. A programme of visual ROV surveys will be carried out to inspect all cables and moorings at the site, and a set of surveys was carried out in late 2023 in accordance with the O+M plan. The results of the surveys have been made available to MD-LOT upon completion. No nets or entangled debris were found during the November 2023 surveys, nor during the works associated with the Major Component Exchange on KIN-02 and KIN-03.Should any entangled debris be found on future surveys, this will be removed (as long as it is safe to do so). The next set of ROV surveys is planned for mid- 2025.

Furthermore, KOWL have recently granted permission to HiDef to analyse aerial survey data gathered at the site (during bird monitoring studies) to search for discarded fishing gear that could pose an entanglement risk, as part of a new SAMS project.[3]

5.3. Reporting – Marine Mammal Monitoring Programme

In accordance with consent condition 22, KOWL will continue to submit survey reports and raw data to MD-LOT on behalf of the Scottish Ministers in support of the discharge of conditions where appropriate within three months of receiving the data from survey contractors or equivalent. Outputs of the SAMS Drifting Ear studies and the Supergen/FORTUNE project have been provided to MD-LOT and it is anticipated that the results of the Supergen/FORTUNE project will be published in a peer-reviewed academic journal. Outputs from the 2024 3-month noise monitoring deployment will also be provided to MD-LOT. ROV survey results including details of any entangled materials found or removed will be provided to MD-LOT by KOWL on receipt of the reports from the ROV contractors.

5.4. Summary of Marine Mammal Monitoring Programme

The marine mammal monitoring programme described in Section 5.2 is summarised in Table 5-3 below.

Table 5-3 Summary of Bird Monitoring Programme phases, activities and purpose

Project Phase	Proposed Activity	Purpose
Pre-construction	Noise profiling (One 1-day survey)	Create a baseline noise profile prior to installation (Consent condition 22 b).

[3] "Investigation into the potential risk of entanglement of marine mammals with discarded fishing gear associated with floating offshore windfarms (CASE/701072) Project code: Project_MM_24-25_2 Short title: Marine Mammal Entanglement Floating Offshore Wind

2MW turbine March 2019-July 2020	Noise profiling (One 1-day survey)	Create a noise profile for the 2MW turbine (Consent condition 22 b).
Post construction/O+M – 5x 9.5MW turbines	Pre-Tranche 2 Data Review with NS and PEMP Update for Final PEMP	To discuss data collected from Tranche 1 and agree any amendments to PEMP (Consent condition 22 b).
Post construction/O+M – 5x 9.5MW turbines	Monitoring strains on mooring lines via changes in offset of the structure	Continuous monitoring for position of the moored structure (Consent condition 22 a ii).
	ROV surveys	Visual inspection of the mooring lines including for entanglement of marine mammals at minimum intervals of approximately 1- year (Consent condition 22 a ii). Removal of any entangled material provided it is safe to do so. Report any findings of entangled material and removal to MD-LOT.
	Noise profiling (One 1-month survey as part of Supergen/FORTUNE project)	Create a noise profile post-construction for the 9.5MW turbines, allowing comparison with acoustic signatures of other floating wind turbine designs (Consent condition 22 b)
	Noise profiling (One 3-month survey as part of Supergen/FORTUNE project)	Additional noise profiling to include transient noise signals (Consent condition 22 b)

6. DIADROMOUS FISH MONITORING PLAN

6.1. Monitoring Approach – Diadromous Fish

Consent condition 22 a iii requires KOWL to provide monitoring or data collection for diadromous fish, and condition 28 requires the company to participate in monitoring requirements as laid out in the "SpORRAn" (Scottish Offshore Renewables Research Framework) for Diadromous fish. The SpORRAn framework has now been superseded by ScotMER, and the current monitoring approaches were developed subsequent to KOWL's attendance at the 2023 ScotMER symposium.

Table 6-1 summarises the outcomes of meetings to discuss the approach to diadromous fish monitoring that have been held to date between KOWL and NatureScot, MD-LOT, MSS and RSPB. Table 6-2 describes the key questions that will be addressed by the diadromous fish monitoring programme.

Table 6-1 Summary of Diadromous Fish monitoring discussions in PEMP meetings held with NS, RSPB, MD-LOT and MSS

Date	Summary of key discussions and agreements
05/05/2017	It was noted during the meeting that the likely impacts to diadromous fish were of lesser significance than other organisms, namely Kittiwake and Puffin and therefore the level of monitoring should reflect that. It was suggested that KOWL could provide a contribution to the Scottish Government Strategy that is currently being conducted and this would constitute sufficient monitoring for diadromous fish.
03/03/2023	Meeting with MSS following the 2023 ScotMER symposium to discuss key knowledge gaps for effects of offshore wind developments on diadromous fish and possible areas where KOWL could make an impactful contribution. Discussions centred on techniques for assigning fish caught at sea to their natal rivers. It was decided to approach Dr Anna Sturrock of the University of Essex to develop a research proposal.
31/03/23	Meeting with MSS and Dr Anna Sturrock to discuss potential options for a research programme focused on using biogeochemical markers to assign fish to natal rivers. The preferred option would be for KOWL to co-fund a PhD student at the University of Essex to develop these tools for the Scottish context.
23/5/23	MD-LOT responded to initial proposal to conduct a PhD study with the University of Essex. MD-LOT recommended that a PhD panel is convened with representatives from the developers, NatureScot and MSS to guide this topic and the successful candidate as the PhD progresses. MD-LOT requested a detailed project proposal for review in line with MSS advice (this was subsequently provided by KOWL). MD-LOT stated that in principle the proposal would be sufficient to address condition 22aiii of the s.36 consent, but the consent condition will not be met until the PhD is in progress and reporting regularly to the PhD panel.
28/9/23	Funding for the PhD project was secured by KOWL and University of Essex in summer 2023 and the PhD student was recruited. The first meeting of the PhD advisory panel took place on 28/9/23, including representatives from KOWL, NatureScot and MSS along with the PhD supervisory team and the student. Subsequent panel meetings have been held at 6 monthly intervals and minutes sent to MD-LOT.

Table 6-2 Monitoring Approach to Diadromous Fish

Monitoring Approach	Pre-Construction: No pre-construction monitoring or data collection on diadromous fish was considered necessary as agreed during consultation with key stakeholders Construction: The construction of the substructures took place at port, and therefore the activities on site was limited to installation of the units (substructures and WTGs) including towing, hook up and commissioning only. Installation of the units on site takes less than 1 week (tow to sites, hook up to moorings and export cables), and therefore, monitoring during construction and installation of the units was not considered necessary as agreed during consultation with key stakeholders. Post-Construction: KOWL have contributed towards a PhD study starting in autumn 2023 which addresses the key knowledge gaps in assigning diadromous fish to their natal rivers (see below). KOWL have also attended meetings of the Forth and Tay Commercial Fisheries Working Group as well as the 2023 and 2024 ScotMER symposia.

6.2. Objectives and Methods of the Diadromous Fish Monitoring Programme

In order to meet the requirements of Consent condition 22 (a iii), KOWL had discussed the potential to contribute to a monitoring programme regarding tagging adult salmon and/or sea trout and investigating adult returns to the Rivers Dee and Don Trusts and in conjunction with other on-going monitoring programmes. However, as the smolt tagging programme has now come to an end, KOWL initiated dialogue with stakeholders to explore alternative research programmes that address key knowledge gaps as identified at the 2023 ScotMER symposium. Discussions with Dr Anna Sturrock of the University of Essex centred on a project to investigate using biogeochemical markers to assign fish to their natal rivers, which will contribute towards understanding the impacts of offshore wind developments on the movements of diadromous fish. Subsequently KOWL has provided funding towards a 4-year PhD study which commenced in autumn 2023 to develop and validate these tools (previously developed by Dr Sturrock for Pacific Salmon in the US/Canada) in the Scottish context, thereby allowing fish caught at or near offshore renewable developments to be assigned to their natal rivers with greater certainty than is provided by current methods.

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6.3. Reporting – Diadromous Fish Monitoring Programme

Confirmation of the contribution given from KOWL to the programme has been provided to MD-LOT in order to discharge the licence conditions in Consent conditions 22 (a iii) and 28. A PhD panel consisting of representatives from KOWL, NatureScot, MSS and the University of Essex has been convened to further guide the PhD candidate and studies, and data and research outputs from the project will be provided for the panel to review. The panel has convened at 6 monthly intervals starting in September 2023; minutes of each panel meeting have been provided to MD-LOT. Thereafter there will not be any further reporting requirements from KOWL, but it has been agreed that the data and research outputs from the programme will be provided to the Scottish Government as a requirement of the programme. These outputs include a presentation by the PhD student at the 2024 ScotMER symposium.

6.4. Summary – Diadromous Fish Monitoring Programme

No further monitoring requirements for diadromous fish are expected to be undertaken at this stage, however, during further PEMP meetings, this will be discussed along with the monitoring scopes for bird and marine mammals, and the PEMP will be updated accordingly as required to include key outputs from the proposed PhD research.

7. UNEXPLODED ORDNANCE (UXO) CLEARANCE

Consent condition 22 b requires KOWL to record and report noise levels from construction and operations in relation to marine mammals.

No further UXO clearance activities are planned at the site, but if such activities are required in future, further advice will be sought in advance of these activities commencing from MD-LOT and NatureScot. KOWL will ensure that noise monitoring is conducted during these activities and provide associated technical reports to MD-LOT. The design of the noise monitoring methodologies employed will be informed by the guidance provided in the NPL Good Practice Guide no. 133 (NPL, 2014), the NPL (2020) “Protocol for in-situ underwater measurement of explosive ordnance disposal for UXO”, and Merchant and Robinson (2020) – see references below[4]. Noise monitoring would typically be conducted using vessel-based over-the-side sound recorders, or bottom-mounted monitors, or a combination of both approaches depending on the specific nature of the UXO clearance activity.

[4] NPL (2014). Good Practice Guide for Underwater Noise Measurement, National Measurement Office, Marine Scotland, The Crown Estate, Robinson, S.P., Lepper, P. A. and Hazelwood, R.A., NPL Good Practice Guide No. 133, ISSN: 1368-6550, 2014.

NPL (2020) Protocol for in-situ measurement of underwater explosions, version 2 11 (publishing.service.gov.uk)

Merchant, N.D., Robinson, S.P. (2020). Abatement of underwater noise pollution from pile-driving and explosions in UK waters. Report of the UKAN workshop held on Tuesday 12 November 2019 at The Royal Society, London. 31pp. doi: 10.6084/m9.figshare.11815449

8. SUMMARY

A summary of recent environmental monitoring activities by KOWL and its partners associated with each receptor and associated consent condition is shown in Table 8-1 below, updated as of March 2025:

Table 8-1 KOWL environmental monitoring activities

Receptor	Consent Condition	Activity	Partners and suppliers	Key Reports
Birds	22ai, ci, ciii	Collision monitoring via video cameras installed on original 2MW Kincardine turbine	DTBird	Report submitted to MD-LOT Q4 2021
Birds	22ai, ci, ciii	Collision monitoring via video cameras installed on KIN-01 to 05	DTBird	Report submitted to MD-LOT Q1 2025.
Birds	22ci	Aerial survey analysis – comparison of pre and post construction data around KOWF plus power analysis	HiDef	Report plus power analysis submitted to MD-LOT Q4 2024
Birds	22cii	Aerial survey flight height analysis	HiDef	Report sent to MD-LOT Q4 2025
Sea Mammals	22aii	Annual ROV monitoring of KOWF assets for ghost nets/marine mammal entanglement. Next survey planned for 2025.	ROVCO	Report on November 2023 survey submitted to MD-LOT Q2 2024
Sea Mammals	22b	SUPERGEN/ FORTUNE project – underwater noise monitoring near KOWF.	SAMS: Dr D Risch Dr S Benjamins	Report on initial 1 month deployment submitted to MD-LOT Q2 2023. Follow on project collected 3 months of data in 2024 to analyse transients – report due in 2025
Diadromous Fish	22aiii	Ongoing PhD project on assignment of diadromous fish to natal rivers in East Scotland	Uni of Essex: Dr A. Sturrock M. Bevins Cameron (PhD student)	Project expects to generate a method by which migratory fish e.g. salmon can be assigned to their natal rivers. Project started Sept 2023 for 3 years; advisory panel meeting minutes submitted to MD-LOT every 6 months.

APPENDIX A DTBIRD V8N2 (MANUFACTURING AND SOFTWARE VERSION 2021) SYSTEM SPECIFICATIONS[5]

DTBird® *Day Detection Module*			V4	V8
Service description	Automatic and real-time¹ detection in daylight of bird flights in the airspace surrounding a Wind Turbine (WTG).		✓	
	Video and audio recordings of every bird flight detected uploaded to DTBird online Data Analysis Platform with Username and Password protected access, ensuring bird flight traceability.			
Installation site	Wind Turbines (WTGs) - On & Offshore.		✓	
Module specifications				
Components	HD cameras: 4 units/WTG.		✓	
	8 units/WTG.			✓
	Environmental sensors: Light, Temperature and Humidity. Optional: Rain and Fog. From the WTG: Wind Speed and Wind Direction.		✓	
	Cabinet (1/WTG): Analysis Unit, Detection Software, Electrical and Lighting Protection Systems and Communications Hardware.			
	Mounting System (not intrusive on WTG).			
	Cables & Connections.			
Location on the facility	HD Cameras + Environmental Sensors + Mounting System (patented): outdoors on the WTG tower, from 5 to 80 m height (Project specific).		✓	
	Cabinet: indoors, normally inside the tower.			
	Cables & Connections: outdoors on the WTG tower, and inside the WTG tower.			
Cabinet				
Dimensions	51x65x25 cm, WxHxD.		✓	
	51x130x25 cm, WxHxD.			✓
Weight	10 Kg.		✓	
	20 Kg.			✓
Power supply	110-250 AC monophasic 50/60Hz (Power Grid Connection).		✓	
Power consumption	55 W.		✓	
	95 W.			✓
Operation conditions	Daylight (>50 lux).		✓	
Weatherproof	Outdoor components: IP 66 / -30° to 50° C. Falling blocks of ice protection system (optional).		✓	
	Cabinet components: IP 65 / 0° to 40° C.			
Communications	Wind Farm Network/Mobile Router 4G/ADSL/Optic Fiber/Satellite Internet.		✓	
Service specifications				
Detectable bird Species/Groups	All bird Species/Groups.		✓	
Bird Species/Group identification	Yes, through the review of bird flight video and audio recordings.		✓	
Surveillance area	360° around the WTG. See pages 7-8 (Examples of the Surveillance Area of DTBird Detection Module models V4 and V8).		✓	
Radius around the WTG	**Bird wingspan**	**Set up range**		
	>150 cm	200-320 m	✓	
		350-600 m		✓
	75-150 cm	100-200 m	✓	
		175-350 m		✓

[5] See also DTBird (2017). DTBird System Specifications. https://www.dtbird.com/images/Downloads/DTBird_System_Specifications._November_2017.pdf

	<75 cm	25-100 m	✓	
		25-175 m		✓
Simultaneous detection of multiple bird flights	Yes (360° around WTG), detection of an unlimited number of flights and birds at the same time.		✓	
Bird flight detectability	>80%[2]		✓	
Bird flight traceability[3]	Video and audio recordings of every bird flight stored in the Wind Farm online Data Analysis Platform, with Username and Password protected access.		✓	
False Positive rate (recording with no bird)	0.5 - 5.5 FP/day (yearly average).		✓	
Recorded data	Location.		✓	
	Flight ID.			
	Flight time data: Init time and total length.			
	Flight video records, with embedded audio record.			
	Online Snapshots of HD cameras every hour.			
	Environmental data, and WTG operational parameters during bird flight.			
	Species/group and bird behavior analysis from video and audio recordings.			
Online Data Analysis Platform	Bird flights videos with audio storage for 2 years (up to 50 Gb/Year/DTBird unit) and data storage for 5 years, in DTBird® Server in Data Center Classified Tier 4. Optional one-year extensions.		✓	
	Flight Analysis tools: review of video and audio records, flight analysis, data export, video download and automatic service reports.			
Service Control	Self-checking and daily verification done remotely from DTBird Headquarters.		✓	
Warranty	2-year worldwide.		✓	

1 Real-time means that time from image capture by the HD Camera to bird detection, is <1 second.

2 Norwegian Institute for Nature Research (NINA). 2012. Evaluation of the DTBird video-system at the Smola wind-power plant. Detection capabilities for capturing near-turbine avian behavior.

DTBird® ***Night Detection Module***	
Service description	Automatic and real-time detection at night of bird flights in the airspace surrounding a Wind Turbine (WTG).
	Video and audio recordings of every bird flight detected uploaded to DTBird online Data Analysis Platform with Username and Password protected access, ensuring bird flight traceability.
Installation site	Wind Turbines (WTGs) - On & Offshore.
Module specifications	
Components	Thermal Cameras: Variable number per WTG (Project specific).
	Environmental sensors: Light, Temperature and Humidity. Optional: Rain and Fog. From the WTG: Wind Speed and Wind Direction.
	Cabinet (1/WTG): Analysis Unit, Detection Software, Electrical and Lighting Protection Systems and Communications Hardware.
	Mounting System (not intrusive on WTG).
	Cables & Connections.
Location on the facility	Thermal Cameras + Environmental Sensors + Mounting System (patented): outdoors on the WTG tower, from 5 to 80 m height (Project specific).
	Cabinet: indoors, normally inside the tower.
	Cables & Connections: outdoors on the WTG tower, and inside the WTG tower.
Cabinet	
Dimensions	51x65x25 cm, WxHxD.
Weight	10 Kg.

Power supply	110-250 AC monophasic 50/60Hz (Power Grid Connection).	
Power consumption	55 W.	
Operation conditions	Night (<50 lux).	
Weatherproof	Outdoor components: IP 66 / -30° to 50° C. Falling blocks of ice protection system (optional). Cabinet components: IP 65 / 0° to 40° C. Heating or Cooling (optional).	
Communications	Wind Farm Network/Mobile Router 4G/ADSL/Optic Fiber/Satellite Internet.	
Service specifications		
Detectable bird Species/Groups	All bird Species/Groups.	
Bird Species/Group identification	The review of bird flight video and audio records, allows the identification based on bird shape, flight pattern, and wing beats frequency.	
Surveillance area	45° horizontal and 33° vertical per HD Camera.	
Radius around the WTG	**Bird wingspan**	**Set up range**
	>150 cm	140-230 m
	75-150 cm	70-140 m
	<75 cm	20-70 m
Simultaneous detection of multiple bird flights	Yes, detection of an unlimited number of flights and birds at the same time.	
Bird flight detectability	Under evaluation.	
Bird flight traceability[1]	Video and audio recordings of every bird flight stored in the Wind Farm online Data Analysis Platform, with Username and Password protected access.	
False Positive rate (recording with no bird)	1 - 4 FP/day (yearly average)/Camera. Based on preliminary test.	
Recorded data	Location. Flight ID. Flight time data: Init time and total length. Flight video records, with embedded audio record. Environmental data, and WTG operational parameters during bird flight. Species/group and bird behavior analysis from video and audio recordings.	
Online Data Analysis Platform	Bird flights videos with audio storage for 2 years (up to 50 Gb/Year/DTBird unit) and data storage for 5 years, in DTBird® Server in Data Center Classified Tier 4. Optional one-year extensions. Flight Analysis tools: review of video and audio records, flight analysis, data export, video download and automatic service reports.	
Service Control	Self-checking and daily verification done remotely from DTBird Headquarters.	
Warranty	2-year worldwide.	

[1] Traceability: Ability to verify bird flights' location, time and Species/Group identification by means of recorded video and data.

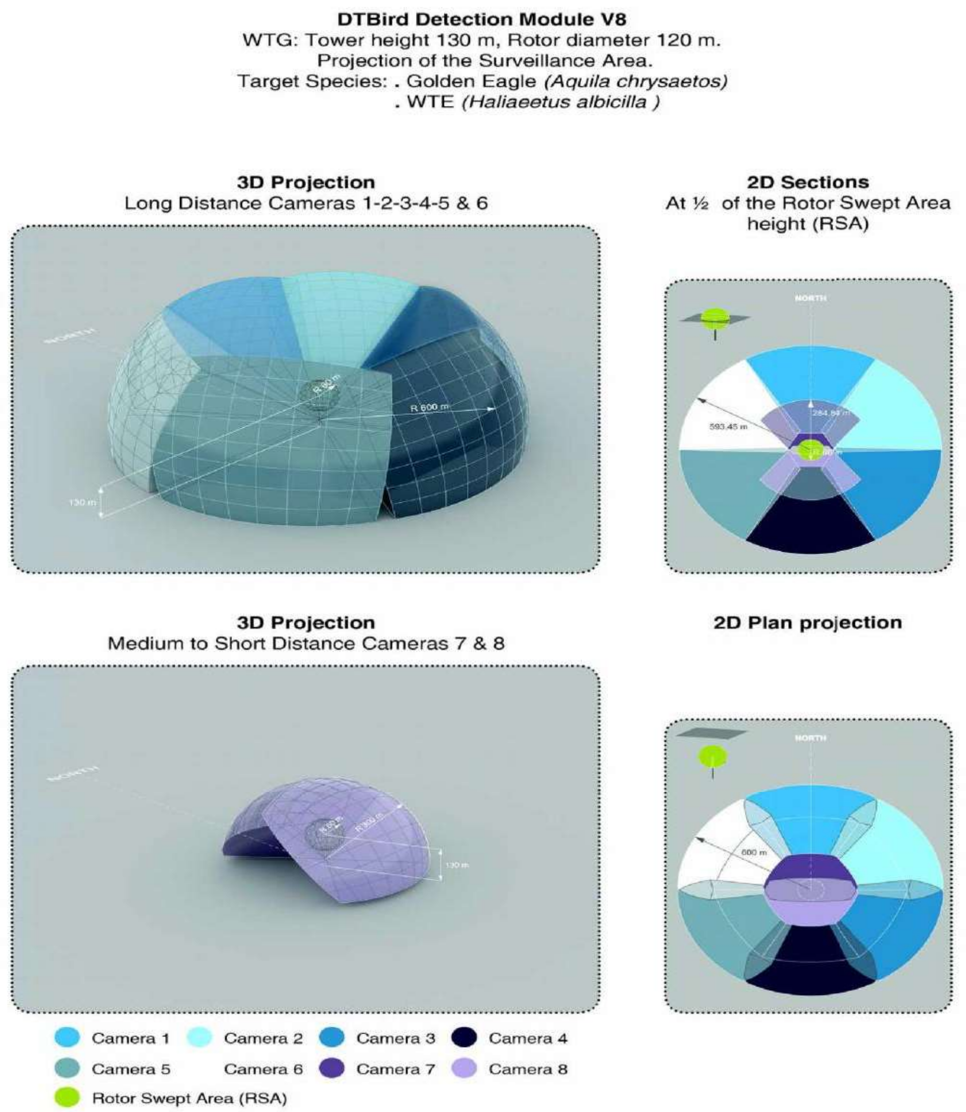
DTBird® Collision Control Module	
Service description	Automatic and real-time detection of bird flights in Collision Risk Areas, and collision check from video and sound recordings, including birds potentially injured that fly away. Video and audio recordings uploaded to DTBird online Data Analysis Platform, with Username and Password protected access, that ensure bird flight and collision traceability.
Installation site	WTGs - On & Offshore.
Module specifications	DTBird® *Detection Module V4 or V8. See pages 7-8 (Examples of the Surveillance Area of DTBird Detection Module models V4 and V8).* Simultaneous video and sound recording of interconnected cameras for every detected bird flight. Continuous video recording saved for 5-10 days.
Service specifications	
Detectable bird Species/Groups	All bird Species/Groups.
Bird Species/Group identification	Yes, through the review of bird flight video and audio recordings.
Surveillance area	Whole WTG (including blades, nacelle and tower).

Multiple bird flights track & detection	Yes.
Nº of bird collisions simultaneously recorded	Unlimited.
Bird flights detectability	>80%
Bird collision detectability in video recordings	>96% (within the bird flights detected).
Overall bird collision detectability	>77%
	0.8 (bird flight detectability) x 0.96 (collision detectability in video recordings) = 0.77
Collision traceability[1]	Video with audio recordings of every bird flight and potential collision uploaded to DTBird online Data Analysis Platform, with Username and Password protected access.
Request of in situ inspection to verify a potential collision and/or to recover a potentially injured bird	E-mail notifications of potential collision events, including online video data of the bird flight.
Recorded data	Location.
	Collision ID.
	Collision time data: Init time and total length.
	Collision video records, with embedded audio record.
	Environmental data, and WTG operational parameters of the collision event.
	Species/group, bird behavior and collision event analysis from video and sound recordings.
Online Data Analysis Platform	Bird flights videos with audio storage for 2 years (up to 50 Gb/Year/DTBird unit) and data storage for 5 years, in DTBird® Server in Data Center Classified Tier 4. Optional one-year extensions.
	Flight Analysis tools: review of video and audio records, flight analysis, data export, video download and automatic service reports.
Service Control	Self-checking and daily verification done remotely from DTBird® Headquarters.
Warranty	2-year worldwide.

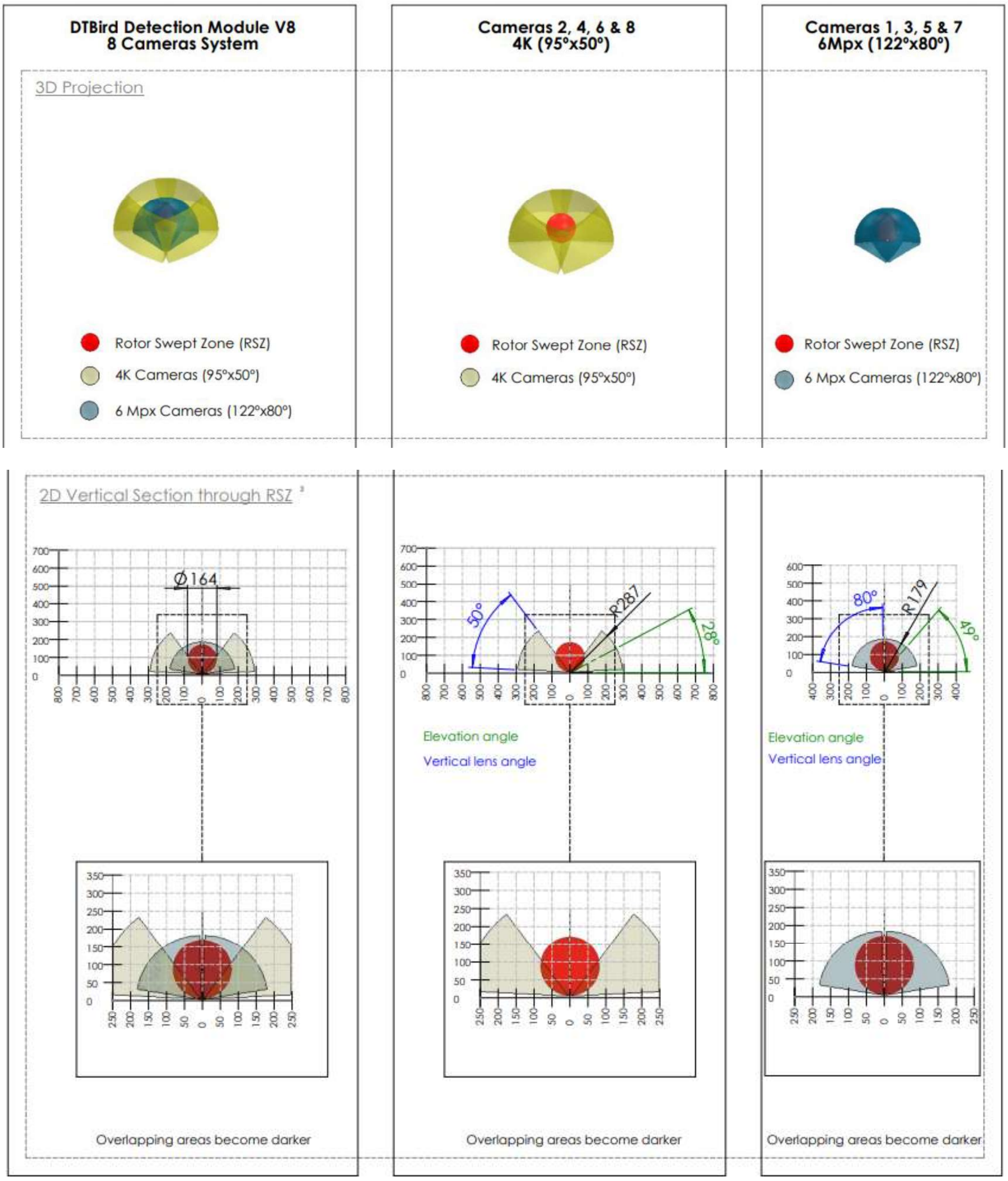
[1] Traceability: Ability to verify bird flight collision events, time and Species/Group identification by means of recorded video and sound.

BIRD & BAT PROTECTION

These visualisations show the camera configuration for the original 2MW turbine



Visualisations below are for the 9.5MW turbine DTBird V8N2 (manufacturing and software version 2021) camera configuration



Projection based on the Theoretical Maximum Detection Distance (T-MDD) for a bird entering the exterior edge of the Surveillance Area in ventral/dorsal position toward the HD Camera, with wings fully extended (maximum wing span), and occupying completely the width of the minimum object size detectable. In other bird positions, the detection distances can be shorter, and directly related with the bird profile offered to the Camera´s sensors. Birds can fly into the Surveillance Area from above and below the Surveillance Area, at shorter distances than the T-MDD. A field study of DTBird Detection Module V4 (manufactured in 2016), evaluating the detection distance by means of random UAV flights simulating a Golden Eagle, found that the actual MDD was 39% greater than the T-MDD, with a flight detectability at this furthest distance range of 51% ("American Wind Wildlife Institute (AWWI). 2018. Technical Report: Evaluating a Commercial-Ready Technology for Raptor Detection and Deterrence at a Wind Energy Facility in California").

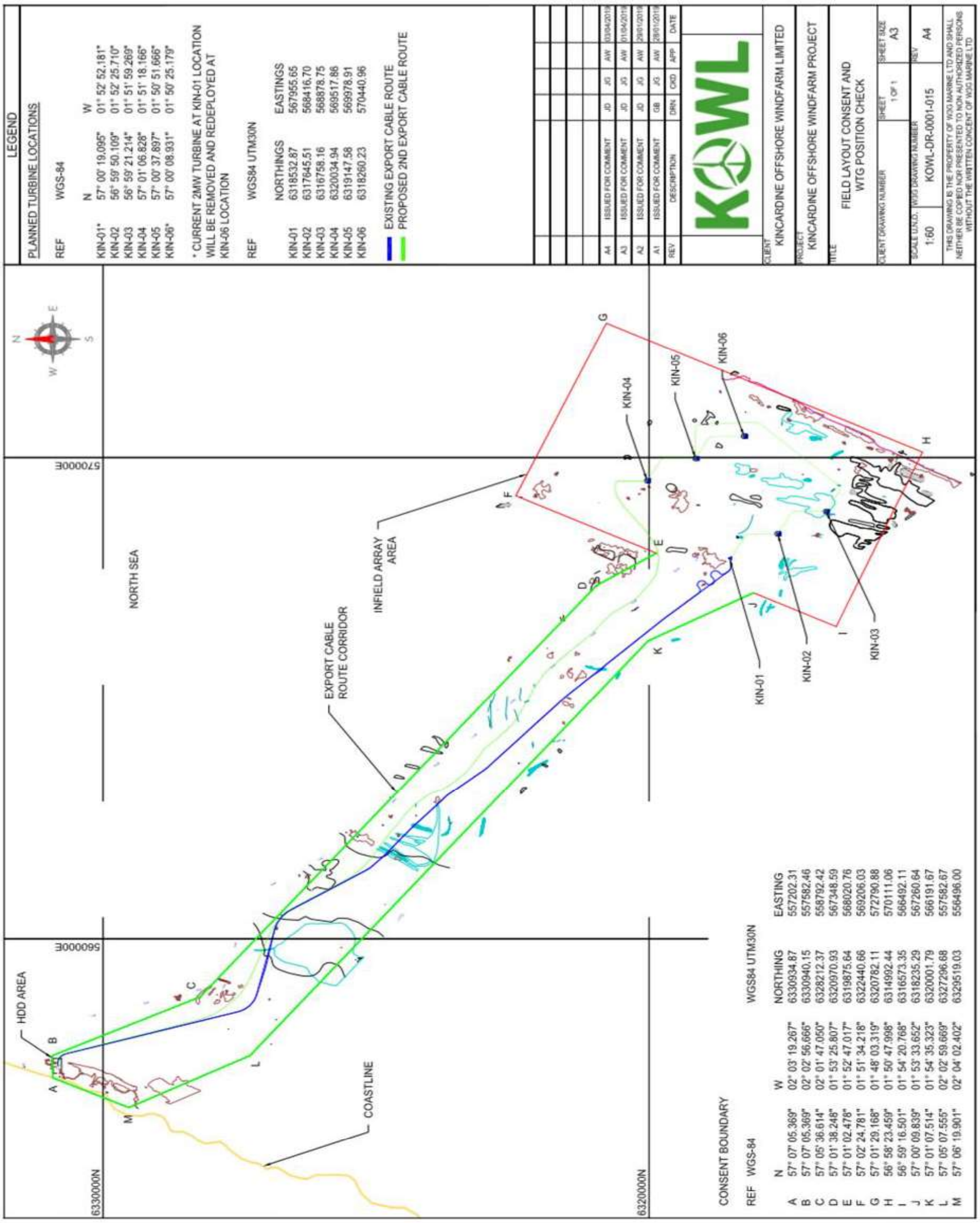
Surveillance Area Projections are based on the upper wingspan range for a Black-legged Kittiwake (wingspan 0.93-1.05m).

APPENDIX B KEY MONITORING CONTRACTORS

Topic	Contractor	Contact Detail
Bird monitoring	DTBird	Agustín Riopérez Edificio Indubuilding Avd. Democracia, 7, N 209 Madrid - 28031 (Spain) Tel: +34 91 344 90 86 arioperez@dtbird.com - www.dtbird.com
Bird Monitoring	Royal HaskoningDHV	Murray Grant Principal Ornithologist, Environment Royal HaskoningDHV **T**+44 (0)131 561 2271 |**M**+44 (0)7557 316138 **Email** murray.grant@rhdhv.com www.royalhaskoningdhv.com 74/2 Commercial Quay, Commercial Street, Leith, Edinburgh, EH6 6LX, United Kingdom
Bird Monitoring and KOWL Research programmes	Broad Horizons Consulting Ltd.	Ian Broadbent Managing Director, Broad Horizons Consulting Ltd. ian@broadhorizonsconsulting.com Tel. 07790 562892
Noise Profiling	SAMS	Paul Jowitt SAMS Research Services Ltd, Malin House, The European Marine Science Park, Oban, Argyll, PA37 1SZ UK Tel: +44 (0)1631 559470 Paul.Jowitt@sams.ac.uk
ROV	Contractor will be chosen through a tender for each survey.	Contact details will be provided prior to the surveys.

APPENDIX C FIELD LAYOUT AND WTG LOCATIONS

KOWL-DR-0001-015- FIELD LAYOUT CONSENT AND WTG POSITION CHECK



Project Environmental Monitoring Plan

Final Audit Report 2025-03-27

Created:	2025-03-27
By:	Moyra Reid (mreid@w3gmarine.co.uk)
Status:	Signed
Transaction ID:	CBJCHBCAABAA6v6hop5P32AKH9DfHCw0zzUfqZLycVes

"Project Environmental Monitoring Plan" History

Document created by Moyra Reid (mreid@w3gmarine.co.uk)
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2025-03-27 - 9:11:57 AM GMT

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Agreement completed.
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