MONA OFFSHORE WIND PROJECT

Preliminary Environmental Information Report

Volume 2, chapter 10: Offshore ornithology

Image of an offshore wind farm

April 2023
FINAL

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Rev01	First draft	RPS	bpEnBW		14/10/22
Rev02	Author updates	RPS	bpEnBW		02/12/22
Rev03	Final	RPS	bpEnBW	bpEnBW	16/12/22

Prepared by:	Prepared for:
RPS	**Mona Offshore Wind Ltd.**

Content

Tables

Figures

Annexes

Glossary

Term	Meaning
Air Gap	The gap between the mean sea level and the lowest point of a turbine rotor blade.
Avoidance	Probability that a bird takes successful evasive action to avoid collision with a wind turbine.
Bio-season	Bird behaviour and abundance is recognised to differ across a calendar year, with particular months recognised as being part of different seasons. The biologically defined minimum population scales (BDMPS) bio-seasons used in this report are based on those in Furness (2015), hereafter referred to as bio-seasons. Separate bio-seasons are recognised in this technical report in order to establish the level of importance any seabird species has within the study area during any particular period of time.
Biologically Defined Minimum Population Scales	Seasonal subdivision of bird population size. The rationale behind these subdivisions is that the likely origin of a bird in a particular location depends on the time of year.
Bootstrapping	Bootstrapping is a statistical procedure that resamples a single dataset to create many simulated samples.
Collision risk	Risk of a bird lethally colliding with a wind turbine within a wind farm.
Collision risk model	A model that calculates collision risk for a species within a wind farm based on a set of wind farm and bird species specific parameters. Collision risk models can be run deterministically or stochastically.
Confidence Interval	A confidence interval displays the probability that a parameter will fall between a pair of values around the mean.
Design-based Abundance Estimates	An estimated total abundance of birds within a given area. The design-based method is based on the premise that the portion of the study area that is surveyed is representative of the remainder of the study area.
Deterministic model	Model where a single value for each input parameter that goes into the model is used, leading to a single output without variation.
Disturbance sensitivity	Disturbance by wind farm structures, ship and helicopter traffic factor used scores from 1 (limited escape behaviour and a very short flight distance when approached), to 5 (strong escape behaviour, at a large response distance).
Habitat specialisation	The habitat specialisation factor represents the range of habitats species are able to use and whether they use these as specialists or generalists. This score classifies species into categories from 1 (tend to forage over large marine areas with little known association with particular marine features) to 5 (tend to feed on very specific habitat features, such as shallow banks with bivalve communities, or kelp beds).
Large array correction	Adjustment to the probability of bird collision to account for the depletion of bird density in later rows of a wind farm with a large array of wind turbines.
Light Detection And Ranging (LiDAR)	A remote sensing method using pulsed lasers to measure distances to the earth.
Lowest Astronomical Tide	The lowest level of the sea surface with respect to the land.
Maximum Design Scenario	The wind farm design scenario that is considered the worst case from the perspective of collision risk.
Mean Sea Level	The average level of the sea surface with respect to the land.
MRSea	The "Marine Renewables Strategic Environmental Assessment" statistical package for R to model spatial count data and predict spatial abundances. This package has been developed by the Centre for Research into Ecological and Environmental Modelling (CREEM) specifically for dealing with data collected for offshore wind farm projects.
Negligible magnitude	Very slight change from the size or extent of distribution of the relevant biogeographic population.
Nocturnal Activity Factor	The percentage of a bird species that is considered active at night.
Ornithology	Ornithology is a branch of zoology that concerns the study of birds.
Parameter	Parameters are the input elements of a model that together affect the output of a model. In collision risk models, examples of parameters are the number of wind turbines and the length of the bird.
Significant effect	The significance of an effect is determined by considering the overall importance of the receptor and the magnitude of the effect using a matrix-based approach and applying professional judgement as to whether the integrity of an SPA feature will be affected.
Stochastic model	Model where the input parameters that go into the model are allowed to vary, leading to a range of output.

Acronyms

Acronym	Description
BDMPS	BDMPS Biologically Defined Minimum Population Scales
BEIS	Department for Business, Energy and Industrial Strategy
BoCC	Birds of Conservation Concern
BTO	British Trust for Ornithology
CEA	Cumulative Effects Assessment
CFP	Common Fisheries Policy
CREEM	Centre for Research into Ecological and Environmental Modelling
CRM	Collision Risk Modelling
DCO	Development Consent Order
EIA	Environmental Impact Assessment
EWG	Expert Working Group
HRA	Habitat Regulations Assessment
IEF	Important ecological features
ISAA	Information to Support Appropriate Assessment

Acronym	Description
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
MDS	Maximum Design Scenario
MLWS	Mean Low Water Springs
MRSea	Marine Renewables Strategic Environmental Assessment
NPS	National Policy Statements
NRW	Natural Resources Wales
NSIPs	Nationally Signficiant Infrastructure Projects
PEIR	Preliminary Environmental Information Report
sCRM	Stochastic Collision Risk Model
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body
SOSS-MAT	Strategic Ornithological Support Services Migration Assessment Tool
SPAs	Special Protection Areas
SSCs	Suspended Sediment Concentrations
UK	United Kingdom
ZOI	Zone of Influence

Units

Unit	Description
%	Percentage
km^2	Square kilometres
km	kilometres
m	metres
MW	Megawatts

10 Offshore ornithology

10.1 Introduction

10.1.1 Overview

10.1.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the assessment of the potential impact of the Mona Offshore Wind Project on offshore ornithology. Specifically, this chapter considers the potential impact of the Mona Offshore Wind Project seaward of Mean Low Water Springs (MLWS) during the construction, operations and maintenance, and decommissioning phases. Those impacts of the Mona Offshore Wind Project landward of MLWS are addressed in volume 3, chapter 24: Onshore and intertidal ornithology of the PEIR.

10.1.1.2 The assessment presented is informed by the following technical reports:

- Volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR
- Volume 6; annex 10.2: Offshore ornithology displacement assessment of the PEIR
- Volume 6, annex 10.3: Offshore ornithology non-migratory seabird collision risk assessment of the PEIR
- Volume 6 annex 10.4: offshore ornithology migratory non-seabird collision risk modelling of the PEIR
- Volume 6, annex 10.5: Offshore ornithology apportioning assessment of the PEIR
- Volume 6, annex 10.6: Offshore ornithology population viability analysis of the PEIR.

10.1.1.3 The offshore ornithology chapter deals with any seabirds that are present at some point in their life cycle in the study areas and non-seabird species using the study areas during migratory flights. The overarching term ‘seabird’ is used to refer to species that depend on the marine environment for survival at some point in their life cycle. Therefore, in addition to the true seabirds, seaducks, divers and grebes are also included because of their additional reliance on marine areas, especially in the non-breeding season.

10.1.2 Purpose of chapter

10.1.2.1 The primary purpose of the PEIR is outlined in volume 1, chapter 1: Introduction of the PEIR. In summary, the primary purpose of an Environmental Statement is to support the Development Consent Order (DCO) application for the Mona Offshore Wind Project under the Planning Act 2008 (the 2008 Act). The PEIR constitutes the Preliminary Environmental Information for the Mona Offshore Wind Project and sets out the findings of the Environmental Impact Assessment (EIA) to date to support the pre-application consultation activities required under the 2008 Act. The EIA will be finalised following completion of pre-application consultation and the Environmental Statement will accompany the application to the Secretary of State for Development Consent.

10.1.2.2 The PEIR forms the basis for statuary consultation which will last for 47 days and conclude on 4 June 2023 as outlined in volume 1, chapter 2: Policy and legislation of the PEIR. At this point, comments received on the PEIR will be reviewed and incorporated (where appropriate) into the Environmental Statement, which will be submitted in support of the application for Development Consent scheduled for quarter one of 2024.

10.1.2.3 In particular, this PEIR chapter:

- Presents the existing environmental baseline established from desk studies, site-specific surveys and consultation
- Identifies any assumptions and limitations encountered in compiling the environmental information
- Presents the potential environmental effects on offshore ornithology arising from the Mona Offshore Wind Project, based on the information gathered and the analysis and assessments undertaken
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects of the Mona Offshore Wind Project on offshore ornithology.

10.1.3 Study area

10.1.3.1 There are three study areas for the offshore ornithology assessment. These are:

- The Mona Offshore Ornithology Array Area study area: this includes the Mona Array Area plus a buffer extending 4km to 10km (Figure 10.1). This area was defined by the extent of the digital aerial bird surveys. Due to the changes in the proposed Mona Array Area since the design of the digital aerial survey in spring 2020, the Mona Offshore Ornithology Array Area study area does not extend fully to 10km in all directions around the current Mona Array Area. However, it mostly covers the 10km buffer and consistently exceeds 4km
- The Mona Offshore Ornithology Offshore Cable Corridor study area: this encompasses the Mona Offshore Cable Corridor running between the landfall area on the Welsh Coast and the Mona Array Area, plus a 4km buffer (Figure 10.1). Part of the Mona Offshore Ornithology Offshore Cable Corridor study area has been covered by the digital aerial bird surveys
- The Cumulative Mona Offshore Ornithology study area: this was identified by consideration of the foraging ranges of seabird species recorded within the Mona Offshore Ornithology Array Area study area. As the extent of the breeding foraging ranges varies greatly between species (Woodward *et al*., 2019), the Zone Of Influence (ZOI) of the Mona Offshore Wind Project therefore varies between the species considered in the assessment. The ZOI of the Mona Offshore Wind Project was defined according to the species-specific foraging ranges (as compiled by Woodward *et al.,* 2019). However, the Cumulative Mona Offshore Ornithology study area extends up to 500km around the Mona Array Area. This is based on the approximate published mean-maximum foraging range for northern gannet (315.2±194.2km), which was chosen as a reasonable maximum extent within which cumulative effects might be likely to occur as a result of the Mona Offshore Wind Project. For the

non-breeding season, the ZOI was defined by the relevant Biologically Defined Minimum Population Scales (BDMPS) region (Furness, 2015).

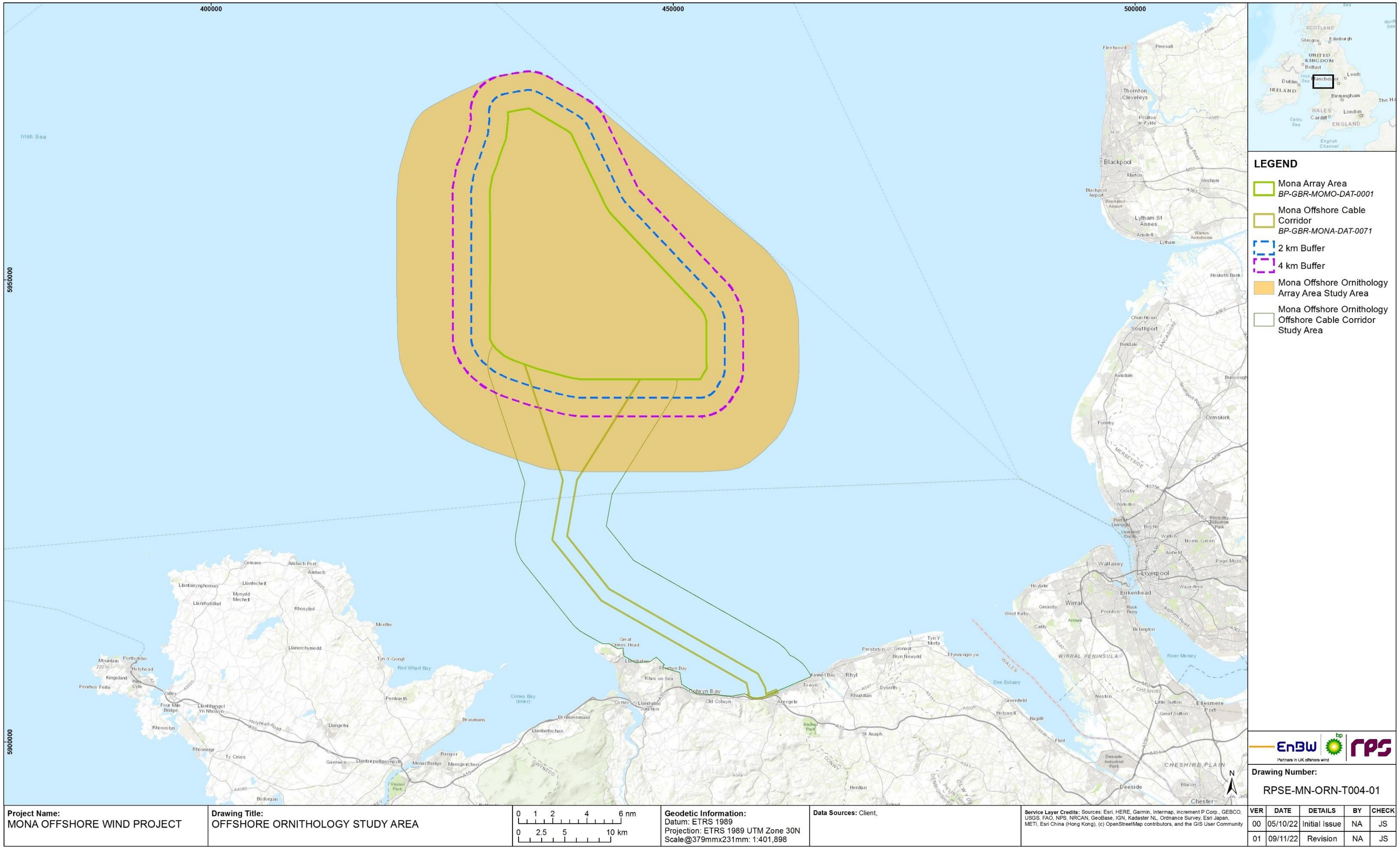

Figure 10.1: The Mona Offshore Ornithology Array Area study area and the Mona Offshore Ornithology Offshore Cable Corridor study area.

10.2 Policy context

10.2.1 National Policy Statements

10.2.1.1 Planning policy on renewable energy infrastructure is presented in volume 1, chapter 2: Policy and legislation of the PEIR. Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIPs), specifically in relation to offshore ornithology, is contained in the Overarching National Policy Statement (NPS) for Energy (EN-1; DECC, 2011a) and the NPS for Renewable Energy Infrastructure (EN-3, DECC, 2011b).

10.2.1.2 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment. These are summarised in Table 10.1. NPS EN-1 and NPS EN-3 also highlight a number of factors relating to the determination of an application and in relation to mitigation. These are summarised below (Table 10.1).

10.2.1.3 Table 10.1 refers to the current NPSs, specifically NPS EN-1 (DECC, 2011a) and NPS EN-3 (DECC, 2011b). If the NPSs are updated prior to the application for Development Consent, the revised NPSs will be fully considered in relation to offshore ornithology within the Environmental Statement.

Table 10.1: Summary of the NPS EN-1 and NPS EN-3 provisions relevant to offshore ornithology.

Summary of NPS EN-3 and EN-1 provision	How and where considered in the PEIR
NPS-EN1	
Where the development is subject to EIA the applicant should ensure that the Environmental Statement clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. (NPS EN-1 paragraph 5.4.3)	Important protected areas for seabirds are discussed in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR. Assessment of the potential effects of the Mona Offshore Wind Project on the features of these protected sites are provided in section 10.8.
"the Secretary of State should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; habitats and other species of principal importance for the conservation of biodiversity; and to biodiversity and geological interests within the wider environment". (NPS EN-1 paragraph 5.4.7)	Species of principal importance are considered in determining the conservation value of receptors as part of this assessment, as outlined in section 10.4.4. These designated sites are considered in determining the conservation value of receptors as part of this assessment, outlined in section 10.4.4.
Important sites for biodiversity are those identified through international conventions and the Habitats Regulations. (NPS EN-1 paragraph 5.4.8)	These designated sites are considered in determining the conservation value of receptors as part of this assessment, outlined in section 10.4.4.
Many individual wildlife species receive statutory protection under a range of legislative provisions. (NPS EN-1 paragraph 5.4.15)	Statutory protection afforded to bird species has been considered in determining the conservation value of receptors as part of this assessment (section 10.4.4).
Other species and habitats have been identified as being of principal importance for the conservation of biodiversity in England and Wales and thereby requiring conservation action. The IPC should ensure that these species and habitats are protected from the adverse effects of development by using requirements or planning obligations. The IPC should refuse consent where harm to the habitats or species and their habitats would result, unless the benefits (including need) of the development outweigh that harm. In this context the IPC should give substantial weight to any such harm to the detriment of biodiversity features of national or regional importance which it considers may result from a proposed development. (NPS EN-1 paragraph 5.4.16)	Species of principal importance are considered in determining the conservation value of receptors as part of this assessment, as outlined in section 10.4.4.
The applicant should include appropriate mitigation measures as an integral part of the proposed development. In particular, the applicant should demonstrate that: • During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works • The timing of construction has been planned to avoid or limit disturbance to birds during the breeding season • During construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements • Habitats will, where practicable, be restored after construction works have finished • Mitigation measures should take into account existing habitats and should generally seek opportunities to enhance them, rather than replace them. Where practicable, mitigation measures should seek to create new habitats of value within the site landscaping proposals. Habitats will, where practicable, be restored after construction works have finished. (NPS EN-1 paragraph 5.4.18)	Measures adopted as part of the Mona Offshore Wind Project relevant to seabirds are detailed in section 10.8.
NPS-EN3	
Assessment of offshore ecology and biodiversity should be undertaken by the applicant for all stages of the lifespan of the proposed Offshore Wind Farm (OWF) and in accordance with the appropriate policy for OWF EIAs. (NPS EN-3 paragraph 2.6.64)	The construction, operations and maintenance and decommissioning phases of Mona Offshore Wind Project have been assessed in section 10.8.
Consultation on the assessment methodologies should be undertaken at early stages with the statutory consultees as appropriate. (NPS EN-3 paragraph 2.6.65)	Throughout the Mona Offshore Wind Project consultations with relevant statutory and non-statutory stakeholders have been carried out (e.g. via the Evidence Plan Process Expert Working Groups (EWG)) and are presented in section 10.2.3.

Summary of NPS EN-3 and EN-1 provision	How and where considered in the PEIR
The Secretary of State should consider the effects of a proposal on marine ecology and biodiversity [and the physical environment] taking into account all relevant information made available to it. (NPS EN-3 paragraph 2.6.68)	Section 10.8. presents the assessment of effects of the Mona Offshore Wind Project on offshore ornithology receptors.
Offshore wind farms have the potential to impact on birds through: • Collisions with rotating blades • Direct habitat loss • Disturbance from construction activities such as the movement of construction/decommissioning vessels and piling • Displacement during the operations phase, resulting in loss of foraging/ roosting area • Impacts on bird flight lines (i.e. barrier effect) and associated increased energy use by birds for commuting flights between roosting and foraging areas. (NPS EN-3 paragraph 2.6.101)	Potential impacts on offshore ornithology are assessed in section 10.8.
The scope, effort and methods required for ornithological surveys should have been discussed with the relevant statutory advisor, [taking into consideration baseline and monitoring data from operational windfarms]. (NPS EN-3 paragraph 2.6.102)	Baseline survey methods have been discussed with Natural Resources Wales (NRW), Natural England, the Joint Nature Conservation Committee (JNCC) and the Royal Society for the Protection of Birds (RSPB) through the Evidence Plan Process EWG.
Relevant data from operational offshore wind farms should be referred to in the applicant's assessment. (NPS EN-3 paragraph 2.6.103)	Relevant data from other operational offshore wind farms has been considered to inform the assessment of potential significant effects of the Mona Offshore Wind Project and the cumulative effects assessment in section 10.10.
It may be appropriate for the assessment to include collision risk modelling for certain bird species. (NPS EN-3 paragraph 2.6.104)	Collision risk modelling has been undertaken for migratory and non-migratory birds using parameters that have been agreed with Statutory Nature Conservation Bodies (SNCBs) through the Evidence Plan process EWG. Potential effects from collision risk are presented and assessed in section 11.8.

Table 10.2: Summary of NPS EN-1 policy on decision making relevant to offshore ornithology.

Summary of NPS EN-1 provision	How and where considered in the PEIR
The NPS' aim is to ensure a halting, and if possible, a reversal, of declines in priority habitats and species, with wild species and habitats as part of healthy, functioning ecosystems. (NPS EN-1 paragraph 5.3.5)	The conservation status of habitats and species is considered throughout this assessment and measures have been adopted, where reasonably practicable, to reduce impacts (section 10.7).
In having regard to the aim of the Government's biodiversity strategy the Secretary of State should take account of the context of the challenge of climate change: failure to address this challenge will result in significant adverse impacts to biodiversity. (NPS EN-1 paragraph 5.3.6)	The future impact of climate change on the habitats in the east Irish Sea has been considered in section 10.4.1.
Developments should aim to avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives; where significant harm cannot be avoided, then appropriate compensation measures should be sought. (NPS EN-1 paragraph 5.3.7)	Significant effects have been avoided so further mitigation will not be required.
In taking decisions, the Secretary of State should ensure that appropriate weight is attached to designated sites of international, national and local importance; protected species; habitats and other species of principal importance for the conservation of biodiversity; and to biodiversity and geological interests within the wider environment. (NPS EN-1 paragraph 5.3.8)	As part of this chapter the process of identifying designated sites has been undertaken for the Mona Offshore Ornithology study areas (sections 10.1.3 and 10.4.3). This was done to ensure all features and species of conservation importance were considered, where relevant, in this assessment.

10.2.2 The Welsh National Marine Plan and its relevance to offshore ornithology

10.2.2.1 The assessment of potential changes to offshore ornithology has also been made with consideration to the specific policies set out in the Welsh National Marine Plan (Welsh Government, 2019).

10.2.2.2 The Welsh National Marine Plan was published on 12 November 2019 and sets out the policy for the next 20 years for the sustainable use of Welsh seas. It includes sector objectives for renewable energy to support the decarbonisation of the Welsh economy and the use of marine renewable energy, including offshore wind farms.

10.2.2.3 Key provisions are set out in Table 10.3 along with details as to how these have been addressed within the assessment.

Table 10.3: Welsh National Marine Plan and its relevance to offshore ornithology.

Policy	Key provisions	How and where considered in the PEIR
ENV_01: Resilient marine ecosystems	Proposals should demonstrate how potential impacts on marine ecosystems have been taken into consideration and should, in order of preference: • avoid adverse impacts; and/or • minimise impacts where they cannot be avoided; and/or • mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding. Proposals that contribute to the protection, restoration and/or enhancement of marine ecosystems are encouraged.	The potential impacts on important ecological features have been assessed in section 10.8 and measures adopted as part of the Mona Offshore Wind Project are summarised in section 10.7.
ENV_02: Marine Protected Areas	Proposals should demonstrate how they: • avoid adverse impacts on individual Marine Protected Areas (MPAs) and the coherence of the network as a whole; • have regard to the measures to manage MPAs; and • avoid adverse impacts on designated sites that are not part of the MPA network.	Designated sites supporting important ecological features have been identified as appropriate, and any potential impacts to features and the site network will be assessed in an Information to Support Appropriate Assessment (ISAA) report.
ENV_05: Underwater sound.	Proposals should demonstrate that they have considered man-made noise impacts on the marine environment and, in order of preference: • avoid adverse impacts; and/or • minimise impacts where they cannot be avoided; and/or • mitigate impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding.	Section 10.8 assesses the impact of underwater and airborne sound on seabirds.
ENV_07: Fish species and Habitats	Proposals potentially affecting important feeding, breeding (including spawning and nursery) and migration areas or habitats for key fish and shellfish species of commercial or ecological importance should demonstrate how they, in order of preference: • avoid adverse impacts on those areas; and/or • minimise adverse impacts where they cannot be avoided; and/or • mitigate adverse impacts where they cannot be minimised. If significant adverse impacts cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding	The potential effects on fish species and their habitats have been assessed in full in volume 2, chapter 8: Fish and shellfish ecology of the PEIR. Section 10.8 of this chapter assesses the potential effects on seabirds in the context of how seabird prey species may be impacted.

10.2.3 North West Inshore and North West Offshore Coast Marine Plans

10.2.3.1 The assessment of potential changes to offshore ornithology has also been made with consideration to the specific policies set out in the North West Inshore and North West Offshore Coast Marine Plans (MMO, 2021). Key provisions are set out in Table 10.4 along with details as to how these have been addressed within the assessment.

Table 10.4: North West Inshore and North West Offshore Marine Plan policies of relevant to offshore ornithology.

Policy	Key provisions	How and where considered in the PEIR
NW-SCP-1	Proposals within or relatively close to nationally designated areas should have regard to the specific statutory purposes of the designated area. Great weight should be given to conserving and enhancing landscape and scenic beauty in National Parks and Areas of Outstanding Natural Beauty.	As part of this chapter (as well as volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR), designated sites with mobile features connected to the Mona Offshore Wind Project have been identified. This is to ensure that all features and species of conservation importance were considered, where relevant, in this assessment. The Habitats Regulations Assessment (HRA) Screening Report considers the direct or indirect effects on features of relevant SPA sites, and where relevant will be included in the ISAA.
NW-MPA-1	Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported.	As part of this chapter (as well as volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR), designated sites with mobile features connected to the Mona Offshore Wind Project have been identified (section 10.4.3). This is to ensure that all features and species of conservation importance were considered, where relevant, in this assessment. The HRA Screening Report considers the direct or indirect effects on features of relevant SPA sites, and where relevant will be included in the ISAA.
NW-BIO-1	NW-BIO-1 encourages and supports proposals that enhance the distribution of priority habitats and priority species.	The Mona Offshore Wind Project will aim to conserve habitats and species as far as reasonably practicable through a number of measures adopted to reduce the impact of the Mona Offshore Wind Project (section 10.7).
NW-BIO-2	NW-BIO-2 requires proposals to manage negative effects which may significantly adversely impact the functioning of healthy, resilient and adaptable marine ecosystems.	In addition to measures adopted as part of the Mona Offshore Wind Project and sensitive project design, secondary mitigation has considered where an impact is considered to be significant in EIA terms. This assessment is undertaken for each impact.
NW-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised, or reasonably foreseeable proposals must demonstrate that they will avoid, minimise and mitigate.	Cumulative effects have been quantified and their significance assessed in section 10.10.

10.3 Consultation

10.3.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to offshore ornithology is presented in Table 10.5 below, together with how these issues have been considered in the production of this PEIR chapter. Further detail is presented in the following annexes:

- Volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR
- Volume 6; annex 10.2: Offshore ornithology displacement assessment of the PEIR
- Volume 6, annex 10.3: Offshore ornithology non-migratory seabird collision risk assessment of the PEIR
- Volume 6, annex 10.4: Offshore ornithology migratory non-seabird collision risk modelling of the PEIR.

10.3.2 Evidence Plan process

10.3.2.1 The purpose of the Evidence Plan process is to agree the information the Mona Offshore Wind Project needs to supply to the Secretary of State, as part of its DCO application, with NRW and the JNCC.

10.3.2.2 The Evidence Plan seeks to ensure compliance with the HRA and EIA. Consultation on the offshore ornithology topic was undertaken via the Offshore Ornithology EWG, with meetings held in February 2022, July 2022 and November 2022.

10.3.2.3 The first EWG meeting (February 2022) provided an update on current site-specific surveys and approach to baseline characterisation (including desktop data sources), as set out in the Mona EIA Scoping Report. The second EWG meeting (July 2022) provided an update on the approach used to characterise the baseline conditions and assess the effects on ornithological receptors. A summary of discussions and key issues raised is set out in Table 10.5 below.

10.3.2.4 A series of technical papers detailing the approach to assessing the baseline conditions and the main effects (i.e. collision and displacement) was distributed to the EWG for consultation. Following the responses from the stakeholders on the technical papers, agreed changes were incorporated in the assessment of the baseline conditions and the main effects. Changes to the suggested approach were minor, and all information regarding the approach to assessment is detailed in each of the individual subsections and technical appendices of this chapter. The responses provided and changes suggested by the stakeholders through the EWG are summarized in Table 10.5 together with changes implemented in the technical reports underpinning the PEIR.

Table 10.5: Summary of key topics and issues raised during consultation activities undertaken for the Mona Offshore Wind Project relevant to offshore ornithology.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this chapter
February 2022	**Offshore Ornithology Expert Working Group 1** **Attended by:** Natural England, JNCC, NRW, The Wildlife Trusts (TWT)	Agreed on ways of working document, including timescales.	n/a
		Agreed on broad approach to digital aerial surveys.	The Mona digital aerial survey area includes a buffer of 4-10km from the Mona Array Area. The Mona digital aerial survey area does not extend fully to 10km in all directions around the Mona Array Area, as this area was refined following commencement of the digital aerial surveys. However, it will mostly reach 10km and will consistently exceed 4km. The uneven buffer around the Mona Array Area is a result of the surveys being designed on the basis of an array area that differed to the final boundary awarded through the Offshore Wind Leasing Round 4. The use of LiDAR as a method for collecting flight height data to parameterise collision risk models was not been endorsed by Natural England; as such it has not been progressed and flight heights are to be based on existing literature.
		Agreed on broad approach to characterisation for the Mona Offshore Cable Corridor using desktop data sources only.	The approach to the characterisation of the Mona Offshore Cable Corridor is to rely on available desktop data. This approach is standard for offshore wind farm transmission assets.
May 2022	**Scoping Opinion** IOM Department of Infrastructure	The Isle of Man Department of Infrastructure noted that Manx shearwater, guillemot, razorbill and kittiwake were numerous in previous surveys of the generation assets study area. These are all within foraging range of their Isle of Man breeding colonies.	Abundance at breeding colonies on the Isle of Man (using the Seabird Monitoring Programme (SMP) database (JNCC (2022)) are considered in this chapter.
		The EWG recommended the inclusion of bird data from Manx Birdlife (and the inclusion of non-marine, migratory or nomadic species, in particular birds of prey, which are recognised as being vulnerable to OWF collisions). Manx Birdlife holds the national database for bird data.	The offshore ornithology migratory non-seabird collision risk modelling considers the risk to migratory birds using the SOSS Migration Assessment Tool (Wright *et al.,* 2012), which is comprehensive and adequate for assessing the impact of collision to migratory birds
		The Isle of Man govenrment requested that the national bird statuses and conservation concerns of the Isle of Man are taken into account by reference to the recently published Manx Birds of Conservation Concern, and had a current concern regarding severe declines in many seabird populations on the Isle of Man (See Hill *et al.,* 2019). Schedule 1 of the Wildlife Act 1990 lists the specially protected birds. Both of these are relevant to the status of these species in the vicinity of this development and in particular, the considerations of potential impacts on Manx populations.	The conservation value of Isle of Man birds has been included in this chapter.
	Scoping Opinion Natural Resource Wales	NRW advised that further information on how survey design has been arrived at is required. It is likely that all Welsh SPAs and Sites of Special Scientific Interest (SSSIs) with marine or estuarine bird features should be scoped in until surveys are complete and the data analysis has been finalised. NRW also highlighted the availability of revised guidance for red-throated diver displacement.	The rationale for the study area design is presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		NRW advised that further information on how survey design has been arrived at is required, including results of a power analysis to detect the sample size needed for the analysis of aerial survey data.	The rationale for the digital aerial survey design is presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		NRW highlighted the availability of revised guidance for red-throated diver displacement – see Joint SNCB Interim Advice on the Treatment of Displacement for Red-Throated Diver (2022). NRW advised that the Mona offshore ornithology study should include the Potential Array Area with a 10km buffer. It may help the reader to include a clearer visualisation of where this buffer does and does not fully reach 10km, and the justification for this.	Despite the near-absence of red-throated diver in the Mona Offshore Ornithology Array Area study area, red-throated diver design-based estimates are presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR. This provided the justification for scoping out the displacement/disturbance effect of red-throated diver in the Mona Array Area for all phases.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this chapter
		In particular with reference to red throated diver, further information on the use of a buffer that does not consistently exceed 10km is required. NRW advised the use of a 10km buffer. It may help the reader to include a clearer visualisation of where this buffer does and does not fully reach 10km. For further information, please see Joint SNCB Interim Advice on the Treatment of Displacement for Red-Throated Diver (2022).	Due to the changes in the proposed Mona Array Area since the design of the digital aerial survey in spring 2020, the Mona Offshore Ornithology Array Area study area does not extend fully to 10km in all directions around the current Mona Array Area assessed in this PEIR. However, it mostly covers the 10km buffer and consistently exceeds 4km. The Applicant is aware of the guidance on the treatment of displacement for red-throated diver. However, only a total of three birds were recorded in the Mona Array Area plus 10km buffer during the two years of digital aerial surveys. As such, the displacement/disturbance effect on red-throated diver was not considered.
		With reference to site-specific surveys, NRW suggested that further information on how survey design has been arrived at would be useful, including more detail on the justification for 12% analysed. To determine whether survey coverage and design provide an adequate baseline characterisation, NRW (A) advised that evidence from a power analysis is used. The level of coverage required to be sufficient for baseline characterisation will depend on the nature of the area being surveyed and the abundance and distribution of receptors across the area. A power analysis should be undertaken to inform survey design and ensure that such designs maximise the probability of detecting changes in abundance and distribution through future comparison with data that may be collected post-consent. Webb *et al.* (2014) provide some examples of power analyses applied to sampling of focal bird species within a marine SPA.	The rationale for the digital aerial survey design is presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR. Coverage standing at 12.9%, exceeding the 10% minimum coverage suggested by literature (BSH, 2013). Coefficient of variation (CVs) are also provided in the offshore ornithology baseline characterisation to give measure of precision to support approach.
		With reference to site-specific surveys, it would be useful to clarify if the intention is to provide records of all species detected from aerial surveys.	All species recorded during the digital aerial surveys are presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		It would be useful to understand how the applicant proposes to determine flight height. NRW are not yet satisfied that flight height calculations based on digital aerial survey data are accurate, so generic flight heights from Johnston *et al.*, (2014) should also be used in assessing collision risk	Generic flight height data from Johnston *et al*., (2014) were used in volume 6, annex 10.3: Offshore ornithology non-migratory seabird collision risk assessment of the PEIR as site-specific data collected was deemed not to be suitable.
		NRW (A) advise that digital aerial survey data collected for this project should be the primary data source used for the analysis. However, useful supplementary data (e.g. tracking data) and information may be found in a number of sources.	Resources where relevant were included in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
June 2022	**Scoping Opinion** The Planning Inspectorate	The Planning Inspectorate acknowledged that data and knowledge regarding the baseline environment exists from surveys, assessments and post-construction monitoring for other proposed and existing offshore wind projects. The Inspectorate understood the benefits of utilising this information to supplement site specific survey data but advised that suitable care should be taken to ensure that the information in the Environmental Statement remains representative and fit for purpose. This should include taking into account the impact of more recent developments that have occurred subsequent to when the data was collected. Similarly, where data from other wind farms is used to support the assessment, the Environmental Statement should confirm that these are truly comparable, for example in terms of the size of foundations/turbines. The Applicant should make effort to agree the suitability of information used for the assessments in the Environmental Statement with relevant consultation bodies (e.g. NRW).	The relevance of data from other wind farm Environmental Statements has been discussed with the Offshore Ornithology EWG and where relevant included in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		Where possible, the Applicant should seek to agree the magnitude of impact or sensitivity of receptors with relevant consultees through the PEIR and pre-application process. Where differences in opinion remain, these should be identified within the Environmental Statement with justification given for the Applicant's choice.	This chapter includes a description of the maginitude of each impact and sensitivity of each receptor or each receptor group considered in the EIA. Comments note that where differences in opinion remain, these will be identified and justification given for the Applicant's choice.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this chapter
		The Environmental Statement should define what a 'reasonable timescale' or 'short time period' would be within which recovery could occur so that an impact would be reversible/not permanent.	For each impact where recovery is considered, the timescales for recovery has been stated.
		A number of mitigation plans have been referred to in aspect chapters. Where plans are relied upon to avoid significant environmental effects, outline or in-principle plans should be submitted as part of the DCO application.	Where a significant environmental effect has been identified, further mitigation has been proposed in this chapter.
		The Applicant proposed to assess the effects of underwater noise on marine life due to jacket or monopile cutting and removal during decommissioning. The Scoping Report does not propose to assess this potential impact within the fish and shellfish ecology, marine mammals or offshore ornithology Environmental Statement chapters. The outcomes of this assessment should be presented within the relevant chapters.	The indirect impact of underwater sound on prey species relevant to ornithological receptors has been assessed for the construction, operations and maintenance, and decommissioning phases.
		Direct disturbance and displacement impacts from underwater noise during the operations and maintenance and decommissioning phases.	Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure has been assessed in-combination across all phases.
		The Inspectorate agreed that collision risk to birds from the offshore booster station structures is unlikely and is therefore content to scope this matter from the Environmental Statement.	The Offshore Booster Substation is no longer in the design for the Mona Offshore Wind Project and is therefore not included in the impact assessments.
		The Planning Inspectorate proposes a range (4km to 10km) within the study area proposed for the offshore ornithology aspect chapter. The Environmental Statement should clearly state and provide justification for the final study area adopted in the impact assessment. It should also be supported by a figure(s) clearly presenting the extent of the buffer and where these buffer distances differ. The study area should be based on the ZOI for the Proposed Development. The Applicant's attention is directed to the recent issue of the 'Joint SNCB1 Interim Advice on the treatment of displacement for red- throated diver (2022)' with regards to revised guidance for red- throated diver displacement. The Inspectorate advises that the marine ornithology study area should include the array area and a minimum 10km buffer. Where the buffer does not consistently reach 10km, the Environmental Statement should clearly justify the approach.	There are three study areas adopted for the offshore ornithology assessment presented in this chapter, with justifications (section 10.1.3).
		Tracking studies should also be used to inform and evidence connectivity (or a lack of) for the marine ornithology impact assessment, where available, such as site-specific tracking data for Northern gannet at Grassholm, Manx shearwater at Skomer and the Copeland Islands, black-legged kittiwake at Rockabill, and guillemot at Isle of Canna.	Tracking data available from the Seabird Tracking Database (Birdlife International, 2021) have been reviewed and summarized in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		The Environmental Statement should consider those birds listed on Schedule 1 of the Wildlife Act 1990 (Isle of Man) and refer to the Manx Birds of Conservation Concern (2021) when considering conservation status of Manx birds (where relevant).	The conservation value of Isle of Man birds has been included in this chapter.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this chapter
		The Scoping Report explains that aerial digital marine mammal surveys collected 30% of the sea surface and 12% was analysed. The Environmental Statement should explain how the site-specific aerial digital surveys have been determined, including justification of the 12% analysis value and the selection of the transect distance and alignment. The Environmental Statement should clearly demonstrate that the survey coverage is appropriate to provide adequate baseline characterisation. The Environmental Statement should include reference to any agreements reached through the EWG with relevant consultation bodies such as NRW and Natural England. With regards to the transmission assets, the Scoping Report indicates no further site-specific aerial digital surveys are planned of the Mona offshore ornithology study area for the transmission assets as it is expected that the bird assemblage recorded during these site- specific surveys in the 4km to 10km buffer area will also be representative for the majority of the marine areas within the study area for the transmission assets. The Applicant should seek to agree the scope of any further surveys to inform the transmission assets with the EWG, including NRW and Natural England.	The methodology section of volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR explains the rationale beyond the site-specific surveys design. The data limitations associated with the site-specific surveys are further discussed in the this chapter. Coverage standing at 12.9%, exceeding the 10% minimum coverage suggested by literature (BSH, 2013). CVs are also provided in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR to give a measure of precision to support the approach.
		The Applicant's attention is directed to the response of the Isle of Man Government at Appendix 2 to this Opinion with regards to designated sites and in particular the Calf of Man National Bird Observatory.	The importance of the National Bird Observatory for monitoring, research and recreational activities is acknowledge. However, the status of the Bird Observatory is of limited relevance to the assessment of ornithological receptors.
		The Scoping Report proposes to determine connectivity between breeding seabird colonies at designated sites and the Proposed Development through the application of the metric 'mean maximum (plus one standard deviation)'. Until the site-specific surveys are complete, and the data analysis finalised, it may be prudent to scope in all SPAs, Ramsar sites, and SSSIs with marine or estuarine bird qualifying features to the impact assessment. The Applicant should seek to agree the appropriate metric with relevant consultation bodies, including NRW and Natural England.	Best practice (i.e. using the mean-max + 1 SD from Woodward *et al*., (2019)) guidelines were followed to determine connectivity between sites and the ZOI of the Mona Offshore Wind Project.
		The Scoping Report states that the displacement matrix approach for the transmission assets may be modified (in terms of the appropriate displacement and mortality rates) to assess the potential temporary impact of disturbance during installation of the offshore export cables. If fundamental disagreements remain regarding the assessment methods and modelling for assessing effects from displacement and collision-related mortality, the Environmental Statement should include assessments based on the Applicant's preferred method and those advocated by NRW and Natural England. The Applicant is advised to agree the detailed assessment methodologies with relevant stakeholders represented on the ornithology EWG.	The displacement matrix approach has been agreed with the Offshore Ornithology EWG and the findings are presented in volume 6; annex 10.2: Offshore ornithology displacement assessment of the PEIR.
		It is unclear from the Scoping Report how the Applicant intends to determine flight heights and whether this will be taken from the digital aerial survey data only. However, the Scoping Report does state such information would be collected 'where possible'. The Environmental Statement should confirm the approach taken and also consider use of generic flight heights agreed with the EWG where possible.	Generic flight height data from Johnston *et al*., (2014) was used in volume 6, annex 10.3: Offshore ornithology non-migratory seabird collision risk assessment of the PEIR, as site-specific data collected was deemed not suitable.
	Scoping Opinion JNCC	In addition to generating density and abundance estimates for frequently recorded seabird species, we would advise that a log of all species encountered in aerial surveys is provided.	All species encountered on the digital aerial surveys are presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this chapter
		To help assign birds seen at footprint to colony-of-origin, and potentially additional parameters or contextual evidence, it may be worth reviewing available and relevant tracking data, for instance Manx shearwater tracking at Skomer and the Copeland Islands, northern gannet at Grassholm, black-legged kittiwake at Rockabill, and guillemot at Isle of Canna as a few examples.	Tracking data available from the Seabird Tracking Database (Birdlife International, 2021) have been reviewed and summarized in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		Note that joint SNCB guidance regarding the assessment of displacement of red-throated diver has recently been updated. We recommend that displacement out to at least 10km from the proposed wind farm boundary is assessed for red-throated diver (SNCBs, 2022).	Despite the near-absence of red-throated diver in the Mona Offshore Ornithology Array Area study area, red-throated diver design-based estimates are presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR. This provided the justification for scoping out the displacement/disturbance effect of red-throated diver in the Mona Array Area for all phases.
		Displacement and barrier effects to seabirds occurring during O&M should also be assumed to occur during both construction and decommissioning. Table 4.19 indicates that displacement will be considered during construction and decommissioning phases, but not barrier effects. In the absence of evidence to the contrary, then an assumption of a mean annual mortality of 50% of that assessed during O&M should be applied to the construction and decommissioning phases.	Displacement assessment was carried out for the construction, operations and maintenance, and decommissioning phases assuming that 50% of the annual displacement impact resulting from the operations and maintenance phase will occur during construction and decommissioning phases. Approach and results are presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.
		We agree with the use of Woodward *et al.* (2019) and Furness (2015) to identify breeding and non-breeding seabird populations potentially affected by this project, respectively, and agree with the intention to use mean maximum plus one standard deviation to establish connectivity to breeding sites. Please clarify the rationale for surveying at an altitude of 396m and provide evidence that disturbance to sensitive seabird species would not occur at this altitude.	Although not included in the PEIR, the rationale for surveying at an altitude of 396m has been provided to the EWG.
		Clarity is required as to how impacts from operational developments will be included within a cumulative assessment. If built and operational projects are classed as part of the baseline conditions, then the project alone assessment needs to consider whether it brings 'baseline mortality' (including the mortality contributed from baseline projects) above a level that is unacceptable. Mortality that can be attributed to projects that were built and operational at the time that survey data were collected do need to be considered alongside predicted mortality from the Mona proposal. We would suggest that, given the difficulties in assessing 'actual' mortality or population consequences for mobile species such as marine birds, from existing built and operational infrastructure (such as windfarms), then in practice this means that the assessment is based on a combined 'predicted' mortality across built, operational, under construction, consented and otherwise identified infrastructure projects. The Scoping Report appears to suggest that operational project/plans will be included within a cumulative assessment, which contracts with the list of developments in stated elsewhere in the document . Please clarify whether and how the impact operational developments will be incorporated in a cumulative assessment.	The impact of operational developments has been included in the cumulative assessment which is based on predicted mortality.
	Scoping Opinion Natural England	Tracking studies should also be used where available to evidence connectivity, or lack thereof, they should also be used to aid screening where possible.	Tracking data available from the Seabird Tracking Database (Birdlife International, 2021) have been reviewed and summarized for each species in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		Identification of receptors and the sensitivity of receptors to impact scale definitions should be discussed and agreed as part of the Evidence Plan process with the relevant EWG.These definitions should be set out within the Environmental Statement.	The definition of sensitivity for receptors and receptor groups is included in volume 1, chapter 5: EIA methodology of the PEIR. These will be consulted on via the PEIR and EWGs where necessary.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this chapter
		A matrix for assessment of significance is provided as an example, demonstrating how the sensitivity of receptor against magnitude of impact can determine the significance of effect. As with above comments, sensitivity of receptor, magnitude of impact and the matrix of significance of effect should bediscussed and agreed through the Evidence Planning process.Discuss and agree with the relevant EWGs and definitions should be provided in the Environmental Statement.	The matrix for assessment of significance will be included in volume 1, chapter 5: EIA methodology of the PEIR. These will be consulted on via the PEIR and EWGs where necessary.
		We understand that at the current stage this is a high level definition, however, all definitions will require refining. Discussion and agreement should be sought through the Evidence Plan process with the relevant EWG.	The definition if significance levels will be included in volume 1, chapter 5: EIA methodology of the PEIR. These will be consulted on via the PEIR and EWGs where necessary.
		Consideration of climate change impacts over the operational period of Mona OWF should be considered. These impacts will become important if they cause an alteration in the baseline conditions and become detectable above natural inter-annual variations.	An assessment of the future baseline scenario including the impact of climate change is presented in section 10.4.5.
		Tracking studies should also be used where available to evidence connectivity, or lack thereof. Review and consider all relevant tracking studies.	Tracking data available from the Seabird Tracking Database (Birdlife International, 2021) have been reviewed and summarized for each species in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		It would be helpful if the figure within the Scoping Report clearly shows the areas where the buffer extends to a full 10km from the potential array area. If this Figure is to be used in the Environmental Statement, add detail to descriptive text and update the Figure to clarify the changing buffer distances and confirm the area that is covered by a full 10km buffer, including rationale for how this was selected.	The rationale for the study area design is presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		Has the selection of 12% of the sea surface area been justified, or is it simply following precedents from other projects? Although analysis of 12% of the sea surface is thought likely to be sufficient, best practice would dictate conducting a power analysis to determine the level and distribution of survey coverage to analyse. Furthermore, the selection of transect lines spaced at 2km on a NW-SE axis will require further justification, (i.e. the gradients that the transects were anticipated to intersect). We recommend that a power analysis should be carried out to demonstrate that survey coverage is appropriate, with the findings presented in the Environmental Statement technical annexes. The rationale for the chosen transect lines should be discussed at the EWG, and summarised in the Environmental Statement. More generally, the applicant is advised to review 'Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards', which is available on request.	The rationale for the digital aerial survey design is presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR. Coverage standing at 12.9%, exceeding the 10% minimum coverage suggested by literature (BSH, 2013). CVs are also provided in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR to give a measure of precision to support the approach.
		If a modelling approach is to be adopted (e.g. MRSea), early engagement with the SNCBs is recommended. We advise that before running the model that the parameters are discussed and agreed through the Evidence Plan process via the EWG.	The modelling-based approach has been discussed and agreed with the EWG and the full approach is presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		Specific tracking studies should also be used to aid screening where possible. Review and consider all relevant tracking studies.	Tracking data available from the Seabird Tracking Database (Birdlife International, 2021) have been reviewed and summarized in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this chapter
		As noted, the SNCB guidance on CRM is currently being updated. This will include updated parameters for use in both the deterministic and stochastic models, noting that technical issues relating to the latter have now been resolved. Further, a revised approach that accounts for macro-avoidance behaviour of gannet by reducing the densities for that species to beconsidered in CRM is likely to be recommended.The most appropriate approach for CRM needs to be agreed by the EWG. To assist with this, Natural England propose submitting detailed advice on the approach to CRM in response to the 'Displacement and Collision Risk Modelling Technical Notes' (received from the applicant 27 May 2022) by the 24th June 2022.	Advice was considered in the producing volume 6, annex 10.3: Offshore ornithology non-migratory seabird collision risk assessment of the PEIR.
13 July 2022	**Offshore Ornithology Expert Working Group 2** **Attended by:** Natural England, JNCC, NRW, RSPB, TWT	The EWG agreed on the approach to baseline characterisation as set out in the baseline characterisation technical paper.	Approach to the baseline characterisation is presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR and summarised in section 10.4.
		The EWG agreed on the approach to stochastic Collision Risk Model (sCRM) as discussed in the second EWG meeting, which superceed the Mona CRM technical paper following the Natural England advice.	Approach to the (sCRM) is presented in volume 6, annex 10.3: Offshore ornithology non-migratory seabird collision risk assessment of the PEIR and summarised in section 10.4.
		The EWG agreed to scope out red-throated diver for the EIA for the Mona Array Area (noting this will be included for the EIA for the Mona Offshore Cable Corridor) on the basis of low abundance of red throated diver across the Mona Array Area and survey buffer.	Despite the near-absence of red-throated diver in the Mona Offshore Ornithology Array Area study area, red-throated diver design-based estimates are presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR. This provided the justifcation for scoping out the displacement/disturbance effect of red-throated diver in the Monay Array Area for all phases.
July - August 2022	NRW, JNCC and Natural England – displacement technical paper provided and agreed as part of the Offshore Ornithology Expert Working Group 2.	NRW, JNCC and Natural England advised that whole displacement matrices are presented for black-legged kittiwake *rissa tridactyla* and manx shearwater *puffinus puffinus* using a range of mortality rates from 1 to 10%.	Displacement matrices (using a range of mortality rates) for both Manx Shearwater and black-legged kittiwake are presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.
		NRW, JNCC and Natural England advised that a combined estimate of the number of birds on the water (corrected for survey coverage) and of the number of birds in flight (corrected for survey coverage) are used for an assessment of Manx shearwater displacement.	The assessment of Manx shearwater presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR is based on the combined estimate of birds on the water and birds in flight.
		NRW, JNCC and Natural England advised that a displacement assessment is also carried out for the construction and decommissioning phases. This should assume that 50% of the annual displacement impact resulting from the operations phase will occur during construction and decommissioning phases.	Displacement assessment was carried out for the construction, operations and maintenance, and decommissioning phases assuming that 50% of the annual displacement impact resulting from the operations and maintenance phase will occur during the construction and decommissioning phases.
		NRW, JNCC and Natural England advised that assessments of displacement should use the information on uncertainty and variability in the input parameters (e.g. bird densities, mortality and displacement rates) to allow consideration of the range of values predicted impacts may fall within, and to allow an assessment of confidence in the conclusions made regarding adverse effects on site integrity and significance of impacts for populations.	The magnitude of impacts predicted in this chapter accounts for the full range of uncertainty and variability in the input parameters (i.e. bird densities with upper and lower confidence limits, mortality and displacement rate).
		NRW, JNCC and Natural England advised that black-legged kittiwake is screened into the displacement assessment as recent evidence suggests that they can be sensitive to displacement from offshore wind farms.	Displacement assessment has been conducted for black-legged kittiwake and is presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.
July - August 2022	NRW, JNCC and Natural England – collision technical paper provided and agreed as part of the Offshore Ornithology Expert Working Group 2.	NRW, JNCC and Natural England advised on the use of a migration-free breeding season.	Collision risk is reported for each 'bio-season'. Bio-seasons were defined according to the breeding, non-breeding and migratory periods using seasonal divisions proposed for BDMPS by Furness (2015).
		NRW, JNCC and Natural England recommended the use of the sCRM for the basic Band model (i.e. Options 1 and 2).	Collision risk modelling was undertaken using the sCRM developed by Marine Scotland (McGregor *et al.*, 2018) and the results are presented in volume 6, annex 10.3: Offshore ornithology non-migratory seabird collision risk assessment of the PEIR.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or were considered in this chapter
		NRW, JNCC and Natural England advised that collision risk assessment use the information on uncertainty and variability in the input parameters (e.g. bird densities, flight heights, avoidance rates, nocturnal activity) to allow consideration of the range of values predicted impacts may fall within, and to allow an assessment of confidence in the conclusions made regarding adverse effects on site integrity and significance of impacts for populations.	Collision risk modelling was undertaken using the Stochastic Collision Risk Model (sCRM) developed by Marine Scotland (McGregor *et al*., 2018) and the results are presented in volume 6, annex 10.3: Offshore ornithology collision risk assessment of the PEIR.
July - August 2022	NRW, JNCC and Natural England – baseline characterisation paper provided and agreed as part of the Offshore Ornithology Expert Working Group 2.	NRW, JNCC and Natural England advised that the applicant also provides records of all species detected from aerial surveys.	All species recorded during the digital aerial surveys are presented in this chapter and volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.
		NRW recommended that a power analysis is undertaken to demonstrate that survey coverage is appropriate. Although analysis of 12% of the sea surface is likely to be sufficient, best practice would be to conduct a power analysis to determine the level and distribution of survey coverage to analyse.	Coverage standing at 12.9%, exceeding the 10% minimum coverage suggested by literature (BSH, 2013). CVs are also provided in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR to give a measure of precision to support the approach.
November 2022	**Offshore Ornithology Expert Working Group 3** Natural England, Joint Nature Conservation Committee (JNCC), Natural Resources Wales (NRW), RSPB The Wildlife Trusts (TWT), Isle of Man Government	Discussion on Offshore Ornithology.	Due to the timing of the workshop ahead of publishing the PEIR, discussion outputs will be incorporated into the Environmental Statement.

10.4 Baseline environment

10.4.1 Methodology to inform baseline

Desktop study

10.4.1.1 Information on offshore ornithology within the Mona Offshore Ornithology Array Area study area and the Mona Offshore Ornithology Offshore Cable Corridor study area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 10.6 below with full details presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.

Table 10.6: Summary of key desktop reports.

Title	Source	Year	Author
Identifying important at-sea areas for seabirds using species distribution models and hotspot mapping.	Biological Conservation	2020	Cleasby, I. R., Owen, E., Wilson, L., Wakefield, E. D., O'Connell, P., and Bolton, M.
Distribution maps of cetacean and seabird populations in the northeast Atlantic.	Journal of Applied Ecology	2020	Waggitt, J.J., Evans, P.G., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., Brereton, T., Camphuysen, C.J., Durinck, J. and Felce, T.
All Wales Common Scoter survey: report on 2002/03 work programme.	CCW Contract Science Report no 615	2004	Cranswick, PA, C Hall and L Smith.
An assessment of the numbers and distributions of inshore aggregations of waterbirds using Liverpool Bay during the non-breeding season in support of possible SPA identification.	JNCC Report No. 373	2006	Webb, A., McSorley, C.A., Dean, B.J., Reid, J.B., Cranswick, P.A., Smith, L. and Hall, C.
An assessment of the numbers and distribution of wintering waterbirds and seabirds in Liverpool Bay/Bae Lerpwl area of search.	JNCC Report No 576	2016	Lawson, J., Kober, K., Win, I., Allcock, Z., Black, J. Reid, J.B., Way, L. and O'Brien, S.H.
SEA678 Data Report for Offshore Seabird Populations.	Coastal and Marine Resources Centre, Environmental Research Institute, University College, Cork	2006	Mackey and Giménez
Seabird Tracking Database.	BirdLife International	2022	BirdLife International
Morgan Offshore Wind Project PEIR (volume 2, chapter 10: Offshore Ornithology)	Morgan Offshore Wind Ltd	2023	RPS

Identification of designated sites

10.4.1.2 All designated sites within the three study areas with qualifying interest features that could be affected by the construction, operations and maintenance and decommissioning phases of the Mona Offshore Wind Project were identified using the three-step process described below:

- Step 1: All designated sites of international, national and local importance which overlap with the Mona Offshore Ornithology Array Area study area and the Mona Offshore Ornithology Offshore Cable Corridor study area, or the Cumulative Mona Offshore Ornithology study area were identified using a number of sources. These sources included the JNCC online resource on the SPAs network (https://jncc.gov.uk) and a review of the foraging ranges of seabird species from Woodward *et al*. (2019)
- Step 2: Information was compiled on the relevant seabird and waterbird species qualifying interests for each of these sites
- Step 3: Using the above information and expert judgement, sites were included for further consideration if they:
  - Overlap with the location of the Mona Offshore Ornithology Array Area study area and the Mona Offshore Ornithology Offshore Cable Corridor study area, or within the area in which potential direct effects from the Mona Offshore Wind Project could extend (e.g. displacement effects extending beyond the boundary of the Mona Array Area)
  - Include seabird qualifying features that use the waters in and around the Mona Offshore Ornithology Array Area study area and the Mona Offshore Ornithology Offshore Cable Corridor study area (e.g. for foraging with the mean-max + 1 standard deviation (SD) of the breeding colony)
  - Include qualifying features which may fly through the Mona Offshore Ornithology Array Area study area during migration or winter in and around the Mona Offshore Ornithology Offshore Cable Corridor study area and the Mona Offshore Ornithology Array Area study area.

Site specific surveys

10.4.1.3 In order to inform the PEIR, site-specific surveys were undertaken as agreed with the statutory bodies (see Table 10.5 for further details). A summary of the surveys undertaken to inform the offshore ornithology impact assessment is outlined in Table 10.7 below.

Table 10.7: Summary of site-specific survey data.

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
Digital Aerial Surveys	Mona Array Area with buffer zone (up to 10km)	Digital aerial surveys to characterise the distribution and abundance of seabirds within the Mona Offshore Ornithology Array Area study area.	APEM	March 2020 to February 2022	Volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.

10.4.2 Baseline environment

Desktop studies review findings

10.4.2.1 The Mona Array Area is situated in the central part of the Irish Sea. The Irish Sea separates the islands of Ireland and Great Britain; linked to the Celtic Sea in the south by St George's Channel, and to the Inner Seas off the West Coast of Scotland in the north by the North Channel (also known as the Straits of Moyle).

10.4.2.2 Twenty one species of seabird have been reported as regularly nesting on beaches or cliffs around the Irish Sea (Mitchell *et al.,* 2004) and a large proportion of the Manx shearwater *Puffinus puffinus* biogeographic population has been found breeding on offshore islands around the Irish Sea. Most of the world's Manx shearwater population is found in the United Kingdom (UK) and over 90% of the UK population is found on the Islands of Rum, Egg (Scotland), Skomer and Skokholm (Wales) (Mitchell *et al*., 2004; JNCC, 2020).

10.4.2.3 During the non-breeding season, large populations of common scoter *Melanitta nigra* and red-throated diver *Gavia stellata* use the shallow waters of Liverpool Bay (Lawson *et al*., 2016).

10.4.2.4 For the most widespread and abundant seabirds of the central Irish Sea, namely northern gannet *Morus bassanus*, common guillemot *Uria aalge*, European herring gull *Larus argentatus*, black-legged kittiwake *Rissa tridactyla*, lesser black-backed gull *Larus fuscus*, Manx shearwater and razorbill *Alca torda*, there are a number of breeding colonies within the species-specific foraging ranges (mean-maximum foraging ranges compiled by Woodward *et al.* (2019)) from the Mona Array Area.

10.4.2.5 Desktop review of boat-based and aerial survey data analysed by Waggitt *et al*. (2020) and Bradbury *et al*. (2014) revealed key patterns of temporal and spatial use in the Mona Offshore Ornithology Array Area study area. These are summarised below with full details presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR.

10.4.2.6 Both studies showed that black-legged kittiwake have a patchy seasonal distribution, an overall lower abundance during the breeding season (March to August) and relative low densities in the Mona Offshore Ornithology Array Area study area. It is also apparent from both studies that the Mona Array Area did not overlap with hotspots of abundance of common guillemot and razorbill, which were located further inshore or offshore during the non-breeding and breeding seasons respectively. It is also evident from Waggitt *et al*. (2020) and Bradbury *et al*. (2014) that lesser black-backed gull and European herring gull have a very restricted coastal distribution during the breeding season (April to August) owing to their small foraging range (Woodward *et al*., 2019). Both Bradbury *et al*. (2014) and Waggitt *et al*. (2020) showed densities of Manx shearwater to be relatively low during the breeding season (April to August) with less than one bird per km^2 in the Mona Offshore Ornithology Array Area study area. The work by Waggitt *et al*. (2020), based on aerial and boat-based survey data collected between 1980 to 2018, also indicated that northern gannet were found in the highest densities to the west of the Mona Offshore Ornithology Array Area study area during the breeding season (March to September) whilst Bradbury *et al*. (2014) found the highest densities to be southeast of the Mona Offshore Ornithology Array Area study area during the breeding season.

Site-specific survey findings

10.4.2.7 Table 10.8 presents the raw counts species and species groups recorded within the Mona Offshore Ornithology Array Area study area between March 2020 and February 2022 as part of the site-specific digital aerial surveys. The raw counts (presented in Table 10.8) are calculated by the total number of birds recorded during the survey and differs from the estimated (modelled) abundances presented elsewhere within this chapter. The numbers presented encapsulates the full two years of digital aerial survey data available. Design-based abundance estimates of all species are presented in volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR together with model-based abundance (using the MRSea package) for the most abundant seabird species.

10.4.2.8 Common guillemot was the most abundant seabird species recorded during the digital aerial surveys, with most birds found on the sea. Common guillemot distribution was heterogeneous depending on year and month. Within the Mona Offshore Ornithology Array Area study area, the highest estimates were recorded in March in Year 1 and in Year 2, with 17,177 (95% CI range: 9,723 to 27,481) and 11,786 (95% CI range: 6,325 to 20,451) individuals, respectively.

10.4.2.9 Black-legged kittiwake were most abundant in March at the start of the breeding season. Thereafter, the predicted abundance varied greatly for the rest of the breeding season (April to August) and the predicted distribution within the Mona Array Area appeared to be variable, with high inter-month variability recorded. Black-legged kittiwake were also present in moderate numbers throughout the non-breeding season. MRSea modelled estimates for monthly black-legged kittiwake numbers in the Mona Offshore Ornithology Array Area study area peaked at 4,066 individuals (95% CI range: 2,675 to 5,843) in March 2021.

10.4.2.10 Within the Mona Offshore Ornithology Array Area study area, the highest abundance of Manx shearwater was recorded in June 2021, with an estimated 8,378 birds (95% range: 2,062 to 22,154). The presence of Manx shearwater in July suggested that these birds might be associated with the Welsh colonies and thus forage within the Mona Offshore Ornithology Array Area study area.

10.4.2.11 Although present in much lower abundance than common guillemot, razorbill was recorded in the highest numbers in February 2021 and March 2022, with estimates of 6,473 (95% CI range: 4,129 to 9,450) and 5,818 (95% CI range: 2,674 to 11,258) individuals respectively in the Mona Offshore Ornithology Array Area study area.

10.4.2.12 The distribution of northern gannet during the key breeding months was patchy, and the highest densities were found outside the Mona Array Area. In Year 1, the highest abundance in the Mona Offshore Ornithology Array Area study area was recorded in July and August, with 669 (95% range: 440 to 942) and 509 (95% range: 272 to 841) respectively. In contrast the highest abundance was recorded at the start of the breeding season in Year 2 with 833 individuals (95% range: 413 to 1,434) in March 2022. The low abundances and high inter-annual variability during the breeding season suggests that the Mona Array Area is not favoured by foraging Northern gannet.

Table 10.8. Species/groups and sum of raw counts recorded during the March 2020 to February 2022 surveys, in order of total abundance.

Species/groups	Sum of raw counts
Common guillemot	7,425
Unidentified Common guillemot/razorbill	6,247
Black-legged kittiwake	3,510
Manx shearwater	2,553
Razorbill	1,543
Northern gannet	963
Northern fulmar	242
Auk species (unidentified common guillemot/razorbill/Atlantic puffin)	170
Great black-backed gull *Larus marinus*	128
European herring hull	72
Unidentified thrush species	68
Unidentified bird species	61
Common gull	61
Auk species/shearwater species	59
Lesser black-backed gull	55
Unidentified gull species	29
Little gull *Hydrocoloeus minutus*	28
'Commic' tern (unidentified Arctic tern/common tern)	26
Unidentified wader species	25
Unidentified small gull species	25
Atlantic puffin *Fratercula arctica*	25
Unidentified large gull species	24
Common tern *Sterna hirundo*	13
Black-tailed godwit *Limosa limosa islandica*	13
Sandwich tern *Thalasseus sandvicensis*	10
Black-headed gull *Chroicocephalus ridibundus*	9
Arctic tern *Sterna paradisaea*	5
Red-throated diver *Gavia stellata*	4
Great skua *Stercorarius skua*	3
Unidentified tern species	2
European shag *Gulosus aristotelis*	2
Arctic skua *Stercorarius parasiticus*	2
Unidentified storm-petrel species	1
Unidentified skua species	1
Great cormorant *Phalacrocorax carbo*	1
Unidentified lesser black-backed gull/great black-backed gull species	1

10.4.3 Designated sites

10.4.3.1 Designated sites identified for the offshore ornithology assessment are described below in Table 10.9.

Table 10.9: Designated sites and relevant qualifying interests for the offshore ornithology assessment. Sites are ordered according to distance from the Mona Array Area within each category of site: marine SPAs, breeding seabird colony SPAs and passage/wintering bird SPAs.

Designated site	Closest Distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor (km)	Relevant Qualifying interest
Marine SPAs (designated for feeding and rafting seabirds)			
Liverpool Bay SPA	10	0	Red-throated diver
			Little gull
			Common scoter
			Little tern *Sternula albifrons*

Designated site	Closest Distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor (km)	Relevant Qualifying interest
			Common tern
			Waterbird assemblage
Irish Seafront SPA	57.2	61.4	Manx shearwater
Skomer, Skokholm and the Seas off Pembrokeshire SPA	220.6	201.1	European storm-petrel *Hydrobates pelagicus*
			Manx shearwater
			Lesser black-backed gull
			Seabird assemblage (breeding) including the components:
			Razorbill
			Common guillemot
			Black-legged kittiwake
			Atlantic puffin
			Lesser black-backed gull
			Manx shearwater
SPA designated for breeding seabirds			
Ribble and Alt Estuaries SPA	37.2	39.3	Lesser black-backed gull
Morecambe Bay and Duddon Estuary SPA	47	58.7	Lesser black-backed gull
			European herring gull
Lambay Island SPA	128.9	132.5	Lesser black-backed gull
			European herring gull
			Black-legged kittiwake
			Common guillemot
			Razorbill
Howth Head Coast SPA	134.4	137.7	Black-legged kittiwake
Ireland's Eye SPA	134.7	138	European herring gull
			Black-legged kittiwake
			Common guillemot
			Razorbill
Wicklow Head SPA	148.8	146.2	Black-legged kittiwake

Designated site	Closest Distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor (km)	Relevant Qualifying interest
Ailsa Craig SPA	166.9	193	Northern gannet
			Common guillemot
			European herring gull
			Black-legged kittiwake
			Lesser black-backed gull
			Seabird assemblage including the components: • Common guillemot • Northern gannet • Lesser black-backed gull • European herring gull • Black-legged kittiwake
Rathlin Island SPA	207.7	230.3	Common guillemot
			Razorbill
			Black-legged kittiwake
			Lesser black-backed gull
			European herring gull
Grassholm SPA	229.4	211.4	Northern gannet
Saltee Islands SPA	236.8	228.2	Northern gannet
			Lesser black-backed gull
			European herring gull
			Black-legged kittiwake
			Common guillemot
			Razorbill
North Colonsay and Western Cliffs SPA	281.7	307	Black-legged kittiwake
			Common guillemot
Helvick Head to Ballyquin SPA	292.4	286.6	European herring gull
			Black-legged kittiwake
Rum SPA	365.5	391.8	Black-legged kittiwake
			Common guillemot
Old Head of Kinsale SPA	377.7	371.9	Black-legged kittiwake
			Common guillemot
	384.5	410.7	European herring gull

Designated site	Closest Distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor (km)	Relevant Qualifying interest
Canna and Sanday SPA			Black-legged kittiwake
			Common guillemot
Isles of Scilly SPA/Ramsar	433.3	411.1	Great-black backed gull
			Lesser black-backed gull
Shiant Isles SPA	467.5	494.3	Common guillemot
			Black-legged kittiwake
			Razorbill
Handa SPA	505.1	532.5	Common guillemot
			Black-legged kittiwake
			Razorbill
St Kilda SPA	514.2	538.92	Northern gannet
			Common guillemot
			Black-legged kittiwake
			Razorbill
Cape Wrath SPA	527.1	554.6	Black-legged kittiwake
			Common guillemot
			Atlantic puffin
			Razorbill
Flannan Isles SPA	535.5	561.6	Common guillemot
			Black-legged kittiwake
			Razorbill
Sule Skerry and Sule Stack SPA	573.3	600.9	Northern gannet
			Common guillemot
North Rona and Sula Sgeir SPA	592.7	620	Northern gannet
			Great black-backed gull
			Common guillemot
			Black-legged kittiwake
			Razorbill
SPA designated for passage and wintering waterbirds			
Dee Estuary SPA	34.5	14.1	Pintail Anas acuta
			Teal Anas crecca
			Dunlin Calidris *alpina alpina*
			Knot *Calidris canutus*
			Oystercatcher *Haematopus ostralegus*
			Bar-tailed godwit *Limosa lapponica*
			Black-tailed godwit
			Curlew *Numenius arquata*
			Grey plover *Pluvialis squatarola*
			Shelduck *Tadorna tadorna*
			Redshank *Tringa totanus*
Ribble Alt Estuaries SPA	37.2	39.3	Pintail
			Teal
			Wigeon *Anas penelope*
			Greylag goose *Anser anser*
			Sanderling *Calidris alba*
			Dunlin
			Knot
			Ringed plover *Charadrius hiaticula*
			Bewick's swan *Cygnus columbianus bewickii*
			Oystercatcher
			Bar-tailed godwit
			Black-tailed godwit
			Curlew
			Whimbrel *Numenius phaeopus*
			Ruff *Philomachus pugnax*
			Golden plover *Pluvialis apricaria*
			Grey plover
			Shelduck
			Redshank
			Lapwing *Vanellus vanellus*
Mersey Narrows and North Wirral Foreshore SPA	39.3	27.2	Sanderling
			Dunlin

Designated site	Closest Distance to the Mona Array Area (km)	Closest distance to the Mona Offshore Cable Corridor (km)	Relevant Qualifying interest
			Knot
			Oystercatcher
			Bar-tailed godwit
			Grey plover
			Redshank
Morecambe Bay and Duddon Estuary SPA	47	58.7	Pintail
			Pink-footed goose *Anser brachyrhynchus*
			Turnstone *Arenaria interpres*
			Sanderling
			Dunlin
			Knot
			Ringed plover
			Mute swan *Cygnus cygnus*
			Little egret *Egretta garzetta*
			Oystercatcher
			Bar-tailed godwit
			Black-tailed godwit
			Curlew
			Ruff
			Golden plover
			Grey plover
			Shelduck
			Redshank
Traeth Lafan/ Lavan Sands, Conway Bay SPA	36.6	14.8	Oystercatcher
			Curlew
			Redshank

10.4.4 Important Ecological Features (IEFs)

10.4.4.1 The IEFs included within the assessment are those species recorded during the site-specific surveys and identified in the desktop study review that could be potentially affected by the Mona Offshore Wind Project.

10.4.4.2 The offshore ornithology IEFs have been selected (Table 10.10) based on the conservation status of the ornithological receptor, their sensitivity to impact (for each impact which has been scoped in for the assessment) and known abundance from site specific surveys and desktop studies (volume 6, annex 10.1: Offshore ornithology baseline characterisation of the PEIR).

10.4.4.3 For each IEF identified, it has been stated whether the identified species are listed on Annex I of the European Commission ('EC') Directive 2009/147/EC (codified version of 79/409/EC) on the Conservation of Wild Birds (the 'Birds Directive'). Within the UK, the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (known as the 'Habitats Regulations') provide amendments to the 2017 Habitats Regulations. The 2017 Habitats Regulations transpose aspects of the Birds Directive into national law, covering all environments out to 12nm.

10.4.4.4 For species not listed under Annex I, the level of conservation concern was assessed with the Birds of Conservation Concern (BoCC) (Stanbury *et al.*, 2021), which uses quantitative assessments against standardised criteria to allocate species to Red, Amber or Green lists depending on their level of conservation concern. Furthermore, species of principal importance for the conservation of biodiversity in England (priority species) were included in the assessment as listed under Section 41 of the Natural Environment and Rural Communities Act 2006.

10.4.4.5 Following the evaluation, the IEFs identified in Table 10.10 were taken forward for consideration in the impact assessment. Species that were recorded in very small numbers or very infrequently during the site-specific surveys and the desktop studies review are excluded because a population-level impact will be negligible and thus undetectable.

10.4.4.6 The IEFs included in the assessment showed some seasonality in their distribution and abundance during the site-specific surveys, which reflected the timing of the breeding and non-breeding seasons and migratory periods (i.e. pre- and post-breeding).

10.4.4.7 Species-specific impacts have been assessed in relation to their seasonality as defined in Furness (2015), as shown in Table 10.11.

10.4.4.8 Regional population estimates for the non-breeding, wintering and autumn and spring migration periods have been defined in Table 10.11.

10.4.4.9 and calculated using the Biologically Defined Minimum Population Scales (BDMPS) relevant for each species (Furness, 2015). Population estimates for the breeding population were based on SPA and non-SPA sites located within the species' foraging range of the Mona Offshore Wind Project. Breeding Colony counts were extracted from the Seabird Monitoring Programme (SMP) online database (https://app.bto.org/seabirds/public/index.jsp).

10.4.4.10 Baseline mortality rates for all species (including juvenile and adult survival) and productivity rates were taken from Horswill and Robinson (2015).

Table 10.10: Evaluation of IEFs showing species assessed for significance of effect for the Mona Offshore Wind Project. Species vulnerability to collision and disturbance/displacement is adapted from scores (1 to 5) derived by Wade *et al.* (2016). Abundance is derived from the raw summed abundance recorded during the site-specific surveys and the level of abundance is categorised as follows: absent; very low <19 individuals; low: 20 to 99; moderate: 100 to 499; high: 500 to 4,999 and very high: 5000+.

Important ecological features	Conservation status	Species of principal importance in England	Abundance recorded in the Offshore Ornithology Array Area study area	Sensitivity to collision	Sensitivity to disturbance and displacement	Assessed for significance of effects for the Mona Offshore Wind Project
Arctic skua	Red list	N	Very Low	Medium	Low	N
Arctic tern	Annex 1	N	Very Low	Low	Low	N
Atlantic puffin	Red List	N	Low	Very low	Medium	Y
Black guillemot	Amber list	N	Absent	Very low	Medium	N
Black-headed gull	Amber list	N	Very Low	Medium	Low	N
Black-legged kittiwake	Red list	N	High	Medium	Low	Y
Black-throated diver	Annex 1	N	Absent	Low	Very high	N
Common guillemot	Red list	N	Very high	Very low	Medium	Y
Common gull	Amber list	N	Low	Medium	Low	N
Common scoter	Red list	Y	Absent	Very low	Very high	Y
Common tern	Annex 1	N	Very low	Low	Low	N
European shag	Red list	N	Very low	Low	Medium	N
European storm petrel	Annex 1	N	Absent	Very low	Low	N
Great black-backed gull	Amber list	N	Moderate	Medium	Low	N
Great cormorant	Green List	N	Very low	Low	Medium	N
Great northern diver	Annex 1	N	Absent	Low	Very high	N
Great skua	Amber list	N	Very low	Medium	Low	N
Herring gull	Red list	Y	Low	Medium	Low	N
Leach's storm-petrel	Annex 1	N	Very low	Very low	Low	N
Lesser black-backed gull	Amber list	N	Low	Medium	Low	N
Little gull	Annex 1	N	Low	Low	Low	N
Little tern	Annex 1	N	Absent	Low	Low	N
Manx shearwater	Amber list	N	Moderate	Low	Medium	Y
Mediterranean gull	Annex 1	N	Absent	Medium	Low	N
Northern gannet	Amber list	N	High	Medium	Medium	Y
Northern fulmar	Amber list	N	Moderate	Low	Low	Y
Razorbill	Amber list	N	High	Very low	Medium	Y

Important ecological features	Conservation status	Species of principal importance in England	Abundance recorded in the Offshore Ornithology Array Area study area	Sensitivity to collision	Sensitivity to disturbance and displacement	Assessed for significance of effects for the Mona Offshore Wind Project
Red-throated diver	Annex 1	N	Very low	Low	Very high	N
Roseate tern	Annex 1	N	Absent	Low	Low	N
Sandwich tern	Annex 1	N	Very low	Low	Low	N

Seasonality

10.4.4.11 The IEFs included in the assessment showed some seasonality in their distribution and abundance during the site-specific surveys, which reflected the timing of the breeding and non-breeding seasons and migratory periods (i.e. pre- and post-breeding).

10.4.4.12 The seasonal definitions in Furness (2015) include overlapping months in some instances due to variation in the timing of migration for birds which breed at different latitudes (i.e. individuals from breeding sites in the north of the species' range may still be on spring migration when individuals farther south have already commenced breeding). Bio-seasons used within the assessment were defined according to the breeding, non-breeding and migratory periods (autumn and spring migration), from Furness (2015), shown in Table 10.11.

Table 10.11: Seasonal definitions as the basis for assessment, from Furness (2015).

Species	Pre-Breeding Season/spring migration	Breeding season	Post Breeding Season/autumn migration	Non-breeding/winter season
Atlantic puffin	n/a	April to early August	n/a	Mid-August to March
Black-legged kittiwake	January to April	April to August	August to December	n/a
Common guillemot	n/a	March to July	n/a	August to February
European herring gull	n/a	March to August	n/a	September to February
Great black-backed gull	n/a	Late March to August	n/a	September to March
Lesser black-backed gull	March to April	April to August	August to October	November to February
Northern fulmar	December to March	January to August	September to October	November
Northern gannet	December to March	March to September	September to November	n/a
Manx shearwater	Late March to May	April to August	August to early October	n/a
Razorbill	January to March	April to July	August to October	November to December

Reference populations

10.4.4.13 Regional population estimates for the non-breeding, wintering and autumn and spring migration periods have been defined and calculated using the BDMPS relevant for each species (Furness, 2015). Population estimates for the breeding population were based on SPA and non-SPA sites located withing the species' foraging range (using Woodward *et al.,* 2019) of the Mona Offshore Wind Project . Breeding Colony counts were extracted from the SMP online database (JNCC, 2022).

10.4.4.14 During the breeding season, in addition to seabirds associated with breeding colonies, there will be immature seabirds, juvenile seabirds and 'sabbatical' seabirds (mature seabirds not breeding in a given year) present within the region. Population counts therefore must be adjusted to account for these seabirds. It was assumed that all immature seabirds in the BDMPS population in the bio-season immediately before the breeding season (usually the return migration bio-season) return to breeding colonies. The total regional population within the breeding season is therefore the sum of breeding adults associated with nearby colonies plus the proportion of immature seabirds from the BDMPS return migration population. This is shown in Table 10.12.

Table 10.12: Calculation of regional population during the breeding season.

Species	Breeding population within mean-max foraging range (JNCC, 2022)	BDMPS return migration population (Furness, 2015)	Proportion of juvenile and immature (Furness, 2015)	Juvenile and immature individuals	Total regional breeding population
Common guillemot	130,389	1,139,220	42.5%	484,169	614,558
Razorbill	28,148	606,914	42.9%	260,366	281,276
Atlantic puffin	34,316	304,557	49.4%	150,451	184,767
Northern gannet	152,372	661,888	44.7%	295,863	448,235
Black-legged kittiwake	71,198	691,526	46.6%	322,251	397,251
Manx shearwater	1,253,612	1,580,895	45.6%	720,888	1,974,500
European herring gull	12,710	173,299	55.2%	95,661	108,371
Lesser black-backed gull	30,140	163,304	40.5%	66,138	96,278
Great black-backed gull	594	17,742	55.8%	9,892	10,486

10.4.4.15 In the non-breeding season, seabirds are not constrained by colony location and can, depending on individual species, range widely within UK seas and beyond. The ZOI for seabird species where an assessment in the non-breeding season and migratory periods is deemed to be required is based on the 'UK Western Waters' populations defined by Furness (2015).

10.4.4.16 All population estimates based on bio-season are provided within Table 10.13.

Table 10.13: Bio-season population sizes used within the assessment.

Species	Pre-Breeding Season/spring migration	Breeding season	Post Breeding Season/autumn migration	Non-breeding/winter season
Common guillemot	n/a	March to July (614,558)	n/a	August to February (1,139,220)
Razorbill	January to March (606,914)	April to July (278,484)	August to October (606,914)	November to December (341,422)
Atlantic puffin	n/a	April to early August (184,767)	n/a	Mid-August to March (304,557)
Northern gannet	December to March (661,888)	March to September (448,235)	September to November (545,954)	n/a
Black-legged kittiwake	January to April (691,526)	April to August (393,449)	August to December (911,586)	n/a
Manx shearwater	March to May (1,580,895)	April to-August (1,974,500)	August to early October (1,580,895)	n/a
European herring gull	n/a	March to August (100,561)	n/a	September to February (173,299)
Lesser black-backed gull	March to April (163,304)	April to August (96,971)	August to October (163,304)	November to February (41,159)
Great black-backed gull	n/a	Late March to August (10,480)	n/a	September to March (17,742)

Baseline mortality rates

10.4.4.17 The impact of additional mortality due to wind farm effects is assessed in terms of the change in the baseline mortality rate which could result. It has been assumed that all age classes are equally at risk of effects, with each age class affected in proportion to its presence in the population. Therefore, a weighted average baseline mortality rate has been calculated which is appropriate for all age classes for use in assessments, calculated for those species screened in for assessment. These were calculated using the different rates for each age class and their relative proportions in the population. Only those species for which impacts have been assessed (i.e. those scoped in for specific impacts in section 10.8) have been included.

10.4.4.18 Demographic rates for each species were taken from Horswill and Robinson (2015) and entered into a matrix population model. This was used to calculate the expected stable proportions in each age class (note, to obtain robust stable age class distributions for less well studied species such as divers it was necessary to adjust the rates in order to obtain a stable population size). Each age class survival rate was multiplied by its stable age proportion and the total for all ages summed to give the weighted average survival rate for all ages. Taking this value from 1 gives the average mortality rate. The demographic rates, and the age class proportions and average mortality rates calculated from them, are presented in Table 10.14.

Table 10.14: Demographic rates from Horswill and Robinson (2015) and population age ratios calculated from stable population models used to estimate average mortality for use in impact assessment.

		Age Class								
Species	**Parameter**	**0-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-6**	**Adult**	**Productivity**	**Average mortality**
Common guillemot	Survival	0.560	0.792	0.917	0.939	0.939	n/a	0.939	0.672	0.139
	Proportion in population	0.167	0.090	0.069	0.061	0.056	n/a	0.557	n/a	n/a
Razorbill	Survival	0.630	0.630	0.895	0.895	n/a	n/a	0.895	0.570	0.174
	Proportion in population	0.161	0.103	0.066	0.060	n/a	n/a	0.610	n/a	n/a
Atlantic puffin	Survival	0.709	0.709	0.709	0.760	0.805	n/a	0.906	0.617	0.181
	Proportion in population	0.164	0.119	0.086	0.062	0.048	n/a	0.521	n/a	n/a
Northern gannet	Survival	0.424	0.829	0.891	0.895	0.895	n/a	0.919	0.700	0.187
	Proportion in population	0.191	0.081	0.067	0.059	0.053	n/a	0.549	n/a	n/a
Black-legged kittiwake	Survival	0.790	0.854	0.854	0.854	n/a	n/a	0.854	0.690	0.157
	Proportion in population	0.169	0.131	0.111	0.093	n/a	n/a	0.496	n/a	n/a
Manx shearwater	Survival	0.870	0.870	0.870	0.870	0.870	n/a	0.870	0.697	0.131
	Proportion in population	0.150	0.128	0.109	0.092	0.078	n/a	0.442	n/a	n/a
European herring gull	Survival	0.798	0.834	0.834	0.834	0.834	n/a	0.834	0.920	0.172
	Proportion in population	0.178	0.141	0.117	0.097	0.082		0.384	n/a	n/a
Lesser black-backed gull	Survival	0.820	0.885	0.885	0.885	0.885		0.885	0.530	0.124
	Proportion in population	0.133	0.109	0.096	0.085	0.075		0.501		n/a
Great black-backed gull	Survival	0.798	0.930	0.930	0.930	0.930		0.930	1.139	0.095
	Proportion in population	0.193	0.138	0.114	0.095	0.079		0.381		n/a

10.4.5 Future baseline scenario

10.4.5.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 requires that "an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge" is included within the PEIR. In the event that the Mona Offshore

Wind Project does not come forward, an assessment of the future baseline conditions has been carried out and is described within this section.

10.4.5.2 The UK holds internationally important populations of seabirds (Mitchell *et al*., 2004). UK seabird populations have shown a marked decline over the last two decades (JNCC, 2020; Mitchell *et al*., 2020) with over a third of species experiencing declines in breeding abundance of up to 30% or more since the early 1990s (Mitchell *et al.,* 2020).

10.4.5.3 A recent study suggests that, in terms of number of species affected and the average impact, the key three threats to seabird populations globally are invasive species (165 species across all the most threatened groups), bycatch in fisheries (100 species but with the greatest average impact) and climate change (96 species affected) (Dias *et al*., 2019 and Mitchell *et al*., 2020).

10.4.5.4 Most seabird species in the UK are at the southern limit of their range in the northeast Atlantic and therefore an increase in global temperatures could result in a shift in species' range with the potential for overall declines in population size (Frederiksen *et al*., 2007, 2013 and Mitchell *et al*., 2020). In the UK and Ireland, climate change is considered to be the likely primary cause of decline in seabird populations in the future, with anticipated depletion of breeding conditions for most species either indirectly, through changes in prey abundance, or directly during extreme weather events (Mitchell *et al.*, 2020).

10.4.5.5 Fisheries management will also likely impact on future seabird populations in the UK and Ireland. For many years, seabird species have benefitted from bycatch and fisheries discards; for scavenging species such as European herring gull, black-legged kittiwake, great skua and fulmar, population levels may already be above those that naturally occurring food sources would sustain (Votier *et al.,* 2004 and Frederiksen *et al.,* 2013), however the introduction between 2015 and 2019 of the Common Fisheries Policy (CFP) Landings Obligation ('discard ban') will likely reduce the discard available and ultimately put more pressure on scavenging species.

10.4.6 Data limitations

10.4.6.1 Baseline characterisation of the Mona Offshore Ornithology Array Area study area and resulting assessments of significance use site-specific data (digital aerial surveys) conducted over a period of 24 months (March 2020 to February 2022). As sampling is undertaken once a month for a period of 24 months, it may be considered to represent a snapshot of each month. Indeed, seabird numbers may fluctuate both spatially and temporally in response to environmental conditions. However, the sampling regime adopted at the Mona Offshore Wind Project is similar to other baseline characterisation surveys at offshore wind farms projects which have been previously agreed by SNCBs as suitable for baseline characterisation.

10.4.6.2 The level of precision of the abundance estimates is crucial as reliable abundance underpins the robustness of the predictions and the assessment of the effects on the IEFs. To characterise the baseline conditions, model-based estimates using the Marine Renewables Strategic environmental assessment (MRSea) package were produced in order to predict numbers across the survey area alongside 95% confidence intervals to provide a level of uncertainty. Design based estimates for bird numbers and densities in each month were also generated and compared to the MRSea estimates to provide additional validation of the MRSea outputs and provide estimates for months where low raw abundances prevented the use of the MRSea model. Flight heights for the sCRM were derived from the published literature rather than site-specific data. Generic flight height distributions published by Johnston *et al*. (2014a, 2014b) were therefore used in sCRM for this assessment. The application of site-specific flight height data collected by LiDAR survey was considered during the survey programme but was not undertaken following consultation with Natural England in 2021. At the time of consultation, Natural England did not endorse the use of LiDAR as a method for collecting flight height data to parameterise CRMs due to the lack of an established body of scientific evidence. Other methods to collect site-specific flight height data (e.g. derived from aerial imagery) were not currently considered to be sufficiently robust or precise in their estimates and have associated issues with the application of appropriate avoidance rates. The use of generic flight heights conforms to current best practice and has been agreed through the Evidence Plan Process EWG as presented in section 10.2.3.

10.4.6.3 The impact of the short, medium and long-term effects of the 2022 Highly Pathogenic Avian Influenza (HPAI) outbreak on seabird colony abundance and vital rates (productivity and survival) on UK breeding colonies is unclear. It is also unclear how the distribution and abundance of seabirds at sea has been affected during the 2022 summer outbreak. The disease has affected 61 bird species, including species such as Northern gannets, razorbill, guillemot, puffin, Manx shearwater, Northern fulmar and small and large gull species (BTO, 2022). The impact has affected Northern gannet and great skua colonies profoundly, with both species now facing increased risk of global extinction (BTO, 2022) (the United Kingdom supports 55.6% of the global Northern gannet population and 60% of the global great Skua population; JNCC, 2021).

10.4.6.4 All of the data collected for the Mona Offshore Ornithology Array Area study area was collected prior to the 2022 outbreak and therefore represents the 'typical' seabird distribution and abundance. As stated in Natural England's advice note (from September 2022), "*any changes in abundance at colonies would be reflected proportionately in the at sea data. That is, it is reasonable to assume distribution patterns will remain broadly similar, but densities to change accordingly*" and therefore, all data collected remains valid (Natural England, 2022d).

10.5 Impact assessment methodology

10.5.1 Overview

10.5.1.1 The offshore ornithology impact assessment has followed the methodology set out in volume 1, chapter 5: EIA methodology of the PEIR. Specific to the offshore ornithology impact assessment, the following guidance documents have also been considered:

- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase I: Expectations for pre-application baseline data for designated nature conservation and landscape receptors to support offshore wind applications (Natural England, 2022a)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase II: Expectations for pre-application engagement and best practice guidance for the evidence plan process (Natural England, 2022b)

- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications (Natural England, 2022c).

10.5.1.2 In addition, the offshore ornithology impact assessment has considered the legislative framework as defined by:

- The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 and the 2017 Habitats Regulations
- European Commission ('EC') Directive 2009/147/EC (codified version of 79/409/EC) on the Conservation of Wild Birds (the 'Birds Directive')
- Ramsar Convention on Wetlands of International Importance 1971.

10.5.2 Impact assessment criteria

10.5.2.1 The criteria for determining the significance of effects is a two-stage process that involves defining the magnitude of the impacts and the sensitivity of the receptors. This section describes the criteria applied in this chapter to assign values to the magnitude of potential impacts and the sensitivity of the receptors. The terms used to define magnitude and sensitivity are based on those which are described in further detail in volume 1, chapter 5: EIA methodology of the PEIR.

10.5.2.2 The criteria for defining magnitude in this chapter are outlined in Table 10.15 below. This set of definitions has been determined on the basis of changes to bird populations.

Table 10.15: Definition of terms relating to the magnitude of an impact.

Magnitude of impact	Definition
High	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is predicted to irreversibly alter the population in the short to long term and to alter the long-term viability of the population and/or the integrity of the protected site. Impacts felt long-term. Impacts predicted to be reversed in the long-term (i.e. more than five years) following cessation of the project activity.
Medium	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that occurs in the short and long-term, but which is not predicted to alter the long-term viability of the population and/or the integrity of the protected site. Impacts felt medium to long-term. Impacts predicted to be reversed in the medium-term (i.e. no more than five years) following cessation of the project activity.
Low	A change in the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site that is sufficiently small-scale or of short duration to cause no long-term harm to the feature/population. Impacts present for a short to medium duration. Impacts predicted to be reversed in the short-term (i.e. no more than one year) following cessation of the project activity.
Negligible	Very slight change from the size or extent of distribution of the relevant biogeographic population or the population that is the interest feature of a specific protected site. Impacts present for a short duration Impacts predicted to be reversed rapidly (i.e. no more than circa six months) following cessation of the project related activity.
No change	No loss or alteration of characteristics, features or elements; no observable impact either adverse or beneficial.

10.5.2.3 The criteria for defining recoverability and sensitivity in this chapter are outlined in Table 10.16 and Table 10.17 below. The definition of sensitivity considers the vulnerability and recoverability of a receptor as well as taking into account the conservation importance of each receptor (outlined in Table 10.18).

10.5.2.4 It should be noted that high vulnerability and/or low recoverability are not necessarily linked with high conservation value within a particular impact. A receptor could be categorised as being of high conservation value (e.g. an interest feature of a SPA) but have a low or negligible physical/ecological vulnerability to an effect and vice versa. Determination of sensitivity takes these differing aspects into consideration.

Table 10.16: Definition of recoverability.

Recoverability	Definition
High	A species with a low to medium reproductive success and a stable or increasing UK trend in breeding abundance and productivity.
Medium	A species with a low reproductive success and a stable or increasing UK long-term trend in breeding abundance and productivity.
Low	A species with a low reproductive success and a declining UK long-term trend in breeding abundance and productivity or uncertainty regarding the the long-term trend (due to data availability).

Table 10.17: Definition of sensitivity of the receptor.

Sensitivity	Definition
Very High	Bird species has high conservation value, very high vulnerability to impact and has no ability to recover
High	Bird species has high conservation value, medium vulnerability to impact and has low recoverability
	Bird species has medium conservation value, high vulnerability to impact and has low recoverability
Medium	Bird species has high conservation value, low vulnerability to impact and has medium recoverability
	Bird species has high conservation value, low vulnerability to impact and has low recoverability
	Bird species has medium conservation value, high vulnerability to impact and has medium recoverability
	Bird species has medium conservation value, medium vulnerability to impact and has medium recoverability
	Bird species has medium conservation value, low vulnerability to impact and has medium recoverability
Low	Bird species has medium conservation value, medium vulnerability to impact and high recoverability
	Bird species has low conservation value, medium to high vulnerability to impact and medium to high recoverability
Negligible	Bird species has low conservation value, low vulnerability to impact and medium to high recoverability
	Bird species is not vulnerable to impacts.

10.5.2.5 The conservation value of ornithological receptors is based on the population from which individuals are predicted to be drawn. This reflects current understanding of the movements of species, with site-based protection (e.g. SPAs) generally limited to specific periods of the year (e.g. the breeding season). Therefore, conservation value can vary through the year depending on the relative sizes of the number of individuals predicted to be at risk of impact and the population from which they are estimated to be drawn. Conservation value therefore corresponds to the degree of connectivity which is predicted between the wind farm site and protected populations. Using this approach, the conservation importance of a species seen at different times of year may fall into any of the defined categories (Table 10.18).

Table 10.18: Definition of conservation importance of the receptor.

Conservation Importance	Definition
High	A species for which individuals at risk can be clearly connected to a particular SPA
Medium	A species for which individuals at risk are probably drawn from particular SPA populations, although other colonies (both SPA and non-SPA) may also contribute to individuals observed on the Mona Offshore Wind Project
Low	A species for which it is not possible to identify the SPAs from which individuals on the Mona Offshore Wind Project have been drawn, or for which no SPAs are designated.

10.5.2.6 The significance of the effect upon offshore ornithology is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The method employed for this assessment is presented in Table 10.19. Where a range of significance of effect is presented in section 10.8, the final assessment for each effect is based upon expert judgement and a precautionary approach.

10.5.2.7 For the purposes of this assessment, any effects with a significance level of ‘moderate’ or ‘major’ have been concluded to be significant in terms of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.

Table 10.19: Matrix used for the assessment of the significance of the effect.

Sensitivity of Receptor	Magnitude of Impact				
	No Change	Negligible	Low	Medium	High
Negligible	No change	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	No change	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	No change	Negligible or Minor	Minor	Moderate	Moderate or Major
High	No change	Minor	Minor or Moderate	Moderate or Major	Major
Very High	No change	Minor	Moderate or Major	Major	Major

10.5.3 Designated sites

10.5.3.1 Where National Site Network sites (i.e. internationally designated sites) are considered, this chapter summarises the assessments made on the interest features of internationally designated sites as described within section 10.4.3 of this chapter (with the assessment on the site itself deferred to the ISAA). With respect to nationally and locally designated sites, where these sites fall within the boundaries of an internationally designated site (e.g. SSSIs which have not been assessed within the ISAA), only the international site has been taken forward for assessment. This is because potential effects on the integrity and conservation status of the nationally designated site are assumed to be inherent within the assessment of the internationally designated site (i.e. a separate assessment for the national site is not undertaken).

10.5.3.2 The draft ISAA has been prepared in accordance with Advice Note Ten: Habitats Regulations Assessment Relevant to Nationally Significant Infrastructure Projects (Planning Inspectorate, 2022) and will be submitted alongside the PEIR.

10.6 Key parameters for assessment

10.6.1 Maximum design scenario

10.6.1.1 The maximum design scenarios (MDSs) identified in Table 10.20 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the Project Design Envelope provided in volume 1, chapter 3: Project description of the PEIR. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope (e.g. different infrastructure layout), to that assessed here be taken forward in the final design scheme.

Table 10.20: Maximum design scenario considered for the assessment of potential impacts on offshore ornithology.

[a] C=construction, O=operations and maintenance, D=decommissioning

Potential impact	Phase[a] C	Phase[a] O	Phase[a] D	Maximum Design Scenario	Justification
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure	✓	✓	✓	**Construction phase** Installation of wind turbines, offshore substation platforms (OSPs), inter-array and interconnector cables in the Mona Array Area Area of up to 450km^2, and offshore export cables within the Mona Offshore Cable Corridor. • Monopiles (spatial maximum) – Wind turbines: installation of up to 68 wind turbines with a 16m diameter monopile foundations installed by impact piling – OSPs: installation of one OSP with foundations consisting of two 16m diameter piled monopile foundations installed by impact piling – Maximum hammer energy up to 5,500kJ – Up to two vessels piling concurrently (minimum distance 875m, maximum distance 35.2km, between piling vessels) – Up to 9.5 hours of piling per monopile, with a realistic maximum of 6.3 hours – Assuming concurrent piling and two monopiles installed within 24 hours = 35 piling days. • Monopiles (temporal maximum) – Wind turbines: installation of up to 107 monopiles with up to 12m diameter piled monopile foundations – OSPs: installation of up to four OSPs with foundations consisting of four 12m diameter piled monopile foundations – Maximum hammer energy of up to 4,500kJ (wind turbine and OSP) – Single piling vessel – Up to 4.25 hours of piling per monopile (wind turbine and OSP) – Assuming one monopile installed within 24 hours = 111 piling days. • Pin piles (spatial maximum) – Wind turbines: installation up to 68 3-legged jacket foundations with either one or two piles per leg (a total of up to 408 piles) and each pile with a diameter of 5.5m installed by impact piling – OSP: installation of one OSP with 6-legged jacket foundations, with three piles per leg (a total of 18 piles) and each pile with a diameter of 5.5m – Maximum hammer energy of up to 2,800kJ – Up to two vessels piling concurrently (minimum distance 875km, maximum distance 35.2km, between piling vessels) – Up to 6.4 hours of piling per pin pile – Total duration of piling per OSP foundation =115.2 hours with total installation of up to 5 days – Consecutive piling over a maximum of 24 hours. Single piling of 68 days for wind turbine plus approx. 5 days for OSP = 73 days (maximum temporal) or 37 days for two vessels (maximum spatial). • Pin piles (temporal maximum) – Wind turbines: installation of up to 107 piled 4-legged jacket foundations, with two piles per leg (a total of 856 piles) and each pile with a diameter of 3.2m – OSPs: installation of up to four OSPs with piled 3-legged jacket foundations, with three piles per leg (a total of 48 piles) and each pile with a diameter of 3.5m – Maximum hammer energy of up to 1,400kJ (wind turbines and OSPs) – Single piling vessel – Up to 5.25 hours of piling per pin pile (wind turbines and OSPs) – Assuming single piling and four piles installed within 24 hours = 226 piling days. • Total piling phase (foundation installation) of up to two years within a four year construction programme.	Represents the maximum density of wind turbines and structures across the maximum Mona Array Area and the Mona Offshore Cable Corridor that would cause greatest extent of disturbance and displacement to birds or the greatest duration of impact. Represents the maximum underwater sound impacts from impact piling for each of the relevant infrastructure foundation options. Represents the maximum number of vessel and helicopter movements that would cause greatest visual and noise disturbance and displacement to birds from the Mona Array Area and the Mona Offshore Cable Corridor.

Potential impact	Phase[a] C	O	D	Maximum Design Scenario	Justification
				• Up to 1,983 installation vessel movements (return trips) during construction (535 main installation and support vessels, 76 tug/anchor handlers, 48 cable lay installation and support vessels, 18 guard vessel, 34 survey vessels, 43 seabed preparation vessels, 1,165 CTVs, 42 scour protection installation vessels and 22 cable protection installation vessels). • Up to a total of 91 construction vessels on site at any one time. • Up to 1,185 helicopter movements by up to 8 helicopters on site at any one time. • Other activities: – Drilling of up to 107 4-legged wind turbine jacket foundations with pin pile diameter of 3.5m and four 4-legged OSP jacket foundations with a pin pile diameter of 3.5m; up to two concurrent drilling vessels – Burial of up to 500km of inter-array cables, 50km of interconnector cables and 360km of export cable via ploughing, trenching and jetting; cable burial and rock dumping. • Maximum offshore construction duration of up to four years. **Operations and maintenance phase** Disturbance and displacement from presence of operational wind turbines and associated operations and maintenance activity, including increased vessel, helicopter and inspection drone activity: • Presence of up to 107 operating turbines and four OSPs occupying the Mona Array Area of up to 450km^2 • Minimum spacing of 875m between wind turbines • Up to 2,351 operations and maintenance vessel movements (return trips) each year • Up to a total of 21 operations and maintenance vessels on site at any one time • Up to 730 helicopter return trips per year with up to five on site at any one time • Up to 214 inspection drones return trips per year (operated from vessel, two inspections per wind turbine per year as a maximum) • Operational lifetime of up to 35 years. **Decommissioning phase** • Vessels used for a range of decommissioning activities such as removal of foundations • Noise from vessels assumed to be as per vessel activity described for the construction phase above.	
Indirect impacts from underwater sound affecting prey species	✓	✗	✓	**Construction phase** • As described in volume 2, chapter 8: Fish and shellfish ecology of the PEIR for: – Injury and/or disturbance to fish and shellfish from underwater sound and vibration. **Decommissioning phase** • As described in volume 2, chapter 8: Fish and shellfish ecology of the PEIR for: – Injury and/or disturbance to fish and shellfish from underwater sound and vibration.	As described in volume 2, chapter 8: Fish and shellfish ecology of the PEIR.
Temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs)	✓	✓	✓	**Construction phase** • As described in volume 2, chapter 8: Fish and shellfish ecology of the PEIR for: – Increased suspended sediment concentrations and associated sediment deposition. **Operations and maintenance phase** • As described in volume 2, chapter 8: Fish and shellfish ecology of the PEIR for: – Increased suspended sediment concentrations and associated sediment deposition **Decommissioning phase** • As described in volume 2, chapter 8: Fish and shellfish ecology of the PEIR for: – Increased suspended sediment concentrations and associated sediment deposition.	As described in volume 2, chapter 8: Fish and shellfish ecology of the PEIR.

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
Collision risk	×	✓	×	**Operations and maintenance phase** • Presence of up to 107 wind turbines within the Mona Array Area • Minimum lower blade tip height of 34m above LAT • Maximum hub height of 168m above LAT • Maximum blade tip height of 293m above LAT • Maximum rotor diameter of 250m • Maximum chord width of 6.8m • Maximum rotor speed of 8.4rpm (with maximum average speed of 6.4rpm) • Operational lifetime of up to 35 years.	The potential for collision risk is derived from wind turbine parameters including rotor diameter, chord width, rotor speed and minimum lower blade tip height. The parameters associated with the most numerous wind turbines (107) represents the MDS because it will result in the greatest potential for collision risk.
Barrier to movement	×	✓	×	**Operations and maintenance phase** • Presence of up to up to 107 turbines, four OSPs within the Mona Array Area of 450km^2 with a minimum spacing of 1,000m between rows of wind turbines and 875m between wind turbines within a row.	Maximum density of wind turbines and structures across the Mona Array Area, which maximises the potential barrier to foraging grounds and migration routes for bird species.

10.6.2 Impacts scoped out of the assessment

10.6.2.1 On the basis of the baseline environment and the description of development outlined in volume 1, chapter 3: Project description of the PEIR, a number of impacts have been scoped out of the assessment at the scoping stage for offshore ornithology. These impacts are outlined, together with a justification for scoping them out, in Table 10.21.

Table 10.21: Impacts scoped out of the assessment for offshore ornithology.

Potential impact	Justification
Direct disturbance and displacement impacts from underwater sound during the operations and maintenance phase.	Underwater sound as a result of operation of the wind turbines is extremely unlikely to result in noise levels that would harm birds. In the unlikely event that such low levels of noise emission result in displacement of birds away from wind turbines, this impact would already be accounted for by the above-water operational displacement assessment.
Accidental pollution during all phases of the Mona Offshore Wind Project.	Pollution impacts (accidental oil/fuel spills) during all phases of the Mona Offshore Wind Project relating to the generation assets are scoped out on the basis that the implementation of a Marine Pollution Contingency Plan (MPCP) will avoid the risk of significant pollution events. Consequently, seabirds and shorebirds are extremely unlikely to be significantly affected by any such pollution impacts.
Indirect impact from underwater noise from wind turbine operation on prey fish species during the operations and maintenance phase.	Noise generated by operational wind turbines is of a very low frequency and low sound pressure level (Andersson *et al.*, 2011). Studies have found that sound levels are only high enough to possibly cause a behavioural reaction within metres from a wind turbine (Sigray and Andersson, 2011) and therefore such levels are not considered to have potentially significant effects on fish. The Marine Management Organisation (MMO, 2014) review of post-consent monitoring at offshore wind farms found that available data on the operational wind turbine noise, from the UK and abroad, in general showed that noise levels from operational wind turbines are low and the spatial extent of the potential impact of the operational noise is low. This is supported by project specific modelling which indicated that effects on fish (e.g. injury or behavioural effects) are unlikely to occur for the modelled operations wind turbines. See volume 5, annex 3.1: Underwater sound technical report of the PEIR for further details.

10.7 Measures adopted as part of the Mona Offshore Wind Project

10.7.1.1 For the purposes of the EIA process, the term 'measures adopted as part of the project' is used to include the following measures (adapted from IEMA, 2016):

- Measures included as part of the project design. These include modifications to the location or design envelope of the Mona Offshore Wind Project which are integrated into the application for consent. These measures are secured through the consent itself through the description of the development and the parameters secured in the DCO and/or marine licences (referred to as primary mitigation in IEMA (2016))
- Measures required to meet legislative requirements, or actions that are standard practice used to manage commonly occurring environmental effects and are secured through the DCO requirements and/or the conditions of the marine licences (referred to as tertiary mitigation in IEMA (2016)).

10.7.1.2 A number of measures (primary and tertiary) have been adopted as part of the Mona Offshore Wind Project to reduce the potential for impacts on offshore ornithology. These are outlined in Table 10.22 below. As there is a secured commitment to implementing these measures for the Mona Offshore Wind Project, they have been considered in the assessment presented in section 10.8 (i.e. the determination of magnitude and therefore significance assumes implementation of these measures).

Table 10.22: Measures adopted as part of the Mona Offshore Wind Project.

Measures adopted as part of the Mona Offshore Wind Project	Justification	How the measure will be secured
Primary measures: Measures included as part of the project design		
Increasing air draught to reduce bird collision	The Applicant has committed to a minimum lower blade tip height (air draught) of 34m above Lowest Astronomical Tide (LAT). Air draught is known to be an important factor for collision risk, with typically fewer collisions predicted with increasing air draught.	Proposed to be secured through a condition in the marine licence(s)
Tertiary measures: Measures required to meet legislative requirements, or adopted standard industry practice		
Environmental Management Plan (EMP) that will include measures to minimise disturbance to rafting birds from transiting vessels	The development of and adherence to a Environmental Management Plan which will include measures to minimise disturbance to rafting birds from transiting vessels.	Proposed to be secured through a condition in the marine licence(s)
Environmental Management Plan	Implementation of an EMP including a MPCP which will include planning for accidental spills, address all potential contaminant releases and include key emergency details.	Proposed to be secured through a condition in the marine licence(s)

10.8 Assessment of significant effects

10.8.1.1 The impacts of the construction, operations and maintenance, and decommissioning phases of the Mona Offshore Wind Project have been assessed on offshore ornithology. These potential impacts are listed in Table 10.20, along with the MDS against which each impact has been assessed.

10.8.1.2 A description of the potential effect on offshore ornithology receptors caused by each identified impact is given below.

10.8.1 Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure

10.8.1.1 The construction, operations and maintenance, and decommissioning of the Mona Offshore Wind Project may lead to disturbance and displacement of birds. The MDS is represented by the maximum density of wind turbines and structures across the Mona Array Area and the Mona Offshore Cable Corridor that would cause the greatest extent of disturbance and displacement to birds or the greatest duration of impact. The MDS also represents the maximum underwater sound impacts from impact piling for each of the relevant infrastructure foundation options and the maximum number of vessel and helicopter movements that would cause greatest visual and noise disturbance and displacement to birds from the array area and offshore cable corridor. The MDS is summarised in Table 10.20.

10.8.1.2 Disturbance as the result of activities during the construction, operations and maintenance, and decommissioning phases of an offshore wind farm has the potential to displace seabirds from an area of sea in which the activity is occurring. In relation to offshore wind farm development, displacement is defined as a reduction in the number of seabirds occurring within or immediately adjacent to an offshore wind farm (Furness *et al*., 2013).

10.8.1.3 As the result of disturbance, displaced birds may move to areas already occupied by other birds and thus face higher intra- or inter-specific competition due to a higher density of individuals competing for the same resource. Alternatively, displaced birds may be forced to move into areas of lower quality (e.g. areas of lower prey availability). Such disturbance and resulting displacement could ultimately affect their demographic fitness (i.e. survival rates and breeding productivity) as well as potentially impacting on other birds in areas that displaced birds move to.

10.8.1.4 Disturbance as a result of activities during the construction of a wind farm (such as installing foundations, wind turbines, inter-array cabling and associated vessel movements) and the offshore export cable has the potential to displace birds. Construction activities then result in a point source of disturbance, for example when construction vessels are at a location to undertake piling and install foundations or the wind turbines. The level of disturbance associated with each location would vary depending on the activity undertaken. With regards to vessels in the Mona Array Area, there is no method to quantify the displacement impact of the activities due to their highly local and temporary nature. An EMP that includes measures to minimise disturbance to rafting birds from transiting vessels is anticipated to be secured within the draft DCO and agreed pre-construction. It is expected that impacts of vessels on seabirds are negligible and this has not been taken forward to further assessment. It is expected that impacts of vessels on seabirds are negligible and this has not been taken forward to further assessment.

10.8.1.5 During the operations and maintenance phase, the presence of operational wind turbines has the potential to directly disturb seabirds leading to displacement from the offshore wind farm array area including an area of variable size or buffer around it (Dierschke *et al*., 2016). Therefore, the presence of wind turbines at the Mona Array Area has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea. Additionally, activities associated with the operations and maintenance of wind turbines (e.g. vessel, helicopter and inspection drone activity) may disturb and displace species within the Mona Array Area and potentially within surrounding buffers to a lower extent.

10.8.1.6 The displacement assessment for the Mona Offshore Wind Project is based on the use of the SNCB Matrix table approach, which was agreed during consultation with the Offshore Ornithology EWG on 13 July 2022 as part of the Evidence Plan process. As sensitivity to displacement differs considerably between seabird species, species were screened and progressed for the Matrix table approach using 'Disturbance Sensitivity' and 'Habitat Specialization' scores from Bradbury *et al*. (2014) and Wade *et al*. (2016) as recommended by the Joint SNCB Interim Displacement Advice Note (JNCC, 2017). In addition to the species' sensitivity rating, the abundance of birds in the Mona Array Area was considered as to whether species were progressed to the matrix stage.

10.8.1.7 For each of the species considered (common guillemot, razorbill, Atlantic puffin, black-legged kittiwake, northern gannet and Manx shearwater, Table 10.10), displacement impacts were quantified for the population derived within the Mona Array Area plus 2km buffer.

10.8.1.8 SNCBs recommend for most species a standard displacement buffer of 2km with the exception of the species groups of divers and seaducks as they can be affected at distances over 4km (Natural England, 2021). Red-throated diver and other seaducks were rarely recorded in the Mona Offshore Ornithology Array Area study area during the baseline surveys and have therefore been excluded from the assessment of displacement from the Mona Array Area but included in the Mona Offshore Cable Corridor assessment. There is the potential for disturbance and displacement from airborne noise, underwater sound, and presence of vessels within the Mona Offshore Cable Corridor as the result of site preparation activities in advance of installation activities, cable installation activities (including Unexploded Ordnance (UXO) detonation, pre-cabling seabed clearance, anchor placements and decommissioning activities such as export cable removal.

10.8.1.9 The full approach of the displacement assessment is detailed in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Construction phase

Magnitude of impact

Common guillemot

10.8.1.10 The estimated mortality (when considering a displacement rate of 15 to 35% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons (Table 10.23) as detailed in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.11 In both bio-seasons and for the combined bio-seasons, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

10.8.1.12 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.23: Common guillemot bio-season and annual displacement estimates for Mona during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population		Number of Common guillemot subject to mortality (no. of indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Breeding					
Mean	6,461	614,558	85,424	10 to 226	0.012 to 0.265
LCI	3,669	614,558	85,424	6 to 128	0.007 to 0.150
UCI	10,475	614,558	85,424	16 to 367	0.019 to 0.430
Non-breeding					
Mean	5,451	1,139,220	158,352	8 to 191	0.005 to 0.121
LCI	3,852	1,139,220	158,352	6 to 135	0.004 to 0.085
UCI	7,435	1,139,220	158,352	11 to 260	0.007 to 0.164
Annual (BDMPS)					
Mean	11,912	1,139,220	158,352	18 to 417	0.011 to 0.263
LCI	7,521	1,139,220	158,352	12 to 263	0.008 to 0.166
UCI	17,910	1,139,220	158,352	27 to 627	0.171 to 0.396

Razorbill

10.8.1.13 The estimated mortality (when considering a displacement rate of 15 to 35% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons (Table 10.24) as detailed in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.14 In all four bio-seasons (breeding, non-breeding, autumn, and spring migration) and for the combined bio-seasons, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

10.8.1.15 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.24: Razorbill bio-season and annual displacement estimates for the Mona Array Area plus 2km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population		Number of razorbill subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring Migration					
Mean	2,283	606,914	105,603	3 to 80	0.003 to 0.076
LCI	1,442	606,914	105,603	2 to 50	0.002 to 0.047
UCI	3,382	606,914	105,603	5 to 118	0.005 to 0.112
Breeding					
Mean	173	278,484	48,456	0 to 6	0.000 to 0.012
LCI	91	278,484	48,456	0 to 3	0.000 to 0.006
UCI	312	278,484	48,456	0 to 11	0.000 to 0.023
Autumn Migration					
Mean	140	606,914	105,603	0 to 5	0.000 to 0.005
LCI	47	606,914	105,603	0 to 2	0.000 to 0.002
UCI	233	606,914	105,603	0 to 8	0.000 to 0.008
Non-breeding					
Mean	287	341,422	59,407	0 to 10	0.000 to 0.017
LCI	85	341,422	59,407	0 to 3	0.000 to 0.005
UCI	532	341,422	59,407	1 to 19	0.002 to 0.032
Annual (BDMPS)					
Mean	2,883	606,914	105,603	3 to 101	0.003 to 0.096
LCI	1,665	606,914	105,603	2 to 58	0.002 to 0.055
UCI	4,459	606,914	105,603	6 to 156	0.006 to 0.148

Atlantic puffin

10.8.1.16 The estimated mortality (when considering a displacement rate of 15 to 35% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons (Table 10.25) as detailed further in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.17 In both bio-seasons and for the combined bio-seasons, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

10.8.1.18 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.25: Atlantic puffin bio-season and annual displacement estimates for the Mona Array Area plus 2km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population: Population	Regional Baseline Population: Baseline Mortality	Number of Atlantic puffin subject to mortality (indiv.)	Increase in baseline mortality (%)
Breeding					
Mean	16	184,767	33,443	0 to 1	0.000 to 0.003
LCI	0	184,767	33,443	0 to 0	0.000 to 0.000
UCI	36	184,767	33,443	0 to 1	0.000 to 0.003
Non-breeding					
Mean	14	304,557	55,125	0 to 0	0.000 to 0.000
LCI	2	304,557	55,125	0 to 0	0.000 to 0.000
UCI	27	304,557	55,125	0 to 1	0.000 to 0.002
Annual (BDMPS)					
Mean	30	304,557	55,125	0 to 1	0.000 to 0.002
LCI	2	304,557	55,125	0 to 0	0.000 to 0.000
UCI	63	304,557	55,125	0 to 2	0.000 to 0.004

Northern gannet

10.8.1.19 The estimated mortality (when considering a displacement rate of 30% to 40% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons (Table 10.26) as detailed further in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.20 In all three bio-seasons (spring, breeding and autumn) and for the combined bio-seasons, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

10.8.1.21 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.26: Northern gannet bio-season and annual displacement estimates for the Mona Array Area plus 2km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population: Population	Regional Baseline Population: Baseline Mortality	Number of Northern gannet subject to mortality (indiv.)	Increase in baseline mortality (%)
Spring Migration					
Mean	105	661,888	123,773	0 to 4	0.000 to 0.003
LCI	51	661,888	123,773	0 to 2	0.000 to 0.002
UCI	173	661,888	123,773	1 to 7	0.001 to 0.006
Breeding					
Mean	351	448,235	83,820	1 to 14	0.001 to 0.017
LCI	229	448,235	83,820	1 to 9	0.001 to 0.011
UCI	495	448,235	83,820	1 to 20	0.001 to 0.024
Autumn Migration					
Mean	237	545,954	102,093	1 to 9	0.001 to 0.009
LCI	142	545,954	102,093	0 to 6	0.000 to 0.006
UCI	351	545,954	102,093	1 to 14	0.001 to 0.014
Annual (BDPMS)					
Mean	693	661,888	123,773	2 to 27	0.002 to 0.026
LCI	422	661,888	123,773	1 to 17	0.001 to 0.017
UCI	1,019	661,888	123,773	3 to 41	0.003 to 0.040

Black-legged kittiwake

10.8.1.22 The estimated mortality (when considering a displacement rate of 15% to 35% and a mortality rate of 1% to 10%) resulting from displacement during construction was assessed for each bio-season and for the combined bio-seasons (Table 10.27) as detailed further in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.23 In all three bio-seasons (spring, breeding and autumn) and for the combined bio-seasons, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

10.8.1.24 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.27: Black-legged kittiwake bio-season and annual displacement estimates for the Mona Array Area plus 2km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population Population	Baseline Mortality	Number of Black-legged kittiwake subject to mortality (indiv.)	Increase in baseline mortality (%)
Spring Migration					
Mean	1,135	691,526	108,570	2 to 40	0.002 to 0.037
LCI	741	691,526	108,570	1 to 26	0.001 to 0.024
UCI	1,655	691,526	108,570	2 to 58	0.002 to 0.053
Breeding					
Mean	479	393,449	61,771	1 to 17	0.002 to 0.027
LCI	322	393,449	61,771	0 to 11	0.000 to 0.018
UCI	719	393,449	61,771	1 to 25	0.002 to 0.040
Autumn Migration					
Mean	783	911,586	143,119	1 to 27	0.001 to 0.019
LCI	506	911,586	143,119	1 to 18	0.001 to 0.013
UCI	1,150	911,586	143,119	2 to 40	0.001 to 0.028
Annual (BDPMS)					
Mean	2,397	911,586	143,119	4 to 84	0.003 to 0.059
LCI	1,569	911,586	143,119	2 to 55	0.001 to 0.038
UCI	3,524	911,586	143,119	5 to 123	0.003 to 0.086

Manx shearwater

10.8.1.25 The estimated mortality (when considering a displacement rate of 1% to 10% and a mortality rate of 0% to 5%) resulting from displacement during construction was assessed for each bio-seasons and for the combined bio-seasons (Table 10.28) as detailed further in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.26 In all three bio-seasons (spring, breeding and autumn) and for the combined bio-seasons, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

10.8.1.27 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.28: Manx shearwater bio-season and annual displacement estimates for the Mona Array Area plus 2km buffer during construction.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population Population	Baseline Mortality	Number of Manx shearwater subject to mortality (indiv.)	Increase in baseline mortality (%)
Spring Migration					
Mean	23	1,580,895	207,097	0 to 0	0.000 to 0.000
LCI	7	1,580,895	207,097	0 to 0	0.000 to 0.000
UCI	48	1,580,895	207,097	0 to 0	0.000 to 0.000
Breeding					
Mean	1,955	1,974,500	258,660	1 to 10	0.000 to 0.004
LCI	439	1,974,500	258,660	0 to 2	0.000 to 0.001
UCI	5,519	1,974,500	258,660	3 to 28	0.001 to 0.011
Autumn Migration					
Mean	254	1,580,895	207,097	0 to 1	0.000 to 0.000
LCI	90	1,580,895	207,097	0 to 0	0.000 to 0.000
UCI	527	1,580,895	207,097	0 to 3	0.000 to 0.001
Annual (BDPMS)					
Mean	2,232	1,974,500	258,660	1 to 11	0.000 to 0.005
LCI	536	1,974,500	258,660	0 to 2	0.000 to 0.001
UCI	6,094	1,974,500	258,660	3 to 31	0.001 to 0.015

Common scoter

10.8.1.28 In the absence of quantitative information available, the magnitude of the impact is considered qualitatively for common scoter. One of the highest concentrations of common scoter in Liverpool Bay is located in nearshore waters between the Dee Estuary and Colwyn Bay (Lawson *et al*., 2016). Although the Mona Offshore Cable Corridor intersects this area, the local spatial extent and short term duration of vessel activities associated with the export cable laying will lead to temporary displacement which is not detectable. The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Red-throated diver

10.8.1.29 In the absence of quantitative information available, the magnitude is considered qualitatively for red-throated diver. Webb *et al*. (2006) and Lawson *et al.* (2016) have identified large aggregations of red-throated diver in the nearshore areas of Colwyn

Bay. Although the Mona Offshore Cable Corridor intersects this area, the local spatial extent and short term duration of vessel activities associated with the export cable laying will lead to temporary displacement which is not detectable.

10.8.1.30 The impact is predicted to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

Common guillemot

10.8.1.31 According to Wade *et al*. (2016), common guillemot are considered to be sensitive to disturbance from vessels and helicopters at offshore wind farms, with a vulnerability score of three (out of five). Whilst there is evidence from studies that common guillemot respond negatively to vessel traffic (Ranconi and St. Clair, 2002), behavioural response to underwater and airborne sounds resulting from construction activities are unknown. Although common guillemot are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and common guillemot have the ability to return to the baseline abundance and distribution after construction.

10.8.1.32 Although the species has a low reproductive success (i.e. laying one egg and not breeding until five years old) (Robinson, 2005), common guillemot have a medium recoverability given their increasing trend in abundance and productivity in the UK (JNCC, 2020).

10.8.1.33 Common guillemot is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), however as large colonies from non-SPA sites are also within close proximity (e.g. St Bee’s Head) the species is considered to be of medium value.

10.8.1.34 Common guillemot is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Razorbill

10.8.1.35 As with common guillemot, razorbill are deemed to be sensitive to disturbance from vessels and helicopters at offshore wind farms, with a vulnerability score of three (out of five). Although razorbill are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and razorbill have the ability to return to the baseline conditions after construction.

10.8.1.36 Although the species has a low reproductive success (only laying one egg) and does not breed until four years old (Robinson, 2005), razorbill are deemed to have a medium recoverability given their increasing trend in abundance in the UK (JNCC, 2020).

10.8.1.37 Razorbill is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), however as several non-SPA colonies are also within range of the Mona Array Area, the species is considered to be of medium value.

10.8.1.38 Razorbill is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Atlantic puffin

10.8.1.39 Together with other auk species, Atlantic puffin are considered to be sensitive to disturbance from vessels and helicopters at offshore wind farms. The species is assigned a vulnerability score of three (out of five) by Wade *et al*. (2016).

10.8.1.40 Although Atlantic puffin are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and the population using the Mona Array Area has the ability to return to the baseline conditions after construction.

10.8.1.41 Atlantic puffin have a low reproductive success (i.e. laying one egg and not breeding until five years old) (Robinson, 2005) and are deemed to have a low recoverability given the lack of up-to-date census of the size of the UK breeding population and the overall declining trend in abundance (1986-2018) (JNCC, 2020).

10.8.1.42 Atlantic puffin is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with low to no Atlantic puffin likely coming from the few non-SPA sites within foraging range due to those non-SPA sites consisting of less than 100 birds. The species is therefore considered to be of high value.

10.8.1.43 Atlantic puffin is deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Northern gannet

10.8.1.44 Northern gannet are considered to have a medium sensitivity to other sources of disturbance such as ship and helicopter traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012), and so northern gannet are considered to be of medium vulnerability.

10.8.1.45 Although northern gannet has a low reproductive success (only laying one egg) and does not breed until five years old (Robinson, 2005), the species is deemed to have a medium recoverability given the consistent increasing trend in abundance since the 1990s (JNCC, 2020). However, the species has suffered significant losses from the outbreak of HPAI during the 2022 breeding season, with it being estimated that around at least 25% of Northern gannets within the UK have died due to the disease. It is yet still unclear how badly abundances at colonies around the coast have been affected.

10.8.1.46 Northern gannet is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a large non-SPA colony within close proximity (Monreith Cliffs and Scar Rocks), the species is therefore considered to be of medium value.

10.8.1.47 Northern gannet is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Black-legged kittiwake

10.8.1.48 In terms of behavioural responses to vessels and helicopters at offshore wind farms, black-legged kittiwake are considered to be of low to medium vulnerability to displacement (with a score of two out of five) by Wade *et al*. (2016).

10.8.1.49 Although the reproductive success of black-legged kittiwake is higher (i.e. laying two eggs and breeding until four years old) than auk species and northern gannet (Robinson, 2005), the species is deemed to have a low recoverability given the continuing decline in abundance observed between 1986 and 2018 in the UK (JNCC, 2020). During this period, breeding productivity has declined as the result of food shortage, although it has stabilised in recent years (JNCC, 2020). During the 2022 breeding season HPAI was confirmed in some Kittiwake colonies, but not to the same extent as gannet colonies.

10.8.1.50 Black-legged kittiwake is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of medium value.

10.8.1.51 Black-legged kittiwake is deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Manx shearwater

10.8.1.52 In terms of behavioural responses to vessels and helicopters at offshore wind farms, Manx shearwater are considered to be of low vulnerability to displacement (score of one) by Wade *et al*. (2016).

10.8.1.53 Owing to their large foraging range, Manx shearwater is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range). Most of the world population is found in the UK and over 90% of the UK population is found on the Islands of Rum and Eigg (Scotland) and Skomer and Skokholm (Wales) (Mitchell *et al*., 2004; JNCC, 2020). Therefore, the species is considered to be of high value.

10.8.1.54 Manx shearwater has a low reproductive success (i.e. only laying one egg and not breeding until five years old; Robinson, 2005). There is an incomplete spatial-temporal coverage of breeding abundance at UK colonies and thus a lack of long-term trend (JNCC, 2020). In the light of uncertainly and low reproductive success, Manx shearwater are therefore deemed to have a low recoverability.

10.8.1.55 Manx shearwater is deemed to be of low vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium.**

Common Scoter

10.8.1.56 Common scoter are very vulnerable to disturbance and displacement caused by offshore wind farms. The species has a score of 5 (out of 5) for displacement due to vessels (Wade *et al*., 2016).

10.8.1.57 Common scoter is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **high.**

Red-throated diver

10.8.1.58 Red-throated diver are very vulnerable to disturbance and displacement caused by offshore wind farms. The species has a score of 5 (out of 5) for displacement due to vessels (Wade *et al*., 2016).

10.8.1.59 Red-throated diver is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **high.**

Significance of the effect

10.8.1.60 Given that construction activities will only take place within a small area of the site at any time, displaced birds will be able to resettle within the Mona Array Area or beyond. As alternative habitats exist, species shown in Table 10.29 are therefore not predicted to suffer a significant decline in bird fitness at a population level. Indeed, the displacement assessment analysis showed the magnitude of the increase in mortality to be negligible and below the 1% threshold increase for the species assessed in Table 10.30 to Table 10.35. For common guillemot, negligible was selected from the negligible to minor range due to the impact not exceeding a 0.5% increase in baseline mortality. Additionally, the population is vast with a change in baseline mortality greater than 0.1% would be unnoticeable and hence, was not regarded as a minor significance of effect. For razorbill, northern gannet, black-legged kittiwake and Manx shearwater, negligible was selected from the negligible to minor range due to the impact not exceeding a 0.1% increase in baseline mortality and hence, was not regarded as a minor significance of effect.

Table 10.29: Table summarising the significance of effect during construction.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Common guillemot	Negligible	Medium	**Negligible, not significant in EIA terms**
Razorbill	Negligible	Medium	**Negligible, not significant in EIA terms**
Atlantic puffin	Negligible	High	**Minor adverse, not significant in EIA terms**
Northern gannet	Negligible	Medium	**Negligible, not significant in EIA terms**
Black-legged kittiwake	Negligible	Medium	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**
Common scoter	Negligible	High	**Minor adverse, not significant in EIA terms**
Red-throated diver	Negligible	High	**Minor adverse, not significant in EIA terms**

Operations and maintenance phase

Magnitude of impact

Common guillemot

10.8.1.61 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 10.30) as detailed in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.62 In both bio-seasons and for the combined bio-seasons, the predicted increase in the baseline mortality rate does not surpass the 1% threshold increase.

The impact is predicted to be of local spatial extent, medium-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.30: Common guillemot bio-seasons and annual displacement estimates for the Mona Array Area plus 2km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population: Population	Regional Baseline Population: Baseline Mortality	Number of Common guillemot subject to mortality (indiv.)	Increase in baseline mortality (%)
Breeding					
Mean	6,461	614,558	85,424	19 to 452	0.022 to 0.532
LCI	3,669	614,558	85,424	11 to 257	0.013 to 0.302
UCI	10,475	614,558	85,424	31 to 733	0.036 to 0.862
Non-breeding					
Mean	5,451	1,139,220	158,352	16 to 382	0.010 to 0.241
LCI	3,852	1,139,220	158,352	12 to 270	0.006 to 0.171
UCI	7,435	1,139,220	158,352	22 to 520	0.014 to 0.328
Annual (BMPS)					
Mean	11,912	1,139,220	158,352	35 to 834	0.022 to 0.527
LCI	7,521	1,139,220	158,352	23 to 527	0.015 to 0.333
UCI	17,910	1,139,220	158,352	53 to 1,253	0.033 to 0.791

Razorbill

10.8.1.63 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 10.31) as detailed in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.64 In all bio-seasons and for all bio-seasons combined, the predicted increase in the baseline mortality rate does not surpass the 1% threshold increase.

10.8.1.65 The impact is predicted to be of local spatial extent, medium-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.31: Razorbill bio-seasons and annual displacement estimates for the Mona Array Area plus 2km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population: Population	Regional Baseline Population: Baseline Mortality	Number of razorbill subject to mortality (indiv.)	Increase in baseline mortality (%)
Spring Migration					
Mean	2,283	606,914	105,603	7 to 160	0.007 to 0.152
LCI	1,442	606,914	105,603	4 to 101	0.004 to 0.096
UCI	3,382	606,914	105,603	10 to 237	0.009 to 0.224
Breeding					
Mean	173	280,050	48,729	1 to 12	0.002 to 0.025
LCI	91	280,050	48,729	0 to 6	0.000 to 0.012
UCI	312	280,050	48,729	1 to 22	0.002 to 0.046
Autumn Migration					
Mean	140	606,914	105,603	0 to 10	0.000 to 0.009
LCI	47	606,914	105,603	0 to 3	0.000 to 0.003
UCI	233	606,914	105,603	1 to 16	0.001 to 0.015
Non-breeding					
Mean	287	341,422	59,407	1 to 20	0.002 to 0.034
LCI	85	341,422	59,407	0 to 6	0.000 to 0.010
UCI	532	341,422	59,407	2 to 37	0.003 to 0.062
Annual (BDMPS)					
Mean	2,883	606,914	105,603	9 to 202	0.009 to 0.191
LCI	1,665	606,914	105,603	4 to 130	0.004 to 0.123
UCI	4,459	606,914	105,603	14 to 312	0.013 to 0.295

Atlantic puffin

10.8.1.66 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to10 %) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 10.32) as detailed in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.67 In both bio-seasons and for all bio-seasons combined, the predicted increase in baseline mortality does not surpass the 1% increase threshold.

10.8.1.68 The impact is predicted to be of local spatial extent, medium-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.32: Atlantic puffin bio-seasons and annual displacement estimates for the Mona Array Area plus 2km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population		Number of Atlantic puffin subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Breeding					
Mean	16	184,767	33,443	0 to 1	0.000 to 0.003
LCI	0	184,767	33,443	0 to 0	0.000 to 0.000
UCI	36	184,767	33,443	0 to 3	0.000 to 0.009
Non-breeding					
Mean	14	304,557	55,125	0 to 1	0.000 to 0.002
LCI	2	304,557	55,125	0 to 0	0.000 to 0.000
UCI	27	304,557	55,125	0 to 2	0.000 to 0.002
Annual (BDMPS)					
Mean	30	304,557	55,125	0 to 2	0.000 to 0.004
LCI	2	304,557	55,125	0 to 0	0.000 to 0.000
UCI	63	304,557	55,125	0 to 5	0.000 to 0.009

Northern gannet

10.8.1.69 The estimated mortality (when considering a displacement rate of 60% to 80% and a mortality rate of 1% to 10 %) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 10.33) as detailed in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.70 In all three bio-seasons (spring, breeding and autumn) and for the bio-seasons combined, the predicted increase in baseline mortalities remains well the below the 1% increase threshold.

10.8.1.71 The impact is predicted to be of local spatial extent, medium-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible.**

Table 10.33: Northern gannet bio-seasons and annual displacement estimates for the Mona Array Area plus 2km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population		Number of Northern gannet subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline Mortality		
Spring Migration					
Mean	105	661,888	123,773	1 to 8	0.001 to 0.006
LCI	51	661,888	123,773	0 to 4	0.000 to 0.003
UCI	173	661,888	123,773	1 to 14	0.001 to 0.011
Breeding					
Mean	351	448,235	83,820	2 to 28	0.002 to 0.033
LCI	229	448,235	83,820	1 to 18	0.001 to 0.021
UCI	495	448,235	83,820	3 to 40	0.004 to 0.048
Autumn Migration					
Mean	237	545,954	102,093	1 to 19	0.001 to 0.019
LCI	142	545,954	102,093	1 to 11	0.001 to 0.011
UCI	351	545,954	102,093	2 to 28	0.002 to 0.027
Annual (BDPMS)					
Mean	693	661,888	123,773	4 to 55	0.003 to 0.044
LCI	422	661,888	123,773	2 to 33	0.002 to 0.027
UCI	1,019	661,888	123,773	6 to 82	0.005 to 0.066

Black-legged kittiwake

10.8.1.72 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 10.34) as detailed in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.73 In all three bio-seasons (spring, breeding and autumn) and all bio-seasons combined, the predicted increase in baseline mortalities remains well below the 1% increase threshold.

10.8.1.74 The impact is predicted to be of local spatial extent, medium-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is, therefore, considered to be **negligible.**

Table 10.34: Black-legged kittiwake bio-seasons and annual displacement estimates for the Mona Array Area plus 2km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population: Population	Regional Baseline Population: Baseline Mortality	Number of Black-legged kittiwake subject to mortality (indiv.)	Increase in baseline mortality (%)
Spring Migration					
Mean	1,135	691,526	108,570	3 to 79	0.003 to 0.072
LCI	741	691,526	108,570	2 to 52	0.002 to 0.048
UCI	1,655	691,526	108,570	5 to 116	0.005 to 0.107
Breeding					
Mean	479	393,449	61,771	1 to 34	0.002 to 0.054
LCI	322	393,449	61,771	1 to 23	0.002 to 0.037
UCI	719	393,449	61,771	2 to 50	0.003 to 0.081
Autumn Migration					
Mean	783	911,586	143,119	2 to 55	0.001 to 0.038
LCI	506	911,586	143,119	2 to 35	0.001 to 0.024
UCI	1,150	911,586	143,119	3 to 81	0.002 to 0.057
Annual (BDPMS)					
Mean	2,397	911,586	143,119	6 to 168	0.004 to 0.117
LCI	1,569	911,586	143,119	5 to 110	0.003 to 0.077
UCI	3,524	911,586	143,119	10 to 247	0.007 to 0.173

Manx shearwater

10.8.1.75 The estimated mortality (when considering a displacement rate of 1% to 10% and a mortality rate of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each bio-season and for the combined bio-seasons (Table 10.35) as detailed in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

10.8.1.76 In all three bio-seasons (spring, breeding season and autumn migration) and for all bio-seasons combined, the predicted increase in baseline mortalities does not surpass the 1% increase threshold.

10.8.1.77 The impact is predicted to be of local spatial extent, medium-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible.**

Table 10.35: Manx shearwater bio-seasons and annual displacement estimates for the Mona Array Area plus 2km buffer during the operations and maintenance phase.

Bio-season	Seasonal Abundance (Mona Array Area + 2km buffer)	Regional Baseline Population: Population	Regional Baseline Population: Baseline Mortality	Number of Manx shearwater subject to mortality (indiv.)	Increase in baseline mortality (%)
Spring Migration					
Mean	23	1,580,895	207,097	0 to 0	0.000 to 0.000
LCI	7	1,580,895	207,097	0 to 0	0.000 to 0.000
UCI	48	1,580,895	207,097	0 to 0	0.000 to 0.000
Breeding					
Mean	1,955	1,974,500	258,660	2 to 20	0.001 to 0.008
LCI	439	1,974,500	258,660	0 to 4	0.000 to 0.002
UCI	5,519	1,974,500	258,660	6 to 55	0.002 to 0.021
Autumn Migration					
Mean	254	1,580,895	207,097	0 to 3	0.000 to 0.001
LCI	90	1,580,895	207,097	0 to 3	0.000 to 0.001
UCI	527	1,580,895	207,097	1 to 5	0.000 to 0.002
Annual (BDPMS)					
Mean	2,232	1,974,500	258,660	2 to 23	0.001 to 0.009
LCI	536	1,974,500	258,660	0 to 7	0.000 to 0.003
UCI	6,094	1,974,500	258,660	7 to 60	0.003 to 0.023

Sensitivity of receptor

Common guillemot

10.8.1.78 Common guillemot is considered to have a high vulnerability to displacement from offshore wind farms, being assigned a score of 4 (out of 5) by Wade *et al.* (2016).

10.8.1.79 Although the species has a low reproductive success (i.e., laying one egg and not breeding until five years old; Robinson, 2005), common guillemot have a medium recoverability given their increasing trend in abundance and productivity in the UK (JNCC, 2020).

10.8.1.80 Common guillemot is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), however as large colonies from non-SPA sites are also within close proximity (e.g. St Bee's Head) the species is considered to be of medium value.

10.8.1.81 Common guillemot is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is, therefore, considered to be **medium**.

Razorbill

10.8.1.82 Razorbill is considered to have a high vulnerability to displacement from offshore wind farms, being assigned a score of 4 (out of 5) by Wade *et al*. (2016).

10.8.1.83 Although the species has a low reproductive success (Robinson, 2005), razorbill are deemed to have a medium recoverability given their increasing trend in abundance in the UK (JNCC, 2020).

10.8.1.84 Razorbill is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), however as several non-SPA colonies are also within range of the Mona Array Area, the species is considered to be of medium value.

10.8.1.85 Razorbill is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Atlantic puffin

10.8.1.86 Atlantic puffin is considered to have a medium vulnerability to displacement from offshore wind farms, being assigned a score of 3 (out of 5) by Wade *et al*. (2016).

10.8.1.87 Although the species has a low reproductive success (i.e. laying one egg and not breeding until five years old) (Robinson, 2005), Atlantic puffin are deemed to have a low recoverability given the lack of up-to-date census of the size of the UK breeding population and the overall declining trend in abundance (1986-2018) (JNCC, 2020).

10.8.1.88 As Atlantic puffin is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) the species is considered to be of high value.

10.8.1.89 Atlantic puffin is deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Northern gannet

10.8.1.90 In terms of behavioural response to wind farm structures, Northern gannet are considered to be of high vulnerability, with a score of four out of five assigned by Wade *et al*. (2016). During the breeding season, northern gannet showed a strong avoidance of offshore wind farms (Peschko *et al*., 2021).

10.8.1.91 Northern gannet is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a large non-SPA colony within close proximity (Monreith Cliffs and Scar Rocks), the species is therefore considered to be of medium value.

10.8.1.92 Although northern gannet has a low reproductive success (only laying one egg) and does not breed until five years old (Robinson, 2005), the species is deemed to have a medium recoverability given the consistent increasing trend in abundance since the 1990s (JNCC, 2020). However, the species has suffered from the outbreak of avian flu during the 2022 breeding season.

10.8.1.93 Northern gannet is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Black-legged kittiwake

10.8.1.94 In terms of behavioural response to wind farm structures, black-legged kittiwake are considered to be of low vulnerability, with a score of two (out of five) assigned by Wade *et al.* (2016).

10.8.1.95 Black-legged kittiwake is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of medium value.

10.8.1.96 Although the reproductive success of black-legged kittiwake is higher (i.e. laying two eggs and breeding until four years old) than auk species and northern gannet (Robinson, 2005), the species is deemed to have a low recoverability given the continuing decline in abundance observed between 1986 and 2018 in the UK (JNCC, 2020). During this period, breeding productivity has declined as the result of food shortage, although it has stabilised in recent years (JNCC, 2020).

10.8.1.97 Black-legged kittiwake is deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Manx shearwater

10.8.1.98 In terms of behavioural responses to vessels and helicopters at offshore wind farms, Manx shearwater are considered to be of very low vulnerability to displacement (score of one) by Wade *et al*. (2016).

10.8.1.99 Owing to their large foraging range, Manx shearwater is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range). Most of the world population is found in the UK and over 90% of the UK population is found on the Islands of Rum and Eigg (Scotland) and Skomer and Skokholm (Wales) (Mitchell *et al*., 2004; JNCC, 2020). Therefore, the species is considered to be of high value.

10.8.1.100 Manx shearwater has a low reproductive success (i.e. only laying one egg and not breeding until five years old) (Robinson, 2005). There is an incomplete spatial-temporal coverage of breeding abundance at UK colonies and thus a lack of long-term trend (JNCC, 2020). In the light of uncertainly and low reproductive success, Manx shearwater are therefore deemed to have a medium recoverability.

10.8.1.101 Manx shearwater is deemed to be of low vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of effect

10.8.1.102 The displacement assessment analysis showed the magnitude of the increase in mortality to be negligible and below the 1% threshold increase for the species assessed in tables Table 10.30 to Table 10.35. A summary of the significant of disturbance and displacement during the operations and maintenance phase of the Mona Array Area is provided in Table 10.36. For common guillemot and razorbill, negligible was selected from the negligible to minor range due to the impact not exceeding a 0.5% increase in baseline mortality. Additionally, the population is vast with a change in baseline mortality greater than 0.1% would be unnoticeable and hence, was not regarded as a minor significance of effect. For northern gannet, black-legged kittiwake and Manx shearwater, negligible was selected from the negligible to minor range due to the impact not exceeding a 0.1% increase in baseline mortality and hence, was not regarded as a minor significance of effect.

Table 10.36: Table summarising the significance of effect during the operations and maintenance phase.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Common guillemot	Negligible	Medium	**Negligible, not significant in EIA terms**
Razorbill	Negligible	Medium	**Negligible, not significant in EIA terms**
Atlantic puffin	Negligible	High	**Minor adverse, not significant in EIA terms**
Northern gannet	Negligible	Medium	**Negligible, not significant in EIA terms**
Black-legged kittiwake	Negligible	Medium	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**

Decommissioning phase

10.8.1.103 Decommissioning activities within the Mona Array Area are equal to or less than those carried out during the construction phase within the Mona Array Area. Therefore, for the purpose of this assessment it is assumed that the level of disturbance is likely to be similar and the potential impact on each species is deemed to be reversible in the short-term as birds are likely to return when activities have been completed.

All receptors

10.8.1.104 Overall, the magnitude of the impact during decommissioning is deemed to be negligible and the sensitivity of the receptor is considered to be medium to high, depending on the species. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

10.8.2 Indirect impacts from underwater sound affecting prey species

10.8.2.1 Potential effects on the fish assemblages during the construction and decommissioning phases of the Mona Offshore Wind Project, as identified in volume 2, chapter 8: Fish and shellfish ecology of the PEIR, may have indirect effects on offshore ornithology receptors. Potential effects resulting from changes to prey and habitats during the operational/maintenance has been scoped out of the assessment.

10.8.2.2 Herring and sandeel are sensitive to offshore wind development (including underwater sound). Both species are listed as main prey items for several seabird species (Cramp and Simmons, 1983). Volume 2, chapter 8: Fish and shellfish ecology of the PEIR detailed the findings of the desktop studies in the Mona Fish and Shellfish Ecology study area. High and low intensity sandeel spawning grounds have been identified by Ellis *et al*. (2012) as being present throughout the Mona Fish and Shellfish Ecology study area. Herring spawning grounds have also been identified by Coull *et al*. (1998) as being present within the Mona Fish and Shellfish Ecology study area. The overlap of possible spawning grounds with the Mona Array Area has the potential to indirectly affect the distribution of seabirds, in particular the species showing a high level of specialisation and which feed predominantly on young herring and sandeel.

10.8.2.3 Underwater sound produced during piling activities and cable installation during the construction phase may impact upon the availability of prey items. Indeed, underwater sound may cause fish and mobile invertebrates to avoid the construction area. Underwater sound may also affect the physiology and behaviour of fish and mobile invertebrates.

10.8.2.4 Species were screened and progressed for the assessment of significance on the basis of habitat specialisation (using scoring from Wade *et al.*, 2016), knowledge of the prey species targeted by each species (Cramp and Simmons, 1983) and their abundance in the Mona Array Area.

10.8.2.5 Because the auk species (i.e., Atlantic puffin, razorbill and common guillemot) foraging behaviour and prey species are similar, the species are considered together for the purpose of the assessment of significance.

Table 10.37: Species considered for assessment of underwater sound affecting prey species based on habitat specialisation score (Wade *et al*., 2016).

Ornithological receptor	Habitat specialisation	Abundance recorded in the Mona Offshore Ornithology Array Area Study area	Assessed for significance
Arctic skua	Low	Very Low	N
Arctic tern	Medium	Very Low	N
Atlantic puffin	Medium	Low	Y
Black guillemot	Medium	Absent	N
Black-headed gull	Low	Very Low	N
Black-legged kittiwake	Low	High	N
Black-throated diver	High	Absent	N
Common guillemot	Medium	Very high	Y
Common gull	Low	Low	N
Common scoter	High	Absent	N
Common tern	Medium	Very low	N
European shag	Low	Very low	N
European storm petrel	Very low	Absent	N
Great black-backed gull	Low	Moderate	N
Great cormorant	Medium	Very low	N
Great northern diver	Medium	Absent	N

Ornithological receptor	Habitat specialisation	Abundance recorded in the Mona Offshore Ornithology Array Area Study area	Assessed for significance
Great skua	Low	Very low	N
Herring gull	Very low	Low	N
Leach's storm-petrel	Very low	Very low	N
Lesser black-backed gull	Very low	Low	N
Little gull	n/a	Low	N
Little tern	High	Absent	N
Manx shearwater	Very low	Moderate	N
Mediterranean gull	n/a	Absent	N
Northern gannet	Very low	High	N
Northern fulmar	Very low	Moderate	N
Razorbill	Medium	High	Y
Red-throated diver	High	Very low	N
Roseate tern	Medium	Absent	N
Sandwich tern	Medium	Very low	N

Construction phase

Magnitude of impact

Auk species (common guillemot, razorbill and Atlantic puffin)

10.8.2.6 Auks directly responding to visual cues are likely to be displaced during construction; the magnitude of the impact on the baseline mortality has been assessed using a displacement assessment matrix in section 10.8.1. However, in addition to direct visual disturbance, birds may be indirectly displaced due to a reduction in prey availability. Because of the short-term duration of the construction work and localised nature, it is however expected that birds will be able to re-settle in the Mona Array Area or beyond.

10.8.2.7 In the absence of quantitative information available, the magnitude is considered qualitatively and taking into consideration the assessment of significance presented in volume 2, chapter 8: Fish and shellfish ecology of the PEIR, which concluded of minor adverse significance for herring, cod, sprat and sandeel.

10.8.2.8 The impact is predicted to be of local spatial extent, short-duration, intermittent and reversible. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

Auk species (common guillemot, razorbill and Atlantic puffin)

10.8.2.9 Although the impact of underwater sound on fish has been well studied, there is no published evidence to our knowledge linking reduction of prey availability to avoidance/displacement of seabirds. In absence of information on vulnerability to underwater sound and reduction of prey availability at offshore wind farms, all species were considered to have a medium vulnerability.

10.8.2.10 Auk species have a low reproductive success (Robinson, 2005), and a low to medium recoverability given their increasing trend in abundance, particularly common guillemot and razorbill (JNCC, 2020).

10.8.2.11 As all three species are qualifying interests for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) the species were considered to be of high value.

10.8.2.12 Auk species are deemed to be of medium vulnerability, low to medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

Auk species (common guillemot, razorbill and Atlantic puffin)

10.8.2.13 Overall, the magnitude of the impact is deemed to be negligible, and the sensitivity of the receptors is considered to be medium to high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Decommissioning phase

10.8.2.14 Decommissioning activities within the Mona Array Area are equal to or less than those carried out during the construction phase. Therefore, for the purpose of this assessment it is assumed that the level of disturbance is likely to be similar and the potential impact is deemed to be reversible in the short-term as birds are likely to return when activities have been completed.

Significance of the effect

Auk species (common guillemot, razorbill and Atlantic puffin)

10.8.2.15 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors is considered to be medium to high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

10.8.3 Temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs)

Construction phase

10.8.3.1 Seabirds may be indirectly disturbed and displaced during the construction phase as a result of direct impacts on habitat and increased SSCs, which may result in the loss of a food resource to birds in the Mona Array Area and along the offshore export cable.

10.8.3.2 As a result, displaced seabirds may move to areas already occupied by other birds and thus face higher intra/inter-specific competition due to a higher density of individuals competing for the same resource. Alternatively, displaced birds may be forced to move into areas of lower quality (e.g. areas of lower prey availability). Such disturbance and resulting displacement could ultimately affect their demographic fitness (i.e. survival rates and breeding productivity) as well as potentially impacting on other birds in areas that displaced birds move to.

10.8.3.3 The potential construction phase impacts on fish and shellfish receptors are provided in volume 2, chapter 8: Fish and shellfish ecology of the PEIR and include temporary subtidal habitat loss/disturbance and increased suspended sediment concentrations and associated sediment deposition.

Magnitude of impact

All receptors

10.8.3.4 The increase in SSCs may lead to a short-term avoidance of affected areas that support fish and shellfish species which are susceptible to respond increase SSCs. However, many fish and shellfish species are considered to be tolerant of turbid environments and regularly experience changes in the SSC due to the natural variability in the Irish Sea.

10.8.3.5 In the absence of quantitative information available, the magnitude is considered qualitatively and taking into consideration the assessment of significance on marine fish species presented in volume 2, chapter 8: Fish and shellfish ecology of the PEIR, which concluded of minor adverse significance, which is not significant in EIA terms.

10.8.3.6 Temporary habitat loss could potentially affect spawning, nursery or feeding grounds of fish and shellfish receptors, with demersal fish and shellfish, and demersal spawning species the most vulnerable. The MDS assessed in volume 2, chapter 8: Fish and shellfish ecology of the PEIR represented a very small proportion of the Mona Offshore Wind Project.

10.8.3.7 The impact is predicted to be of local spatial extent, short-duration, intermittent and reversible. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

All receptors

10.8.3.8 Seabirds are deemed to be of medium vulnerability, medium recoverability and medium to high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

All receptors

10.8.3.9 Overall, the magnitude of the impact is deemed to be negligible, and the sensitivity of the receptors is considered to be medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Operations and maintenance phase

Magnitude of impact

All receptors

10.8.3.10 Maintenance activities within the Mona Array Area may lead to increases in SSCs and associated sediment deposition over the operational lifetime of the Mona Offshore Wind Project. The magnitude of the impacts would be a small fraction of those quantified for the construction phase.

10.8.3.11 The impact is predicted to be of local spatial extent, short-duration, intermittent and reversible. It is predicted that the impact will affect the receptor indirectly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

All receptors

10.8.3.12 Seabirds are deemed to be of medium vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

All receptors

10.8.3.13 Overall, the magnitude of the impact is deemed to be negligible, and the sensitivity of the receptors is considered to be medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Decommissioning phase

10.8.3.14 Decommissioning activities within the Mona Array Area are equal to or less than those carried out during the construction phase within the Mona Array Area. Therefore, for the purpose of this assessment it is assumed that the level of disturbance is likely to be similar and the potential impact is deemed to be reversible in the short-term as seabirds are likely to return when activities have been completed.

Significance of the effect

All receptors

10.8.3.15 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptors is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

10.8.4 Collision risk

10.8.4.1 During the operations and maintenance phase of the Mona Offshore Wind Project, the turning rotors of the wind turbines may present a risk of collision for seabirds. Stationary structures, such as the tower, nacelle or when rotors are not operating, are not expected to result in a material risk of collision. When a collision occurs between the turning rotor blade and the bird, it is assumed to result in direct mortality of the bird, which potentially could result in population level impacts.

10.8.4.2 The ability of seabirds to detect and manoeuvre around wind turbine blades is a factor that is considered when modelling and assessing the risk. In response to this it is standard practice to calculate differing levels of avoidance for different species or species groups. Avoidance rates are applied to collision risk models to predict levels of impact more realistically, based on available literature and expert advice about seabird behaviour and their flight response to wind turbines.

10.8.4.3 Species differ in their susceptibility to collision risk, depending on their flight behaviour and avoidance responses, and the vulnerability of their populations (Garthe and Hüppop, 2004; Furness and Wade, 2012; Wade *et al*., 2016). As sensitivity to collision differs considerably between species, species were screened and progressed for assessment of significance on the basis of the density of flying birds recorded within the Mona Array Area and consideration of their perceived risk from collision (Garthe and Hüppop, 2004; Furness and Wade, 2012; Wade *et al*., 2016) (Table 10.38).

10.8.4.4 Five seabird species were identified as potentially at risk due to their recorded abundance in the Mona Array Area and their likelihood of flying at potential collision height between the lowest and highest sweep of the wind turbine rotor blades above sea level. Additionally, consideration was given to species that may not have been accurately captured during baseline digital aerial surveys due to the diurnal timing of the surveys, with such species likely to be more active during the nocturnal, dusk and dawn periods (e.g. Manx shearwater and northern fulmar). In total, the significance of the collision effect was assessed for seven seabird species (Table 10.38). The magnitude of change was determined by calculating the estimated number of collisions with the wind turbines and the resulting percentage increase in the background mortality rate.

10.8.4.5 There is the potential that aviation and navigation lighting on wind turbines might attract seabirds and thus increase the risk of collision. Conversely, aviation and navigation lighting could repel birds moving through the Mona Array Area. To our knowledge, there is little published evidence showing the effects of lighting on seabird collision and displacement, although earlier work on seaducks by Desholm and Kahlert (2005) showed that migrating flocks were more prone to enter the wind farm but the higher risk of collision in the dark was counteracted by increasing distance from individual turbines and flying in the corridors between turbines. For true seabirds, there is published evidence showing that seabirds are less active at night compared to daytime (Kotzerka *et al*., 2010; Furness *et al*., 2018). Wade *et al*. (2016) ranked vulnerability of seabirds to collision by accounting for the nocturnal activity rate of seabirds.

10.8.4.6 Collision risk modelling was undertaken using the Stochastic Collision Risk Model (sCRM) developed by Marine Scotland (McGregor *et al*., 2018). The User Guide for the sCRM Shiny App provided by Marine Scotland (Donovan, 2017) has been followed for the modelling of collision impacts predicted for the Mona Array Area. The full methodology is provided in volume 6, annex 10.3: Offshore ornithology non-migratory seabird collision risk assessment of the PEIR.

10.8.4.7 It is acknowledged that migratory passage movements may be ‘missed’ by aerial survey methods. Therefore, for migratory birds (excluding ‘true seabirds’, gulls, cormorants and divers), the Strategic Ornithological Support Services Migration Assessment Tool (SOSS-MAT) was used, which assessed theoretical biannual passage movements based on estimated flyway populations. The resulting number of birds estimated to cross the Mona Array Area was inputted into the Band (2012) single transit collision risk model. The methodology and results of the collision risk modelling for migratory birds are provided in volume 6, annex 10.4: Offshore ornithology migratory non-seabird collision risk modelling of the PEIR.

Table 10.38: Seabird species considered for assessment of collision based on sensitivity and abundance.

Ornithological receptor	Sensitivity to collision	Abundance recorded in the Mona Offshore Ornithology Array Area study area	Assessed for significance
Arctic skua	Medium	Very Low	N
Arctic tern	Low	Very Low	N
Atlantic puffin	Very low	Low	N
Black guillemot	Very low	Absent	N
Black-headed gull	Medium	Very Low	N
Black-legged kittiwake	Medium	High	Y
Black-throated diver	Low	Absent	N
Common guillemot	Very low	Very high	N
Common gull	Medium	Low	N
Common scoter	Very low	Absent	N
Common tern	Low	Very low	N
European shag	Low	Very low	N
European storm petrel	Very low	Absent	N
Great black-backed gull	Medium	Moderate	Y
Great cormorant	Low	Very low	N
Great northern diver	Low	Absent	N
Great skua	Medium	Very low	N
European herring gull	Medium	Low	Y
Leach's storm-petrel	Very low	Very low	N
Lesser black-backed gull	Medium	Low	Y
Little gull	Low	Low	N
Little tern	Low	Absent	N
Manx shearwater	Low	Moderate	Y

Ornithological receptor	Sensitivity to collision	Abundance recorded in the Mona Offshore Ornithology Array Area study area	Assessed for significance
Mediterranean gull	Medium	Absent	N
Northern gannet	Medium	High	Y
Northern fulmar	Low	Moderate	Y
Razorbill	Very low	High	Y
Red-throated diver	Low	Very low	N
Roseate tern	Low	Absent	N
Sandwich tern	Low	Very low	N

Operations and maintenance phase

Magnitude of impact

Black-legged kittiwake

10.8.4.8 In all three bio-seasons (pre-breeding, breeding and post breeding) and for all bio-seasons combined the estimated increase in baseline mortalities remains well below the 1% increase threshold. As black-legged kittiwake forage mainly in daytime, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk.

10.8.4.9 The impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.39: Black-legged kittiwake expected additional mortality due to collisions with turbines across bio-seasons.

Bio-season	Regional baseline population	Baseline mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Pre-breeding	691,526	108,570	12.6 to 29.1	0.0116 to 0.0268
Breeding	393,307	61,771	4.6 to 11.4	0.0074 to 0.0184
Post-breeding	911,586	143,119	5.7 to 14.3	0.0040 to 0.0100
Annual	911,586	143,119	22.9 to 54.9	0.0230 to 0.0552

Great black-backed gull

10.8.4.10 In both bio-seasons (breeding and non-breeding) and for all bio-seasons combined the estimated increase in baseline mortalities remains well below the 1% increase threshold. Like black legged-kittiwake, great black-backed gulls forage mainly during daylight and are largely inactive at night, therefore have low risk of collision at the Mona Offshore Wind Project during nocturnal time periods.

10.8.4.11 The impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be low.

Table 10.40: Great black-backed gull expected additional mortality due to collisions with turbines across bio-seasons.

Bio-season	Regional Baseline Population	Baseline Mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Breeding	10,480	1,006	1.2 to 6.5	0.1193 to 0.6461
Non-breeding	17,742	1,703	1.9 to 8.4	0.1112 to 0.4910
Annual	17,742	1,703	3.1 to 14.8	0.1801 to 0.8715

European herring gull

10.8.4.12 In both bio-seasons (breeding and non-breeding) and for all bio-seasons combined, the estimated increase in baseline mortalities remains well below the 1% increase threshold. As gulls forage mainly in daytime, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk.

10.8.4.13 The impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.41: European herring gull expected additional mortality due to collisions with turbines across bio-seasons.

Bio-season	Regional Baseline Population	Baseline Mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Breeding	99,462	17,296	0.0 to 0.8	0.0001 to 0.0046
Non-breeding	173,299	29,807	0.7 to 4.1	0.0023 to 0.0136
Annual	173,299	29,807	0.7 to 4.8	0.0024 to 0.0162

Lesser black-backed gull

10.8.4.14 When using an avoidance rate of 0.994 (±0.0004), the estimated mortalities in all four bio seasons and for all bio-seasons combined were very low and did not surpass the 1% increase threshold. As gulls forage mainly in daytime, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk.

10.8.4.15 The impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.42: Lesser black-backed gull expected additional mortality due to collisions with turbines across bio-seasons.

Bio-season	Regional Baseline Population	Baseline Mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Pre-breeding	163,304	20,250	0.4 to 2.2	0.0020 to 0.0107
Breeding	96,971	12,024	0.1 to 0.7	0.0008 to 0.0058
Post-breeding	163,304	20,250	0.0 to 0.0	0.0000 to 0.0000
Non-breeding	41,159	5,104	0.2 to 1.5	0.0005 to 0.0037
Annual	163,304	20,250	0.7 to 4.3	0.0033 to 0.0215

Northern gannet

10.8.4.16 In all three bio-seasons (pre-breeding, breeding and post-breeding) and for all bio-seasons combined, the estimated increase in baseline mortalities remains well below the 1% increase threshold when using an avoidance rate of 0.993 (±0.0003). As Northern gannet forage mainly in daytime, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk.

10.8.4.17 The impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.43: Northern gannet expected additional mortality due to collisions with turbines across bio-seasons.

Bio-season	Regional Baseline Population	Baseline Mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Pre-breeding	661,888	123,773	0.1 to 0.5	0.0000 to 0.0004
Breeding	448,235	83,820	0.4 to 3.5	0.0005 to 0.0042
Post-breeding	545,954	102,093	0.2 to 1.2	0.0001 to 0.0012
Annual (BDPMS)	661,888	123,773	0.7 to 5.3	0.0005 to 0.0043

Northern fulmar

10.8.4.18 When using an avoidance rate of 0.991 (±0.0004), the estimated increase in baseline mortality represents no change or negligible changes in all four bio-seasons and for the combined bio-seasons (Table 10.44). In the absence of quantitative information available on the effect of aviation and navigation lighting on collision risk, the magnitude is considered qualitatively for Northern fulmar. Although the species has a higher activity rate than most seabird species, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk, with very few flights likely to be at collision risk height (Wade *et al*., 2016).

10.8.4.19 The impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Table 10.44: Northern fulmar expected additional mortality due to collisions with turbines across bio-seasons.

Bio-season	Regional Baseline Population	Baseline Mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Pre-breeding	828,194	149,903	0.0 to 1.5	0.0000 to 0.0015
Breeding	393,701	71,260	0.0 to 0.0	0.0000 to 0.0000
Post-breeding	828,194	149,903	0.0 to 0.0	0.0000 to 0.0000
Non-breeding	556,367	100,702	0.0 to 0.0	0.0000 to 0.0000
Annual	828,194	149,903	0.0 to 1.5	0.0000 to 0.0010

Manx shearwater

10.8.4.20 When using an avoidance rate 0.991 (±0.0004), there are no predicted collisions during the operations phase of the wind farm, and thus no increase in mortality relative to the baseline mortality. In the absence of quantitative information available on the effect of aviation and navigation lighting on collision risk, the magnitude is considered qualitatively for Manx shearwater. Although the species has a high activity rate, aviation and navigation lighting at the Mona Offshore Wind Project is unlikely to result in increasing collision risk, with very few flights likely to be at collision risk height (Wade *et al*., 2016) with Manx shearwater flying close to the sea surface.

10.8.4.21 The impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **no change**.

Table 10.45: Manx shearwater expected additional mortality due to collisions with turbines across bio-seasons.

Bio-season	Regional Baseline Population	Baseline Mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Pre-breeding	1,580,895	207,097	0.0 to 0.0	0.0000 to 0.0000
Breeding	1,974,500	254,336	0.0 to 0.0	0.0000 to 0.0000
Post-breeding	1,580,895	207,097	0.0 to 0.0	0.0000 to 0.0000
Annual (BDPMS)	1,974,500	254,336	0.0 to 0.0	0.0000 to 0.0000

Migratory birds (excluding 'true seabirds', gulls, cormorants and divers).

10.8.4.22 Predictions using a range of avoidance rates are provided in Volume 6, annex 10.4: Offshore ornithology migratory non-seabird collision risk modelling of the PEIR. Even assuming a highly precautionary avoidance rate of 98.00%, the estimated numbers of collisions were low and predicted to be below one bird per annum for the majority of species found to be crossing the Mona Array Area. Because of their very large biogeographic population size and migration routes through the Irish Sea, wader species were at the greatest risk of collision.

10.8.4.23 Of the species/populations considered, European golden plover, Northern lapwing, dunlin, common snipe, Eurasian curlew and common redshank were predicted to be above one collision per year (assuming a 98.00% avoidance rate).

10.8.4.24 In the context of their large populations, the estimated increase in baseline mortalities of wader species as the result of collision during migration is expected to be minimal and undetectable given the size of the bio-geographic populations.

10.8.4.25 The impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

Black-legged kittiwake

10.8.4.26 Black-legged kittiwake was rated as relatively highly vulnerable to collision impacts by Wade *et al*. (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight.

10.8.4.27 Despite a higher reproductive success (i.e. laying two eggs and breeding until four years old) than most seabird species (Robinson, 2005), the species is deemed to have a low recoverability given the continuing decline in abundance observed between 1986 and 2018 in the UK (JNCC, 2020). During this period, breeding productivity has declined as the result of food shortage, although it has stabilised in recent years (JNCC, 2020).

10.8.4.28 Black-legged kittiwake is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of medium value.

10.8.4.29 Black-legged kittiwake is deemed to be of high vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **high**.

Great black-backed gull

10.8.4.30 Great black-backed gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al*. (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight.

10.8.4.31 The abundance of breeding great black-backed gull in the UK has changed relatively little between census (JNCC, 2020). The species is deemed to have a medium recoverability due to a low reproductive success and the stable trend in breeding abundance.

10.8.4.32 As great black-backed gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a non-SPA colony within range and so the species is considered to be of medium value.

10.8.4.33 Great black-backed gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

European herring gull

10.8.4.34 European herring gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al*. (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight.

10.8.4.35 As European herring gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) with multiple non-SPA colonies within range, the species is considered to be of medium value.

10.8.4.36 Although European herring gull have a relatively high reproductive success, breeding abundance is declining in the coastal natural nesting population, and this may be indicative of decline in the entire UK breeding population (JNCC, 2020). There is evidence that the urban nesting gull population has increased in recent years, but census of these sites is lacking to derive a UK wide trend that includes both the urban and natural populations. The species is therefore deemed to be of medium recoverability.

10.8.4.37 European herring gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Lesser black-backed gull

10.8.4.38 Lesser black-backed gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al*. (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight.

10.8.4.39 As lesser black-backed gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with multiple non-SPA colonies within range, the species is considered to be of medium value.

10.8.4.40 Although lesser black-backed gull has a relatively high reproductive success, the species breeding abundance has exhibited a downward trend over the last 15-20 years in the UK (JNCC, 2020). It must be noted that this trend excludes urban nesting gulls from the sample and, therefore, may not be representative of trends in the entire UK population. The species is deemed to be of medium recoverability.

10.8.4.41 Lesser black-backed gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Northern gannet

10.8.4.42 Although the latest scientific guidance showed the species to display a high level of macro-avoidance (Peschko *et al*., 2021), the species is rated as relatively vulnerable to collision impacts by Wade *et al*. (2016).

10.8.4.43 Northern gannet is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a large non-SPA colony within close proximity (Monreith Cliffs and Scar Rocks), the species is therefore considered to be of medium value.

10.8.4.44 Although northern gannet has a low reproductive success, the species is deemed to have a medium recoverability given the consistent increasing trend in abundance since the 1990s (JNCC, 2020). It is of note that the species has suffered from the outbreak of avian flu during the 2022 breeding season. The species is deemed to be of medium recoverability.

10.8.4.45 Northern gannet is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Northern fulmar

10.8.4.46 Northern fulmar was rated as the least vulnerable seabird to collision impacts by Wade *et al.* (2016).

10.8.4.47 As northern fulmar is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) with multiple non-SPAs within range, the species is considered to be of medium value. Furthermore, the northern fulmar population is endemic to the North Atlantic and most breed in Britain and Ireland (Mitchell *et al*., 2004).

10.8.4.48 The species has a very low reproductive success (Robinson, 2005). Long term trend data suggests that breeding abundance peaked in 1996 (JNCC, 2020) and recent declines represent a period of ‘re-adjustment’ following a period of artificially inflated population size. The species is deemed to be of medium recoverability.

10.8.4.49 Northern fulmar is deemed to be of low vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **low**.

Manx shearwater

10.8.4.50 Manx shearwater was rated as the least vulnerable seabirds to collision impacts by Wade *et al*. (2016).

10.8.4.51 As Manx shearwater is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) the species is considered to be of high value. Furthermore, the Manx shearwater population is endemic to the North Atlantic and most breed in Britain and Ireland (Mitchell *et al*., 2004).

10.8.4.52 The species has a very low reproductive success (Robinson, 2005). Most of the world population is found in the UK and over 90% of the UK population is found on the Islands of Rum and Eigg (Scotland) and Skomer and Skokholm (Wales) (Mitchell *et al*., 2004; JNCC, 2020). Therefore, the species is considered to be of high value.

10.8.4.53 Manx shearwater has a low reproductive success (i.e. only laying one egg and not breeding until five years old; Robinson, 2005). There is an incomplete spatial-temporal coverage of breeding abundance at UK colonies and thus a lack of long-term trend (JNCC, 2020). In the light of uncertainly and low reproductive success, Manx shearwater are therefore deemed to have a medium recoverability.

10.8.4.54 Manx shearwater is deemed to be of low vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Migratory non-seabird species

10.8.4.55 Although migratory non-seabird species have not been significantly studied in the offshore environment, vulnerability to collisions is likely to be generally low, since most migration will occur on a broad front and also above rotor height, although during periods of poor weather this risk may increase.

10.8.4.56 Recoverability of populations of migrants may vary considerably, with smaller wader species with a relatively favourable conservation status (e.g. dunlin) faring better than larger species with lower reproductive rates (e.g. Eurasian curlew).

10.8.4.57 On a precautionary basis and purposes of this assessment these species are assumed to have medium sensitivity to collision.

Significance of the effect

10.8.4.58 Overall, the magnitude of the collision risk impact at the Mona offshore wind farm is expected to be negligible to low depending on the species (Table 10.46). Although sensitivity of the receptor varies from low to high, the effect is expected to be of **minor to no** adverse significance depending on species, which is not significant in EIA terms. For black-legged kittiwake, minor was selected from the minor to moderate range due to the impact not exceeding a 0.5% increase in baseline mortality. Additionally, the population is vast with a change in baseline mortality greater than 0.1% would be unnoticeable and hence, was not regarded as a moderate significance of effect. For European herring gull, lesser black-backed gull, northern gannet, norther fulmar and migratory birds, negligible was selected from the negligible to minor range due to the impact not exceeding a 0.1% increase in baseline mortality and hence, was not regarded as a minor significance of effect.

Table 10.46: Table summarising the significance of effect of collision from the Mona Offshore Wind Project impacts during the operations and maintenance phase.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Black-legged kittiwake	Negligible	High	**Minor adverse, not significant in EIA terms**
Great black-backed gull	Low	Medium	**Minor adverse, not significant in EIA terms**
European herring gull	Negligible	Medium	**Negligible, not significant in EIA terms**
Lesser black-backed gull	Negligible	Medium	**Negligible, not significant in EIA terms**
Northern gannet	Negligible	Medium	**Negligible, not significant in EIA terms**
Northern fulmar	Negligible	Low	**Negligible, not significant in EIA terms**
Manx shearwater	No change	Medium	**No change, not significant in EIA terms**
Migratory birds	Negligible	Medium	**Negligible, not significant in EIA terms**

10.8.5 Barrier to movement

10.8.5.1 Barrier effects may arise in addition to displacement. Whilst displacement is a reduction in the number of seabirds occurring within or immediately adjacent to an offshore wind farm (Furness *et al*., 2013), the barrier effect refers to the disruption of preferred flight lines. This might impose an additional energetic cost to movements, particularly during the breeding season when seabirds make daily commutes between foraging grounds at sea and nesting sites. Additional energetic costs could have long-term implications for individuals and impact bird fitness (breeding productivity and survival). Birds may also have to navigate around the wind farms during migratory movements. In the case of migrating birds, avoidance of a single wind farm may be trivial relative to the total length and cost of the journey. There is a general lack of empirical data on the barrier effects for migratory birds.

10.8.5.2 For breeding seabirds, in a study of the effects of wind farms as barriers to movement on seabirds of differing morphology, Masden *et al*. (2010) found additional costs, expressed in relation to typical daily energetic expenditures, to be the highest per unit flight for seabirds with high wing loadings, such as cormorants. Most importantly the authors found costs of extra flight to avoid a wind farm to appear to be much less than those imposed by low food abundance or adverse weather, although such costs will be additive to these.

10.8.5.3 Although the site lies within the mean-maximum foraging ranges of several breeding colonies, connectivity has to be established to the Mona Array Area and it is unlikely that the site will provide a barrier to foraging movements given that birds generally forage widely within their mean-maximum foraging ranges. The risk of collision (as detailed in paragraph 10.8.4) is deemed to be greater than the risk of barrier effect.

10.8.5.4 Because the magnitude of the effect is likely to be similar amongst bird species moving through the area, receptors are grouped in the assessment of the barrier effect.

Operations and maintenance phase

Magnitude of impact

All receptors

10.8.5.5 In the absence of quantitative information available, the magnitude is considered qualitatively for breeding seabird and migratory non-seabirds.

10.8.5.6 As breeding seabirds generally forage widely within their foraging range of breeding colonies, the Mona Offshore Wind Project is unlikely to form a significant barrier to the movement from any breeding colonies. Furthermore, the Mona Offshore Wind Project is unlikely to form a barrier to the movement of migratory birds given that migratory movements at sea occur over a broad front.

10.8.5.7 The impact is predicted to be of local spatial extent, long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. Due to the likely absence of any detectable impact on the fitness of individuals and the demography of the populations, the magnitude is therefore, considered to be **negligible.**

Sensitivity of receptor

All receptors

10.8.5.8 Seabird species vary in their vulnerability to barrier effects. Some species such as gulls, fulmars, gannets and terns are considered to have a low sensitivity (Maclean *et al*., 2009). Other species such as divers and auks are considered to have higher sensitivity to barrier effects due to a higher wing-loading (i.e. they have a higher ratio of body weight to wing area and therefore energy expenditure during flight is likely to be higher. These species are notable by their characteristically direct flight paths) compared with other species (Maclean *et al*., 2009). Evidence from studies at operational wind farms (Everaert, 2006; Everaert and Kuijken, 2007; Lawrence *et al*., 2007; Krijgsveld *et al.,* 2011) has shown that gulls are unlikely to see wind turbines as a barrier to movement.

10.8.5.9 Overall breeding seabirds and migratory non-seabirds are deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of effect

10.8.5.10 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

10.8.6 Future monitoring

10.8.6.1 Future monitoring will be considered where there is uncertainty around potential effects. Any proposed monitoring would be discussed with the Offshore Ornithology EWG and where necessary included within the environmental statement submitted at Application.

10.9 Cumulative effects assessment methodology

10.9.1 Methodology

10.9.1.1 The Cumulative Effects Assessment (CEA) takes into account the impact associated with the Mona Offshore Wind Project together with all other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see volume 5, annex 5.1: CEA screening matrix). Each project has been considered on a case-by-case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

10.9.1.2 The offshore ornithology CEA methodology has followed the methodology set out in volume 1, chapter 5: EIA methodology of the PEIR. As part of the assessment, all projects and plans considered alongside the Mona Offshore Wind Project have been allocated into ‘tiers’ reflecting their current stage within the planning and development process, these are listed below.

10.9.1.3 The tiered approach uses the following categorisations:

- Tier 1
  - Under construction
  - Permitted application
  - Submitted application
  - Those currently operational that were not operational when baseline data was collected, and/or those that are operational but have an on-going impact

- Tier 2
  - Scoping report has been submitted and is in the public domain
- Tier 3
  - Scoping report has not been submitted and is not in the public domain
  - Identified in a relevant development plan
  - Identified in other plans and programmes.

10.9.1.4 This tiered approach is adopted to provide a clear assessment of the Mona Offshore Wind Project alongside other projects, plans and activities.

10.9.1.5 The specific projects, plans and activities screened in to the CEA are outlined in Table 10.47. The location of screened in projects and their proximity to the Mona Offshore Wind Project are further shown in Figure 10.2. All projects screened out are detailed within volume 5, annex 5.1 CEA screening annex.

10.9.1.6 Some of the potential impacts considered within the Mona Offshore Wind Project alone assessment are specific to a particular phase of development (e.g. construction, operations and maintenance or decommissioning). Where the potential for cumulative effects with other plans or projects only have potential to occur where there is spatial or temporal overlap with the Mona Offshore Wind Project during certain phases of development, impacts associated with a certain phase may be omitted from further consideration where no plans or projects have been identified that have the potential for cumulative effects during this period.

10.9.1.7 Other aspects, namely indirect impacts associated with prey distribution and availability are very difficult to quantify, and although it is acknowledged that cumulative effects are possible, the magnitude of these impacts is not considered to be significant at a population level for any offshore ornithology receptor and is therefore not considered further within the CEA. The impacts excluded from the cumulative assessment are:

- Indirect impacts (affecting prey species) from airborne noise, underwater sound and the presence of vessels at any phase of the Mona Offshore Wind Project as they will be spatially limited and all were predicted as negligible
- Temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs) at any phase of the Mona Offshore Wind Project as there is low potential for cumulative effect because the contribution from the Mona Offshore Wind Project and surrounding wind farms is small (and even if these occurred at the same time this would not constitute a significant effect)
- Impacts associated with the construction phase including cable landfall and laying of the export cable. Adjudged to cause changes of such small magnitude that these will not contribute in any meaningful way at a population level to a potential cumulative impact (based on determination for the Mona Offshore Wind Project effects alone).

10.9.1.8 Impacts considered in the cumulative assessment are as follows:

- Disturbance and displacement from infrastructure (and barrier effects)
- Collision risk.

Table 10.47: List of other projects, plans and activities considered within the offshore ornithology CEA.

Project/Plan	Status	Distance from Mona array area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Tier 1-							
Awel y Môr offshore wind farm	Submitted application	12.2km	3.6km	1,100MW capacity.	2026 to 2029	2030 to 2055	Potential construction phase overlap with the Mona Offshore Wind Project construction phase. Project operations and maintenance phase overlap
Gwynt y Môr offshore wind farm	Operational	13.8km	9.9km	160 3MW wind turbines. Hub height 98m. Rotor diameter 107m.	2012	2015 to 2033	Project operations and maintenance phase overlap
Rhyl Flats offshore wind farm	Operational	23.3km	3.8km	25 3.6MW wind turbines. Hub height 80m. Rotor diameter 107m.	2007	2009 to 2027	Project operations and maintenance phase overlap
Burbo Bank Extension offshore wind farm	Operational	24.6km	26.1km	32 8MW wind turbines. Hub height 105m. Rotor diameter 160m	2016	2017 to 2045	Project operations and maintenance phase overlap
North Hoyle offshore wind farm	Operational	24.7km	13.6km	30 2MW wind turbines. Hub height 70m. Rotor diameter 80m.	2003	2004 to 2028	Project operations and maintenance phase overlap
Walney Extension 4 offshore wind farm	Operational	27.2km	47.8km	47 7MW wind turbines. Hub height 111m. Rotor diameter 154m.	2017	2018 to 2039	Project operations and maintenance phase overlap
Walney Extension 3 offshore wind farm	Operational	27.3km	53.6km	40 8.25MW wind turbines. Hub height 113m. Rotor diameter 164m.	2017	2018 to 2039	Project operations and maintenance phase overlap
West of Duddon Sands offshore wind farm	Operational	30.4km	43.9km	108 3.6MW wind turbines. Hub height 90m Rotor diameter 120m.	2013	2014 to 2033	Project operations and maintenance phase overlap
Walney 2 offshore wind farm	Operational	31.0km	51.5km	51 3.6MW wind turbines. Hub height 84m. Rotor diameter 107m.	2011	2012 to 2032	Project operations and maintenance phase overlap
Walney 1 offshore wind farm	Operational	32.8km	49.6km	51 3.6MW wind turbines. Hub height 84m. Rotor diameter 107m.	2010	2011 to 2032	Project operations and maintenance phase overlap
Burbo Bank offshore wind farm	Operational	34.0km	32.8km	23 3.6MW wind turbines. Hub height 78m. Rotor diameters 107m.	2006	2007 to 2039	Project operations and maintenance phase overlap
Ormonde offshore wind farm	Operational	41.2km	58.0km	30 5MW wind turbines. Hub Height 100m. Rotor diameter 126m.	2010	2012 to 2036	Project operations and maintenance phase overlap
Barrow offshore wind farm	Operational	42.9km	53.9km	30 3MW wind turbines. Hub height 75m. Rotor diameter 90m.	2005	2006 to 2028	Project operations and maintenance phase overlap

Project/Plan	Status	Distance from Mona array area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Robin Rigg offshore wind farm	Operational	98.6km	126.0km	58 3MW wind turbines. Hub height 80m Rotor diameter 90m.	2009	2010 to 2023	Project operations and maintenance phase overlap
Arklow Bank Phase 1 offshore wind farm	Operational	156.1km	150.9km	7 3.6MW wind turbines. Hub height 73.5m. Rotor diameter 124m.	2002	2004 to 2028	Project operations and maintenance phase overlap
Erebus offshore wind farm	Submitted application	258.9km	240.2km	100MW capacity.	2025	2026 to 2051	Potential construction phase overlap with Mona Offshore Wind Project construction phase. Project operations and maintenance phase overlap
Tier 2-							
Morgan Offshore Wind Project Generation Assets	Pre-application	5.52km	32.93km	1,500MW capacity.	2026 to 2029	2030 to 2065	Potential construction phase overlap with Mona Offshore Wind Project construction phase. Project operations and maintenance phase overlap
Morecambe Offshore Windfarm Generation Assets (hereafter referred to as the Morgan Generation Assets)	Pre-application	8.9km	21.5km	480MW capacity, Area: 497km^2	2026 to 2028	2029 to 2064	Potential construction phase overlap with Mona Offshore Wind Project construction phase. Project operations and maintenance phase overlap
Morgan and Morecambe Offshore Wind Farms Transmission Assets	Pre-application	8.92km	21.53km	n/a	2026 to 2029	2029 to 2065	Potential construction phase overlap
North Irish Sea Array offshore wind farm	Pre-application	112.7km	118.6km	500MW capacity.	unknown	unknown	Project operations and maintenance phase overlap
Codling Wind Park offshore wind farm	Pre-application	125.1km	123.6km	900MW planned capacity, off of the coast Wicklow. Spread over an area of 125km^2	unknown	unknown	Project operations and maintenance phase overlap
Dublin Array offshore wind farm	Pre-application	126.1km	129.0km	600MW offshore wind power project. Area of 54km^2.	unknown	unknown	Project operations and maintenance phase overlap
Oriel offshore wind farm	Pre-application	130.4km	138.1km	375MW capacity, spread over 28km^2.	unknown	unknown	Project operations and maintenance phase overlap
Arklow Bank Phase 2 offshore wind farm	Pre-application	146.7km	142.8km	800MW capacity.	unknown	unknown	Project operations and maintenance phase overlap
Shelmalere offshore wind farm	Pre-application	177.1km	168.9km	1,000MW capcaity.	unknown	unknown	Project operations and maintenance phase overlap

Project/Plan	Status	Distance from Mona array area (km)	Distance from Mona offshore cable corridor (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Mona Offshore Wind Project
Llyr 1 offshore wind farm	Pre-application	267.0km	245.9km	100MW capacity.	2024 to 2025	2026 to 2051	Project operations and maintenance phase overlap
Llyr 2 offshore wind farm	Pre-application	263.17km	240.12km	1,000MW capacity.	2024 to 2025	2026 to 2051	Project operations and maintenance phase overlap
White Cross offshore wind farm	Pre-application	287.7km	264.1km	Test and Demonstration Floating Wind Farm	unknown	unknown	Project operations and maintenance phase overlap
Inis Ealga Marine Energy Park offshore wind farm	Pre-application	302.1km	292.0km	1,000MW capacity.	unknown**	unknown**	Project operations and maintenance phase overlap

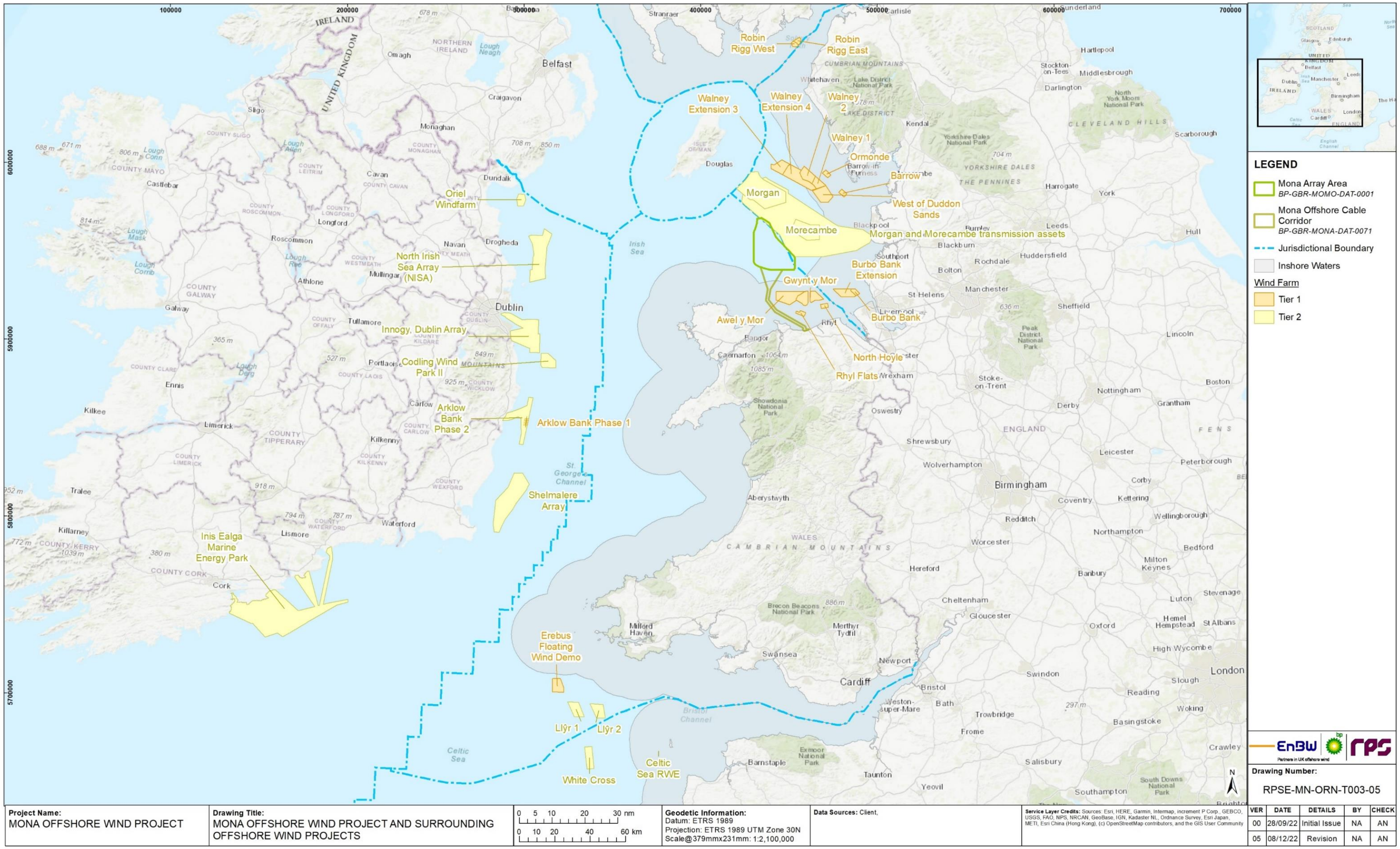

Figure 10.2: Other projects, plans and activities screened into the cumulative effects assessment[1].

[1] The Awel y Môr agreement for lease area extends further to the west than the application boundary presented, however Awel y Môr Offshore Wind Farm Ltd. have decided to develop in the area presented

10.9.1.9 The MDSs identified in Table 10.48 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the MDS table above, Table 10.20 due to there being a potential for cumulative effects. Effects of greater adverse significance are not predicted to arise should any other development scenario (e.g. different wind turbine layout), to that assessed here, be taken forward in the final design scheme.

Table 10.48: Maximum design scenario considered for the assessment of potential cumulative effects on offshore ornithology.

a C=construction, O=operations and maintenance, D=decommissioning
b Barrier effect is included as CEA is based on SNCB Matrix approach (JNCC, 2017)

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
Disturbance and displacement from infrastructure	✓	✓	✓	MDS as described for the Mona Offshore Wind Project (Table 10.20) assessed cumulatively with the following wind farms: **Construction phase** **Tier 1** • Awel y Môr • Erebus. **Tier 2** • Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets. **Operations and maintenance Phase** **Tier 1** • Barrow • Burbo Bank • Burbo Bank Extension • North Hoyle • Ormonde • Walney 1 • Walney 2 • Walney 3 • Walney 4 • West of Duddon Sands • Gwynt y Môr • Rhyl Flats • Robin Rigg • Arklow Bank Phase 1 • Awel y Môr • Erebus.	There is a possibility that construction could overlap temporally with Awel y Môr, the Morgan Generation Assets, Morecambe Offshore Windfarm Generation Assets and Erebus. There is a possibility that decomissioning could overlap temporally with Awel y Môr and Erebus. However, the impact from construction and decommissioning are of small, temporary magnitude. There is potential for a cumulative effect from operations and maintenance activities and so a quantitative cumulative effect assessment is required.

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				Tier 2 • Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets • North Irish Sea Array • Codling Wind Park • Dublin Array • Oriel • Arklow Bank Phase 2 • Shelmalere • Llyr 1 • Llyr 2 • White Cross • Inis Ealga Marine Energy Park. **Decommissioning Phase** **Tier 1** • Awel y Môr • Erebus.	
Collision risk	×	✓	×	MDS as described for the Mona Offshore Wind Project (Table 10.20) assessed cumulatively with the following wind farms: **Operations and maintenance Phase** **Tier 1** • Barrow • Burbo Bank • Burbo Bank Extension • North Hoyle • Ormonde • Walney 1 • Walney 2 • Walney 3 • Walney 4 • West of Duddon Sands • Gwynt y Môr • Rhyl Flats • Robin Rigg • Arklow Bank Phase 1 • Awel y Môr • Erebus **Tier 2**	There is potential for a cumulative effect from operations and maintenance activities so a detailed, quantitative cumulative effect assessment is required.

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets • North Irish Sea Array • Codling Wind Park • Dublin Array • Oriel • Arklow Bank Phase 2 • Shelmalere • Llyr 1 • Llyr 2 • White Cross • Inis Ealga Marine Energy Park.	

10.10 Cumulative effects assessment

10.10.1.1 A description of the significance of cumulative effects upon offshore ornithology receptors arising from each identified impact is given below.

10.10.1.2 The CEA is limited by the data available upon which to base the assessment. Due to the age of developments in the Irish Sea and surrounding areas which have the potential to have a cumulative impact upon receptors, few have comparable datasets upon which to base an assessment.

10.10.1.3 Additionally, older developments did not carry out certain impact assessments (e.g. displacement and/or collision risk) for species such as black-legged kittiwake, northern gannet, northern fulmar, Manx shearwater and gull species (herring gull, great black-backed gull and lesser black-backed gull) due to limited data at the time of assessment on the species' behavioural response to the presence of offshore turbines. As such the CEA is carried out using data from wind farms with available species data to do so.

10.10.1.4 For the cumulative assessment, impacts from Tier 1 and Tier 2 projects have been assessed together.

10.10.1 Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure

10.10.1.1 There is potential for cumulative displacement as a result of construction and operational activities associated with the Mona Offshore Wind Project along with other developments.

10.10.1.2 Disturbance and subsequent displacement of seabirds during the construction phase is primarily centred around where construction vessels and piling activities are occurring. The activities may displace individuals that would normally reside within and around the area of sea where the Mona Offshore Wind Project is located. This in effect represents indirect habitat loss, which will potentially reduce the area available to those seabirds to forage, loaf and/or moult.

10.10.1.3 The level of data available and the ease with which disturbance and displacement impacts can be combined across the wind farms is quite variable, reflecting the availability of relevant data for other projects and the approach to assessment taken. A maximum design approach would be to assume complete overlap in construction for all projects, while the minimum design approach would be to assume no overlap. The most realistic assumption is that at most there will be a degree of construction overlap (and hence increased vessel and helicopter activity), but that it will be limited to a small number of cumulative effects assessment projects and other activities.

10.10.1.4 During the operations and maintenance phase, the presence of offshore wind turbines has the potential to directly disturb and displace seabirds that would normally reside within and around the area of sea where offshore wind farms are located. Displacement may contribute to individual birds experiencing fitness consequences, which at an extreme level could lead to the mortality of individuals. Cumulative displacement therefore has the potential to lead to effects on a wider scale.

10.10.1.5 The species assessed for cumulative displacement impacts were common guillemot, razorbill, Atlantic puffin, northern gannet, and black-legged kittiwake.

10.10.1.6 The cumulative results are presented as displacement matrices ranging from 1% to 100% mortality and 5% to 100% displacement. Each cell presents potential cumulative bird mortality following displacement from the Mona Offshore Wind Project and the other offshore wind farm projects during each bio-season. Light blue highlighted cells are based on the displacement and mortality rates used in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR. Additionally, orange highlighted cells which represent a displacement rate of 50% and a mortality rate of 1% are shown in each bio-season matrices for all species except northern gannet (for which a mortality rate of 1% and a displacement rate of 70% is highlighted instead), in line with values used by other offshore wind farm displacement assessments.

Tier 1 and Tier 2

Construction phase

Magnitude of impact

Common guillemot

10.10.1.7 The estimated mean peak cumulative abundances of guillemot from the relevant projects (projects that potentially overlap in their construction activities with Mona Offshore Wind Project) during each bio-season are presented in Table 10.49.

Table 10.49: Guillemot cumulative abundances for potential overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Cumulative Abundance	Breeding Season Cumulative Abundance	Non-breeding Season Cumulative Abundance
Tier 1			
Awel y Môr	4,488	1,569	2,919
Erebus	18,882	3,558	15,324
Tier 2			
Morgan Generation Assets	8,994	4,893	4,101
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown
Oriel	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown
Llyr 1	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown
White Cross	unknown	unknown	unknown

Project	Annual Cumulative Abundance	Breeding Season Cumulative Abundance	Non-breeding Season Cumulative Abundance
Inis Eagla Marine Energy Park	unknown	unknown	unknown
TOTAL (minus the Mona Offshore Wind Project)	32,364	10,020	22,344
Mona Offshore Wind Project	11,912	6,461	5,451
TOTAL (all projects)	**44,276**	**16,481**	**27,795**

10.10.1.8 The following displacement matrices provide the estimated cumulative mortality of guillemot predicted to occur due to displacement during construction, as determined by the relevant specified rates of displacement and mortality (Table 10.50 to Table 10.52). The approach used for the cumulative displacement assessment follows that presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.50: Construction phase cumulative guillemot mortality following displacement from offshore wind farms in the breeding season.

Common guillemot – Breeding	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	**1%**	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
5%	8	16	41	82	206	412	824
10%	16	33	82	165	412	824	1,648
15%	25	49	124	247	618	1,236	2,472
20%	33	66	165	330	824	1,648	3,296
25%	41	82	206	412	1,030	2,060	4,120
30%	49	99	247	494	1,236	2,472	4,944
35%	58	115	288	577	1,442	2,884	5,768
60%	99	198	494	989	2,472	4,944	9,889
80%	132	264	659	1,318	3,296	6,592	13,185
100%	165	330	824	1,648	4,120	8,241	16,481

Table 10.51: Construction phase cumulative guillemot mortality following displacement from offshore wind farms in the non-breeding season.

Common guillemot – Non-breeding	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	**1%**	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
5%	14	28	69	139	347	695	1,390
10%	28	56	139	278	695	1,390	2,780
15%	42	83	208	417	1,042	2,085	4,169
20%	56	111	278	556	1,390	2,780	5,559
25%	69	139	347	695	1,737	3,474	6,949
30%	83	167	417	834	2,085	4,169	8,339
35%	97	195	486	973	2,432	4,864	9,728
60%	167	334	834	1,668	4,169	8,339	16,677
80%	222	445	1,112	2,224	5,559	11,118	22,236
100%	278	556	1,390	2,780	6,949	13,898	27,795

Table 10.52: Construction phase cumulative guillemot mortality following displacement from offshore wind farms annually.

Common guillemot – Annual	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	**1%**	**2%**	**5%**	**10%**	**25%**	**50%**	**100%**
5%	22	44	111	221	553	1,107	2,214
10%	44	89	221	443	1,107	2,214	4,428
15%	66	133	332	664	1,660	3,321	6,641
20%	89	177	443	886	2,214	4,428	8,855
25%	111	221	553	1,107	2,767	5,535	11,069
30%	133	266	664	1,328	3,321	6,641	13,283
35%	155	310	775	1,550	3,874	7,748	15,497
60%	266	531	1,328	2,657	6,641	13,283	26,566
80%	354	708	1,771	3,542	8,855	17,710	35,421
100%	443	886	2,214	4,428	11,069	22,138	44,276

10.10.1.9 During the breeding season, the potential displacement from construction when using a displacement rate of 25% (range: 15 to 35%) and a mortality of 1% (range: 1% to 10%), results in an additional loss of 41 (25 to 577) individuals from the breeding population (Table 10.50).

10.10.1.10 During the non-breeding season, the displacement from construction results in an additional loss of 69 (42 to 973) individuals from the non-breeding population (Table 10.51).

10.10.1.11 For the combined bio-seasons, the annual estimated mortality resulting from displacement during construction is 111 (66 to 1,550) individuals (Table 10.52).

10.10.1.12 Using the largest BDMPS population of 1,139,220 individuals and, using the average baseline mortality rate of 0.139 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR), the background predicted mortality would be 158,352. The addition of 111 (66 to 1,550) mortalities would increase the baseline mortality rate by 0.069% (0.042% to 0.979%). The annual predicted mortality from the cumulative assessment during construction is below the 1% threshold increase.

10.10.1.13 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **negligible**.

Razorbill

10.10.1.14 The estimated cumulative abundance of razorbill from the relevant projects (projects that overlap in their construction activities with the Mona Offshore Wind Project) are presented in Table 10.53.

Table 10.53: Razorbill cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Cumulative Abundance	Pre-breeding Cumulative Abundance	Breeding Season Cumulative Abundance	Post-breeding Cumulative Abundance	Non-breeding Cumulative Abundance
Tier 1					
Awel y Môr	692	336	140	66	150
Erebus	2,357	460	103	1,228	566
Tier 2					
Morgan Generation Assets	622	166	120	103	233
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown	unknown	unknown
Oriel	unknown	unknown	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown	unknown	unknown
Llyr 1	unknown	unknown	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown	unknown	unknown
White Cross	unknown	unknown	unknown	unknown	unknown
Inis Eagla Marine Energy Park	unknown	unknown	unknown	unknown	unknown
TOTAL (minus the Mona Offshore Wind Project)	**3,671**	**962**	**363**	**1,397**	**949**
Mona Offshore Wind Project	2,883	2,283	173	140	287
TOTAL (all projects)	**6,554**	**3,245**	**536**	**1,537**	**1,236**

10.10.1.15 The following displacement matrices provide the estimated cumulative mortality of guillemot predicted to occur due to displacement during construction, as determined by the relevant specified rates of displacement and mortality (Table 10.54 to Table 10.58). The approach used for the cumulative displacement assessment follows that presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.54: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the pre-breeding season.

Razorbill Pre-breeding		Mortality level (% of displaced birds at risk of mortality)						
		1%	2%	5%	10%	25%	50%	100%
Displacement level (% at risk of displacement)	5%	2	3	8	16	41	81	162
	10%	3	6	16	32	81	162	325
	15%	5	10	24	49	122	243	487
	20%	6	13	32	65	162	325	649
	25%	8	16	41	81	203	406	811
	30%	10	19	49	97	243	487	974
	35%	11	23	57	114	284	568	1136
	60%	19	39	97	195	487	974	1947
	80%	26	52	130	260	649	1298	2596
	100%	32	65	162	325	811	1623	3245

Table 10.55: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the breeding season.

Razorbill Breeding		Mortality level (% of displaced birds at risk of mortality)						
		1%	2%	5%	10%	25%	50%	100%
Displacement level (% at risk of displacement)	5%	0	1	1	3	7	13	27
	10%	1	1	3	5	13	27	54
	15%	1	2	4	8	20	40	80
	20%	1	2	5	11	27	54	107
	25%	1	3	7	13	34	67	134
	30%	2	3	8	16	40	80	161
	35%	2	4	9	19	47	94	188
	60%	3	6	16	32	80	161	322
	80%	4	9	21	43	107	214	429
	100%	5	11	27	54	134	268	536

Table 10.56: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the post-breeding season.

Razorbill Post-breeding		Mortality level (% of displaced birds at risk of mortality)						
		1%	2%	5%	10%	25%	50%	100%
Displacement level (% at risk of displacement)	5%	1	2	4	8	19	38	77
	10%	2	3	8	15	38	77	154
	15%	2	5	12	23	58	115	231
	20%	3	6	15	31	77	154	307
	25%	4	8	19	38	96	192	384
	30%	5	9	23	46	115	231	461
	35%	5	11	27	54	134	269	538
	60%	9	18	46	92	231	461	922
	80%	12	25	61	123	307	615	1230
	100%	15	31	77	154	384	769	1537

Table 10.57: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the non-breeding season.

Razorbill Non-breeding		Mortality level (% of displaced birds at risk of mortality)						
		1%	2%	5%	10%	25%	50%	100%
Displacement level (% at risk of displacement)	5%	1	1	3	6	15	31	62
	10%	1	2	6	12	31	62	124
	15%	2	4	9	19	46	93	185
	20%	2	5	12	25	62	124	247
	25%	3	6	15	31	77	155	309
	30%	4	7	19	37	93	185	371
	35%	4	9	22	43	108	216	433
	60%	7	15	37	74	185	371	742
	80%	10	20	49	99	247	494	989
	100%	12	25	62	124	309	618	1236

Table 10.58: Construction phase cumulative razorbill mortality following displacement from offshore wind farms annually.

Razorbill Annual	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
5%	3	7	16	33	82	164	328
10%	7	13	33	66	164	328	655
15%	10	20	49	98	246	492	983
20%	13	26	66	131	328	655	1,311
25%	16	33	82	164	410	819	1,639
30%	20	39	98	197	492	983	1,966
35%	23	46	115	229	573	1,147	2,294
60%	39	79	197	393	983	1,966	3,932
80%	52	105	262	524	1,311	2,622	5,243
100%	66	131	328	655	1,639	3,277	6,554

10.10.1.16 During the spring migration (pre-breeding) season the displacement from construction when using a displacement rate of 25% (range: 15% to 35%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of 8 (5 to 114) individuals (Table 10.54).

10.10.1.17 During the breeding season, displacement from construction results in the loss of 1 (1 to 15) individual from the breeding population (Table 10.55).

10.10.1.18 During the autumn migration season (post-breeding), displacement from construction results in a loss of 1 (1 to 19) individual from the migratory population (Table 10.56).

10.10.1.19 During the non-breeding season (winter season), displacement from construction results a in a loss of 3 (2 to 43) individuals from the non-breeding population (Table 10.57).

10.10.1.20 The annual estimated mortality resulting from displacement during construction is 16 (10 to 229) individuals (Table 10.58).

10.10.1.21 Using the largest BDMPS population of 606,914 individuals and, using the average baseline mortality rate of 0.174 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR), the background predicted mortality would be 105,603. The addition of 16 (10 to 229) mortalities would increase the baseline mortality rate by 0.016% (0.009% to 0.217%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

10.10.1.22 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore considered to be **negligible**.

Atlantic puffin

10.10.1.23 The estimated cumulative abundance of Atlantic puffin from the relevant projects is presented in Table 10.59.

Table 10.59: Atlantic puffin cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Cumulative Abundance	Breeding Season Cumulative Abundance	Non-breeding Season Cumulative Abundance
Tier 1			
Awel y Môr	unknown	unknown	unknown
Erebus	481	449	32
Tier 2			
Morgan generation	18	18	0
Morecambe generation	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown
Oriel	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown
Llyr 1	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown
White Cross	unknown	unknown	unknown
Inis Eagla Marine Energy Park	unknown	unknown	unknown
TOTAL (minus Mona)	**499**	**467**	**32**
Mona	30	16	14
TOTAL (all projects)	**529**	**483**	**46**

10.10.1.24 The following displacement matrices provide the estimated cumulative mortality of Atlantic puffin predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 10.60 to Table 10.62). The approach used for the cumulative displacement assessment follows that presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.60: Construction phase cumulative Atlantic puffin mortality following displacement from offshore wind farms in the breeding season.

Atlantic puffin Breeding		Mortality level (% of displaced birds at risk of mortality)						
		1%	2%	5%	10%	25%	50%	100%
Displacement level (% at risk of displacement)	5%	0	0	1	2	6	12	24
	10%	0	1	2	5	12	24	48
	15%	1	1	4	7	18	36	72
	20%	1	2	5	10	24	48	97
	25%	1	2	6	12	30	60	121
	30%	1	3	7	14	36	72	145
	35%	2	3	8	17	42	85	169
	60%	3	6	14	29	72	145	290
	80%	4	8	19	39	97	193	386
	100%	5	10	24	48	121	242	483

Table 10.61: Construction phase cumulative Atlantic puffin mortality following displacement from offshore wind farms in the non-breeding season.

Atlantic puffin Non-breeding		Mortality level (% of displaced birds at risk of mortality)						
		1%	2%	5%	10%	25%	50%	100%
Displacement level (% at risk of displacement)	5%	0	0	0	0	1	1	2
	10%	0	0	0	0	1	2	5
	15%	0	0	0	1	2	3	7
	20%	0	0	0	1	2	5	9
	25%	0	0	1	1	3	6	12
	30%	0	0	1	1	3	7	14
	35%	0	0	1	2	4	8	16
	60%	0	1	1	3	7	14	28
	80%	0	1	2	4	9	18	37
	100%	0	1	2	5	12	23	46

Table 10.62: Construction phase cumulative Atlantic puffin mortality following displacement from offshore wind farms annually.

Atlantic puffin Annual		Mortality level (% of displaced birds at risk of mortality)						
		1%	2%	5%	10%	25%	50%	100%
Displacement level (% at risk of displacement)	5%	0	1	1	3	7	13	26
	10%	1	1	3	5	13	26	53
	15%	1	2	4	8	20	40	79
	20%	1	2	5	11	26	53	106
	25%	1	3	7	13	33	66	132
	30%	2	3	8	16	40	79	159
	35%	2	4	9	19	46	93	185
	60%	3	6	16	32	79	159	317
	80%	4	8	21	42	106	212	423
	100%	5	11	26	53	132	265	529

10.10.1.25 During the breeding season, the displacement from construction when using a displacement rate of 25% (range: 15% to 35%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of one (1 to 17) individual from the breeding population (Table 10.60).

10.10.1.26 During the non-breeding season, the displacement from construction results in an additional loss of zero (0 to 2) individuals from the non-breeding population (Table 10.61).

10.10.1.27 The annual estimated mortality resulting from displacement during construction is one (1 to 19) individuals (Table 10.62).

10.10.1.28 Using the largest BDMPS of 304,557 individuals and, using the average baseline mortality rate of 0.181 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR) the background estimated mortality across all seasons is 55,125. The addition of one (1 to 19) mortalities would increase the baseline mortality rate by 0.001% (0.001% to 0.017%). The annual predicted mortality from the cumulative assessment is well below the 1% threshold increase in baseline mortality.

10.10.1.29 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Northern gannet

10.10.1.30 The estimated cumulative abundance of northern gannet from the relevant projects is presented in Table 10.63.

Table 10.63: Northern gannet cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Cumulative Abundance	Pre-breeding Cumulative Abundance	Breeding Season Cumulative Abundance	Post-breeding Cumulative Abundance
Tier 1				
Awel y Môr	529	0	328	201
Erebus	658	224	334	100
Tier 2				
Morgan Generation Assets	454	53	209	192
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown	unknown
Oriel	unknown	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown	unknown
Llyr 1	unknown	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown	unknown
White Cross	unknown	unknown	unknown	unknown
Inis Eagla Marine Energy Park	unknown	unknown	unknown	unknown
TOTAL (minus the Mona Offshore Wind Project)	**1,641**	**277**	**871**	**493**
Mona Offshore Wind Project	693	105	351	237
TOTAL (all projects)	**2,334**	**382**	**1,222**	**730**

10.10.1.31 The following displacement matrices provide the estimated cumulative mortality of northern gannet predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 10.64 to Table 10.67). The approach used for the cumulative displacement assessment follows that presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.64: Construction phase cumulative northern gannet mortality following displacement from offshore wind farms in the pre-breeding season.

Northern gannet – Pre-breeding: Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
10%	0	1	2	4	10	19	38
20%	1	2	4	8	19	38	76
30%	1	2	6	11	29	57	115
35%	1	3	7	13	33	67	134
40%	2	3	8	15	38	76	153
60%	2	5	11	23	57	115	229
70%	3	5	13	27	67	134	267
80%	3	6	15	31	76	153	306
90%	3	7	17	34	86	172	344
100%	4	8	19	38	96	191	382

Table 10.65: Construction phase cumulative northern gannet mortality following displacement from offshore wind farms in the breeding season.

Northern gannet – Breeding: Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
10%	1	2	6	12	31	61	122
20%	2	5	12	24	61	122	244
30%	4	7	18	37	92	183	367
35%	4	9	21	43	107	214	428
40%	5	10	24	49	122	244	489
60%	7	15	37	73	183	367	733
70%	9	17	43	86	214	428	855
80%	10	20	49	98	244	489	978
90%	11	22	55	110	275	550	1,100
100%	12	24	61	122	306	611	1,222

Table 10.66: Construction phase cumulative northern gannet mortality following displacement from offshore wind farms in the post-breeding season.

Northern gannet – Post-breeding	Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
	10%	1	1	4	7	18	37	73
	20%	1	3	7	15	37	73	146
	30%	2	4	11	22	55	110	219
	35%	3	5	13	26	64	128	256
	40%	3	6	15	29	73	146	292
	60%	4	9	22	44	110	219	438
	70%	5	10	26	51	128	256	511
	80%	6	12	29	58	146	292	584
	90%	7	13	33	66	164	329	657
	100%	7	15	37	73	183	365	730

Table 10.67: Construction phase cumulative northern gannet mortality following displacement from offshore wind farms annually.

Northern gannet – Annual	Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
	10%	2	5	12	23	58	117	233
	20%	5	9	23	47	117	233	467
	30%	7	14	35	70	175	350	700
	35%	8	16	41	82	204	408	817
	40%	9	19	47	93	233	467	934
	60%	14	28	70	140	350	700	1,400
	70%	16	33	82	163	408	817	1,634
	80%	19	37	93	187	467	934	1,867
	90%	21	42	105	210	525	1,050	2,101
	100%	23	47	117	233	584	1,167	2,334

10.10.1.32 During the spring migration (pre-breeding) season the displacement from construction when using a displacement rate of 35% (range: 30% to 40%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of one (1 to 15) individuals (Table 10.64).

10.10.1.33 During the breeding season, displacement from construction results in the loss of four (4 to 49) individuals from the breeding population (Table 10.66).

10.10.1.34 The annual estimated mortality resulting from displacement during construction is eight (7 to 93) individuals (Table 10.67).

10.10.1.35 Using the largest UK Western Waters BDMPS population of 661,888 individuals, with an average baseline mortality rate of 0.187 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR), the background predicted mortality would be 123,773. The addition of eight (7 to 93) mortalities would increase the baseline mortality rate by 0.007% (0.006% to 0.075%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

10.10.1.36 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Black-legged kittiwake

10.10.1.37 The estimated cumulative abundance of black-legged kittiwake from the relevant projects is presented in Table 10.68.

Table 10.68: Black-legged kittiwake cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Annual Cumulative Abundance	Pre-breeding Cumulative Abundance	Breeding Season Cumulative Abundance	Post-breeding Cumulative Abundance
Tier 1				
Awel y Môr	unknown	unknown	unknown	unknown
Erebus	2,532	2	2,022	508
Tier 2				
Morgan Generation Assets	2,724	645	460	1,619
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown	unknown
Oriel	unknown	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown	unknown

Project	Annual Cumulative Abundance	Pre-breeding Cumulative Abundance	Breeding Season Cumulative Abundance	Post-breeding Cumulative Abundance
Llyr 1	unknown	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown	unknown
White Cross	unknown	unknown	unknown	unknown
Inis Eagla Marine Energy Park	unknown	unknown	unknown	unknown
TOTAL (minus the Mona Offshore Wind Project)	**5,256**	**647**	**2,482**	**2,127**
Mona Offshore Wind Project	2,397	1,135	479	783
TOTAL (all projects)	**7,653**	**1,782**	**2,961**	**2,910**

10.10.1.38 The following displacement matrices provide the estimated cumulative mortality of black-legged kittiwake predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 10.68 to Table 10.72). The approach used for the cumulative displacement assessment follows that presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.69: Construction phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the pre-breeding season.

Black-legged kittiwake – Pre-breeding; Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
5%	1	2	4	9	22	45	89
10%	2	4	9	18	45	89	178
15%	3	5	13	27	67	134	267
20%	4	7	18	36	89	178	356
25%	4	9	22	45	111	223	446
30%	5	11	27	53	134	267	535
35%	6	12	31	62	156	312	624
60%	11	21	53	107	267	535	1,069
80%	14	29	71	143	356	713	1,426
100%	18	36	89	178	446	891	1,782

Table 10.70: Construction phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the breeding season.

Black-legged kittiwake – Breeding; Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
5%	1	3	7	15	37	74	148
10%	3	6	15	30	74	148	296
15%	4	9	22	44	111	222	444
20%	6	12	30	59	148	296	592
25%	7	15	37	74	185	370	740
30%	9	18	44	89	222	444	888
35%	10	21	52	104	259	518	1,036
60%	18	36	89	178	444	888	1,777
80%	24	47	118	237	592	1,184	2,369
100%	30	59	148	296	740	1,481	2,961

Table 10.71: Construction phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the post-breeding season.

Black-legged kittiwake – Post-breeding; Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
5%	1	3	7	15	36	73	146
10%	3	6	15	29	73	146	291
15%	4	9	22	44	109	218	437
20%	6	12	29	58	146	291	582
25%	7	15	36	73	182	364	728
30%	9	17	44	87	218	437	873
35%	10	20	51	102	255	509	1,019
60%	17	35	87	175	437	873	1,746
80%	23	47	116	233	582	1,164	2,328
100%	29	58	146	291	728	1,455	2,910

Table 10.72: Construction phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms annually.

Black-legged kittiwake Annual	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
5%	4	8	19	38	96	191	383
10%	8	15	38	77	191	383	765
15%	11	23	57	115	287	574	1,148
20%	15	31	77	153	383	765	1,531
25%	19	38	96	191	478	957	1,913
30%	23	46	115	230	574	1,148	2,296
35%	27	54	134	268	670	1,339	2,679
60%	46	92	230	459	1,148	2,296	4,592
80%	61	122	306	612	1,531	3,061	6,122
100%	77	153	383	765	1,913	3,827	7,653

10.10.1.39 During the spring migration (pre-breeding) season the displacement from construction when using a displacement rate of 25% (range: 15% to 35%) and a mortality of 1% (range: 1 to 10%), results in an additional loss of four (3 to 62) individuals (Table 10.68).

10.10.1.40 During the breeding season, displacement from construction results in the loss of seven (4 to 104) individuals from the breeding population (Table 10.69).

10.10.1.41 During the autumn migration season (post-breeding), displacement from construction results in a loss of seven (4 to 102) individuals from the migratory population (Table 10.71).

10.10.1.42 The annual estimated mortality resulting from displacement during construction is 19 (11 to 268) individuals (Table 10.72).

10.10.1.43 Using the largest UK Western Waters BDMPS population of 911,586 individuals, with an average baseline mortality rate of 0.157 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR), the background predicted mortality would be 143,119. The addition of 19 (11 to 268) mortalities would increase the baseline mortality rate by 0.013% (0.008% to 0.187%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

10.10.1.44 The cumulative effect is predicted to be of national spatial extent, medium term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

Common guillemot

10.10.1.45 Evidence of common guillemot sensitivity to displacement from the construction phase of offshore wind farms is summarised from paragraph 10.10.1.7 onwards. Overall, based on evidence from studies and reviews, common guillemot is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Razorbill

10.10.1.46 Evidence of razorbill sensitivity to displacement from the construction phase of offshore wind farms is summarised in paragraph 10.10.1.14 onwards. Overall, based on evidence from studies and reviews, razorbill is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Atlantic puffin

10.10.1.47 Evidence of Atlantic puffin sensitivity to displacement from the construction phase of offshore wind farms is summarised in paragraph 10.10.1.23 onwards. Overall, based on evidence from studies and reviews, Atlantic puffin is deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Northern gannet

10.10.1.48 Evidence of northern gannet sensitivity to displacement from the construction phase of offshore wind farms is summarised in paragraph 10.10.1.30 onwards. Based on evidence from operational wind farms demonstrating that northern gannet show a high avoidance of offshore wind farms, this species is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Black-legged kittiwake

10.10.1.49 Evidence of black-legged kittiwake sensitivity to displacement from the construction phase of offshore wind farms is summarised in paragraph 10.10.1.37 onwards. For kittiwake, there is evidence from other operating offshore wind farm projects that displacement is not likely to occur to any significant level. However, due to low reproductive rates, black-legged kittiwake is deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of effect

Common guillemot

10.10.1.50 Overall, the magnitude of the displacement impact during construction is deemed to be negligible and the sensitivity of the receptor is medium. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

Razorbill

10.10.1.51 Overall, the magnitude of the displacement impact during construction is deemed to be low and the sensitivity of the receptor is medium. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

Atlantic puffin

10.10.1.52 Overall, the magnitude of the displacement impact during construction is deemed to be negligible and the sensitivity of the receptor is high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Northern gannet

10.10.1.53 Overall, the magnitude of the displacement impact during construction is deemed to be negligible and the sensitivity of the receptor is medium. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

Black-legged kittiwake

10.10.1.54 Overall, the magnitude of the displacement impact during construction is deemed to be negligible and the sensitivity of the receptor is medium. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

Tier 1 and Tier 2

Operations and maintenance phase

Magnitude of impact

Common guillemot

10.10.1.55 The estimated cumulative abundance of guillemots from the relevant projects with available data is presented in Table 10.73.

Table 10.73: Guillemot cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Cumulative Abundance	Breeding Season Cumulative Abundance	Non-breeding Season Cumulative Abundance
Tier 1			
Barrow	unknown	unknown	unknown
Burbo Bank	unknown	unknown	unknown
Burbo Bank Extension	5,963	2,414	3,549
North Hoyle	unknown	unknown	unknown
Ormonde	238	238	unknown
Walney 1 + 2	unknown	unknown	unknown
Walney 3 + 4	6,093	4,167	1,926
West of Duddon Sands	833	347	486
Gwynt y Môr	unknown	unknown	unknown
Rhyl Flats	unknown	unknown	unknown
Robin Rigg	28	28	unknown
Arklow Bank Phase 1	unknown	unknown	unknown
Awel y Môr	4,488	1,569	2,919
Erebus	18,882	3,558	15,324
Tier 2			
Morgan Generation Assets	8,994	unknown	unknown
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown
Oriel	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown
Llyr 1	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown
White Cross	unknown	unknown	unknown
Inis Eagla Marine Energy Park	unknown	unknown	unknown
Total (minus the Mona Offshore Wind Project)	**45,519**	**12,321**	**24,204**
Mona Offshore Wind Project	11,912	4,893	4,101
Cumulative total (all projects)	**57,431**	**17,214**	**28,305**

10.10.1.56 The following displacement matrices provide the estimated cumulative mortality of guillemot predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 10.74 to Table 10.76). The approach used for the cumulative displacement assessment follows that presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.74: Operations and maintenance phase cumulative guillemot mortality following displacement from offshore wind farms in the breeding season.

Common guillemot – Breeding. Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
10%	24	47	118	237	592	1,184	2,368
20%	47	95	237	474	1,184	2,368	4,735
30%	71	142	355	710	1,776	3,551	7,103
40%	95	189	474	947	2,368	4,735	9,470
50%	118	237	592	1,184	2,959	5,919	11,838
60%	142	284	710	1,421	3,551	7,103	14,205
70%	166	331	829	1,657	4,143	8,286	16,573
80%	189	379	947	1,894	4,735	9,470	18,940
90%	213	426	1,065	2,131	5,327	10,654	21,308
100%	237	474	1,184	2,368	5,919	11,838	23,675

Table 10.75: Operations and maintenance phase cumulative guillemot mortality following displacement from offshore wind farms in the non-breeding season.

Common guillemot – Non-breeding. Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
10%	34	68	169	338	844	1,688	3,376
20%	68	135	338	675	1,688	3,376	6,751
30%	101	203	506	1,013	2,532	5,063	10,127
40%	135	270	675	1,350	3,376	6,751	13,502
50%	169	338	844	1,688	4,220	8,439	16,878
60%	203	405	1,013	2,025	5,063	10,127	20,254
70%	236	473	1,181	2,363	5,907	11,815	23,629
80%	270	540	1,350	2,700	6,751	13,502	27,005
90%	304	608	1,519	3,038	7,595	15,190	30,380
100%	338	675	1,688	3,376	8,439	16,878	33,756

Table 10.76: Operations and maintenance phase cumulative guillemot mortality following displacement from offshore wind farms annually.

Common guillemot – Annual. Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
10%	57	115	287	574	1,436	2,872	5,743
20%	115	230	574	1,149	2,872	5,743	11,486
30%	172	345	861	1,723	4,307	8,615	17,229
40%	230	459	1,149	2,297	5,743	11,486	22,972
50%	287	574	1,436	2,872	7,179	14,358	28,716
60%	345	689	1,723	3,446	8,615	17,229	34,459
70%	402	804	2,010	4,020	10,050	20,101	40,202
80%	459	919	2,297	4,594	11,486	22,972	45,945
90%	517	1,034	2,584	5,169	12,922	25,844	51,688
100%	574	1,149	2,872	5,743	14,358	28,716	57,431

10.10.1.57 During the breeding season, the displacement from operation when using a displacement of 50% (range of 30 to 70%) and a mortality of 1% (range of 1 to 10%), results in an additional loss of 118 (71 to 1,657) individuals from the breeding population.

10.10.1.58 During the non-breeding season, the displacement from operation results in an additional loss of 169 (101 to 2,363) individuals from the non-breeding population (Table 10.75).

10.10.1.59 For the combined bio-seasons, the annual estimated mortality resulting from displacement during construction is 287 (172 to 4,020) individuals (Table 10.76).

10.10.1.60 Using the largest BDMPS population of 1,139,220 individuals and, using the average baseline mortality rate of 0.139 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR), the background predicted mortality would be 158,352. The addition of 287 (172 to 4,020) mortalities would increase the baseline mortality rate by 0.181 % (0.108 to 2.539%).

10.10.1.61 These numbers demonstrate that the operations and maintenance phase of the Mona Offshore Wind Project combined with the operations phase of the surrounding wind farms in the Irish Sea could cumulatively cause a significant impact to common guillemot populations if the upper range of displacement and mortality are used (displacement rate of 60% and mortality rate of 5% and above).

10.10.1.62 If the upper ranges of displacement and mortality are used, the predicted increase in baseline mortality of the BDMPS populations for common guillemot would exceed an increase of 1%, and as a first step to understand if further mitigation is required.

10.10.1.63 These impacts were assessed in volume 6, annex 10.6: Offshore ornithology population viability analysis (PVA) of the PEIR.

10.10.1.64 The PVA revealed that the most extreme scenario of 70% displacement and 10% mortality would reduce the population growth rate by 0.393% which would result in a maximum decrease in population size by 13.208%. The more likely scenario of 50% displacement and 1% mortality resulted in a growth rate reduction of 0.028% resulting in a 1.004% decrease in population size after 35 years.

10.10.1.65 Regardless of whether the most likely displacement and mortality scenario (50% and 1%) or the maximum scenario (70% and 30%) is utilised, the common guillemot population in the UK Western waters BDMPS is observed to be growing. It is assumed therefore that despite any additional mortality, the population is still expected to continue to grow and will be larger after 35 years than that what is currently recorded.

10.10.1.66 The reduction in growth rate by between 0.017 to 0.393% (depending on the displacement and mortality rate used) would not trigger a risk of population decline and would only result in a slight reduction in the growth rate currently seen in the BDMPS population, which is not significant in EIA terms.

10.10.1.67 Due to the minimal level of change to baseline conditions, the cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Razorbill

10.10.1.68 The estimated cumulative abundance of razorbill from the relevant projects with available data is presented in Table 10.77.

Table 10.77: Razorbill cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Cumulative Abundance	Pre-breeding Cumulative Abundance	Breeding Season Cumulative Abundance	Post-breeding Cumulative Abundance	Non-breeding Cumulative Abundance
Tier 1					
Barrow	unknown	unknown	unknown	unknown	unknown
Burbo Bank	unknown	unknown	unknown	unknown	unknown
Burbo Bank Extension	unknown	unknown	unknown	unknown	unknown
North Hoyle	2,354	534	193	375	1,252
Ormonde	unknown	unknown	unknown	unknown	unknown
Walney 1 + 2	85	85	unknown	unknown	unknown
Walney 3 + 4	unknown	unknown	unknown	unknown	unknown
West of Duddon Sands	3,938	0	873	3,065	0
Gwynt y Môr	455	91	121	152	91
Rhyl Flats	unknown	unknown	unknown	unknown	unknown
Robin Rigg	7	7	unknown	unknown	unknown
Arklow Bank Phase 1	unknown	unknown	unknown	unknown	unknown
Awel y Môr	692	336	140	66	150
Erebus	2,357	460	103	1228	566
Tier 2					
Morgan Generation Assets	622	166	120	103	233
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown	unknown	unknown
Oriel	unknown	unknown	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown	unknown	unknown
Llyr 1	unknown	unknown	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown	unknown	unknown
White Cross	unknown	unknown	unknown	unknown	unknown
Inis Eagla Marine Energy Park	unknown	unknown	unknown	unknown	unknown
Total (minus the Mona Offshore Wind Project)	**10,510**	**1,679**	**1,550**	**4,989**	**2,292**
Mona Offshore Wind Project	2,883	2,283	173	140	287
Cumulative total (all projects)	**13,393**	**3,962**	**1,723**	**5,129**	**2,579**

10.10.1.69 The following displacement matrices provide the estimated cumulative mortality of razorbill predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 10.78 to Table 10.82). The approach used for the cumulative displacement assessment follows that presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.78: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the pre-breeding season.

Razorbill – Pre-breeding	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
10%	4	8	20	40	99	198	396
20%	8	16	40	79	198	396	792
30%	12	24	59	119	297	594	1189
40%	16	32	79	158	396	792	1585
50%	20	40	99	198	495	991	1981
60%	24	48	119	238	594	1189	2377
70%	28	55	139	277	693	1387	2773
80%	32	63	158	317	792	1585	3170
90%	36	71	178	357	891	1783	3566
100%	40	79	198	396	991	1981	3962

Table 10.79: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the breeding season.

Razorbill – Breeding	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
10%	2	3	9	17	43	86	172
20%	3	7	17	34	86	172	345
30%	5	10	26	52	129	258	517
40%	7	14	34	69	172	345	689
50%	9	17	43	86	215	431	862
60%	10	21	52	103	258	517	1,034
70%	12	24	60	121	302	603	1,206
80%	14	28	69	138	345	689	1,378
90%	16	31	78	155	388	775	1,551
100%	17	34	86	172	431	862	1,723

Table 10.80: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the post-breeding season.

Razorbill – Post-breeding	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
10%	5	10	26	51	128	256	513
20%	10	21	51	103	256	513	1,026
30%	15	31	77	154	385	769	1,539
40%	21	41	103	205	513	1,026	2,052
50%	26	51	128	256	641	1,282	2,565
60%	31	62	154	308	769	1,539	3,077
70%	36	72	180	359	898	1,795	3,590
80%	41	82	205	410	1,026	2,052	4,103
90%	46	92	231	462	1,154	2,308	4,616
100%	51	103	256	513	1,282	2,565	5,129

Table 10.81: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the non-breeding season.

Razorbill – Non-breeding	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
10%	3	5	13	26	64	129	258
20%	5	10	26	52	129	258	516
30%	8	15	39	77	193	387	774
40%	10	21	52	103	258	516	1,032
50%	13	26	64	129	322	645	1,290
60%	15	31	77	155	387	774	1,547
70%	18	36	90	181	451	903	1,805
80%	21	41	103	206	516	1,032	2,063
90%	23	46	116	232	580	1,161	2,321
100%	26	52	129	258	645	1,290	2,579

Table 10.82: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms annually.

Razorbill Annual	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
10%	13	27	67	134	335	670	1,339
20%	27	54	134	268	670	1,339	2,679
30%	40	80	201	402	1,004	2,009	4,018
40%	54	107	268	536	1,339	2,679	5,357
50%	67	134	335	670	1,674	3,348	6,697
60%	80	161	402	804	2,009	4,018	8,036
70%	94	188	469	938	2,344	4,688	9,375
80%	107	214	536	1,071	2,679	5,357	10,714
90%	121	241	603	1,205	3,013	6,027	12,054
100%	134	268	670	1,339	3,348	6,697	13,393

10.10.1.70 During the spring migration (pre-breeding) season the displacement from operation when using the displacement of 50% (range of 30 to 70%) and a mortality rate of 1% (range of 1 to 10%), results in an additional loss of 20 (12 to 277) individuals (Table 10.78).

10.10.1.71 During the breeding season, displacement from operation results in the loss of nine (5 to 121) individuals from the breeding population (Table 10.78).

10.10.1.72 During the autumn migration season (post-breeding), displacement from operation results in a loss of 26 (15 to 359) individuals from the migratory population (Table 10.80).

10.10.1.73 During the non-breeding season (winter season), displacement from operation results a in a loss of 13 (8 to 181) individuals from the non-breeding population (Table 10.81).

10.10.1.74 The annual estimated mortality resulting from displacement during construction is 67 (40 to 938 individuals) (Table 10.82).

10.10.1.75 Using the largest BDMPS population of 606,914 individuals and, using the average baseline mortality rate of 0.174 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR), the background predicted mortality would be 105,603. The addition of 67 (40 to 938 individuals) mortalities would increase the baseline mortality rate by 0.063% (0.038 to 0.888%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

10.10.1.76 The cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Atlantic puffin

10.10.1.77 The estimated cumulative abundance of Atlantic puffin from the relevant projects is presented in Table 10.83. There are a number of projects for which there are no, or limited, data on the number of Atlantic puffin predicted to be displaced, in particular, for some of the earlier developments.

Table 10.83: Atlantic puffin cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Cumulative Abundance	Breeding Season Cumulative Abundance	Non-breeding Season Cumulative Abundance
Tier 1			
Barrow	unknown	unknown	unknown
Burbo Bank	unknown	unknown	unknown
Burbo Bank Extension	**10**	10	0
North Hoyle	unknown	unknown	unknown
Ormonde	1	1	unknown
Walney 1 + 2	unknown	unknown	unknown
Walney 3 + 4	172	53	119
West of Duddon Sands	96	61	35
Gwynt y Môr	unknown	unknown	unknown
Rhyl Flats	unknown	unknown	unknown
Robin Rigg	0	0	0
Arklow Bank Phase 1	unknown	unknown	unknown
Awel y Môr	unknown	unknown	unknown
Erebus	481	449	32
Tier 2			
Morgan Generation Assets	18	18	0
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown
Oriel	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown

Project	Annual Cumulative Abundance	Breeding Season Cumulative Abundance	Non-breeding Season Cumulative Abundance
Llyr 1	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown
White Cross	unknown	unknown	unknown
Inis Eagla Marine Energy Park	unknown	unknown	unknown
Total (minus the Mona Offshore Wind Project)	**778**	**592**	**186**
Mona Offshore Wind Project	30	16	14
Cumulative total (all projects)	**808**	**608**	**200**

10.10.1.78 The following displacement matrices provide the estimated cumulative mortality of Atlantic puffin predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 10.84 to Table 10.86). The approach used for the cumulative displacement assessment follows that of the project alone displacement assessment volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.84: Operations and maintenance phase cumulative Atlantic puffin mortality following displacement from offshore wind farms in the breeding season.

Atlantic puffin – Breeding Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
10%	1	1	3	6	15	30	61
20%	1	2	6	12	30	61	122
30%	2	4	9	18	46	91	182
40%	2	5	12	24	61	122	243
50%	3	6	15	30	76	152	304
60%	4	7	18	36	91	182	365
70%	4	9	21	43	106	213	426
80%	5	10	24	49	122	243	486
90%	5	11	27	55	137	274	547
100%	6	12	30	61	152	304	608

Table 10.85: Operations and maintenance phase cumulative Atlantic puffin mortality following displacement from offshore wind farms in the non-breeding season.

Atlantic puffin – Non-breeding Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
10%	0	0	1	2	5	10	20
20%	0	1	2	4	10	20	40
30%	1	1	3	6	15	30	60
40%	1	2	4	8	20	40	80
50%	1	2	5	10	25	50	100
60%	1	2	6	12	30	60	120
70%	1	3	7	14	35	70	140
80%	2	3	8	16	40	80	160
90%	2	4	9	18	45	90	180
100%	2	4	10	20	50	100	200

Table 10.86: Operations and maintenance phase cumulative Atlantic puffin mortality following displacement from offshore wind farms annually.

Atlantic puffin – Annual Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality): 1%	2%	5%	10%	25%	50%	100%
10%	1	2	4	8	20	40	81
20%	2	3	8	16	40	81	162
30%	2	5	12	24	61	121	242
40%	3	6	16	32	81	162	323
50%	4	8	20	40	101	202	404
60%	5	10	24	48	121	242	485
70%	6	11	28	57	141	283	566
80%	6	13	32	65	162	323	646
90%	7	15	36	73	182	364	727
100%	8	16	40	81	202	404	808

10.10.1.79 During the breeding season, the displacement from operation when using the displacement rate of 50% (range of 30 to 70%) and a mortality rate of 1% (range of 1 to 10%), results in an additional loss of three (2 to 43) individuals from the breeding population (Table 10.84).

10.10.1.80 During the non-breeding season, the displacement from operation results in an additional loss of one (1 to 14) individuals from the non-breeding population (Table 10.85).

10.10.1.81 The annual estimated mortality resulting from displacement during construction is four (2 to 57) individuals (Table 10.86).

10.10.1.82 Using the largest BDMPS of 304,557 individuals and, using the average baseline mortality rate of 0.181 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR) the background estimated mortality across all seasons is 55,125. The addition of four (2 to 57) mortalities would increase the baseline mortality rate by 0.007 % (0.002 to 0.103%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

10.10.1.83 The cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Northern gannet

10.10.1.84 The estimated cumulative abundance of northern gannet from the relevant projects is presented in Table 10.87. There are a number of projects for which there are no, or limited, data on the number of northern gannet predicted to be displaced, in particular, for some of the earlier developments.

Table 10.87: Northern gannet cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Cumulative Abundance	Breeding Season Cumulative Abundance	Non-breeding Season Cumulative Abundance
Tier 1			
Barrow	unknown	unknown	unknown
Burbo Bank	unknown	unknown	unknown
Burbo Bank Extension	unknown	unknown	unknown
North Hoyle	unknown	unknown	unknown
Ormonde	unknown	unknown	unknown
Walney 1 + 2	unknown	unknown	unknown
Walney 3 + 4	unknown	unknown	unknown
West of Duddon Sands	unknown	unknown	unknown
Gwynt y Môr	unknown	unknown	unknown
Rhyl Flats	unknown	unknown	unknown
Robin Rigg	unknown	unknown	unknown
Arklow Bank Phase 1	unknown	unknown	unknown
Awel y Môr	529	0	328
Erebus	658	224	334
Tier 2			
Morgan Generation Assets	454	53	209
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown
Oriel	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown
Llyr 1	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown
White Cross	unknown	unknown	unknown
Inis Eagla Marine Energy Park	unknown	unknown	unknown
Total (minus the Mona Offshore Wind Project)	**1,641**	**277**	**871**
Mona Offshore Wind Project	693	105	351
Cumulative total (all projects)	2,334	382	1,222

10.10.1.85 The following displacement matrices provide the estimated cumulative mortality of northern gannet predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (Table 10.88 to Table 10.91). The approach used for the cumulative displacement assessment follows that of the project alone displacement assessment volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.88: Operations and maintenance phase cumulative northern gannet mortality following displacement from offshore wind farms in the pre-breeding season.

Northern gannet Pre-Breeding	Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality) 1%	2%	5%	10%	25%	50%	100%
	10%	0	1	2	4	10	19	38
	20%	1	2	4	8	19	38	76
	30%	1	2	6	11	29	57	115
	40%	2	3	8	15	38	76	153
	50%	2	4	10	19	48	96	191
	60%	2	5	11	23	57	115	229
	70%	3	5	13	27	67	134	267
	80%	3	6	15	31	76	153	306
	90%	3	7	17	34	86	172	344
	100%	4	8	19	38	96	191	382

Table 10.89: Operations and maintenance phase cumulative northern gannet mortality following displacement from offshore wind farms in the breeding season.

Northern gannet Breeding	Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality) 1%	2%	5%	10%	25%	50%	100%
	10%	1	2	6	12	31	61	122
	20%	2	5	12	24	61	122	244
	30%	4	7	18	37	92	183	367
	40%	5	10	24	49	122	244	489
	50%	6	12	31	61	153	306	611
	60%	7	15	37	73	183	367	733
	70%	9	17	43	86	214	428	855
	80%	10	20	49	98	244	489	978
	90%	11	22	55	110	275	550	1100
	100%	12	24	61	122	306	611	1222

Table 10.90: Operations and maintenance phase cumulative norther gannet mortality following displacement from offshore wind farms in the post- breeding season.

Northern gannet Post-breeding	Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality) 1%	2%	5%	10%	25%	50%	100%
	10%	1	1	4	7	18	37	73
	20%	1	3	7	15	37	73	146
	30%	2	4	11	22	55	110	219
	40%	3	6	15	29	73	146	292
	50%	4	7	18	37	91	183	365
	60%	4	9	22	44	110	219	438
	70%	5	10	26	51	128	256	511
	80%	6	12	29	58	146	292	584
	90%	7	13	33	66	164	329	657
	100%	7	15	37	73	183	365	730

Table 10.91: Operations and maintenance phase cumulative northern gannet mortality following displacement from offshore wind farms annually.

Northern gannet Annual	Displacement level (% at risk of displacement)	Mortality level (% of displaced birds at risk of mortality) 1%	2%	5%	10%	25%	50%	100%
	10%	2	5	12	23	58	117	233
	20%	5	9	23	47	117	233	467
	30%	7	14	35	70	175	350	700
	40%	9	19	47	93	233	467	934
	50%	12	23	58	117	292	584	1,167
	60%	14	28	70	140	350	700	1,400
	70%	16	33	82	163	408	817	1,634
	80%	19	37	93	187	467	934	1,867
	90%	21	42	105	210	525	1,050	2,101
	100%	23	47	117	233	584	1,167	2,334

10.10.1.86 During the spring migration (pre-breeding) season the displacement from operation when using the displacement rate of 70% (range of 60 to 80%) and a mortality rate of 1% (range of 1 to 10%), results in an additional loss of three (2 to 31) individuals (Table 10.88).

10.10.1.87 During the breeding season, displacement from operation results in the loss of nine (7 to 98) individuals from the breeding population (Table 10.88).

10.10.1.88 During the autumn migration season (post-breeding), displacement from operation results in a loss of five (4 to 58) individuals from the migratory population (Table 10.90).

10.10.1.89 The annual estimated mortality resulting from displacement during construction is 16 (14 to 187) individuals (Table 10.91).

10.10.1.90 Using the largest UK Western Waters BDMPS population of 661,888 individuals, with an average baseline mortality rate of 0.187 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR), the background predicted mortality would be 123,773. The addition of 16 (14 to 187) mortalities would increase the baseline mortality rate by 0.013% (0.011 to 0.151%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

10.10.1.91 The cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Black-legged kittiwake

10.10.1.92 The estimated cumulative abundance of black-legged kittiwake from the relevant projects is presented in Table 10.92. There are several projects for which there are no, or limited, data on the number of black-legged kittiwake predicted to be displaced, in particular, for some of the earlier developments

Table 10.92: Black-legged kittiwake cumulative abundances for offshore wind projects for disturbance and displacement assessment during the operations and maintenance phase.

Project	Annual Cumulative Abundance	Pre-breeding Cumulative Abundance	Breeding Season Cumulative Abundance	Post-breeding Cumulative Abundance
Tier 1				
Barrow	unknown	unknown	unknown	unknown
Burbo Bank	unknown	unknown	unknown	unknown
Burbo Bank Extension	unknown	unknown	unknown	unknown
North Hoyle	unknown	unknown	unknown	unknown
Ormonde	unknown	unknown	unknown	unknown
Walney 1 + 2	unknown	unknown	unknown	unknown
Walney 3 + 4	unknown	unknown	unknown	unknown
West of Duddon Sands	unknown	unknown	unknown	unknown
Gwynt y Môr	unknown	unknown	unknown	unknown
Rhyl Flats	unknown	unknown	unknown	unknown
Robin Rigg	unknown	unknown	unknown	unknown
Arklow Bank Phase 1	unknown	unknown	unknown	unknown
Awel y Môr	unknown	unknown	unknown	unknown
Erebus	2,532	2	2,022	508
Tier 2				
Morgan Generation Assets	2,724	645	460	1,619
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown	unknown
Oriel	unknown	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown	unknown
Llyr 1	unknown	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown	unknown
White Cross	unknown	unknown	unknown	unknown
Inis Eagla Marine Energy Park	unknown	unknown	unknown	unknown
Total (minus the **Mona** Offshore Wind Project**)**	**5,256**	**647**	**2,482**	**2,127**
Mona Offshore Wind Project	2,397	1,135	479	783
Cumulative total (all projects)	**7,653**	**1,782**	**2,961**	**2,910**

10.10.1.93 The following displacement matrices provide the estimated cumulative mortality of black-legged kittiwake predicted to occur due to displacement, as determined by the relevant specified rates of displacement and mortality (

10.10.1.94 Table 10.93 to Table 10.96). The approach used for the cumulative displacement assessment follows that presented in volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR.

Table 10.93: Operations and maintenance phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the pre-breeding season.

Black-legged kittiwake Pre-breeding	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
10%	2	4	9	18	45	89	178
20%	4	7	18	36	89	178	356
30%	5	11	27	53	134	267	535
40%	7	14	36	71	178	356	713
50%	9	18	45	89	223	446	891
60%	11	21	53	107	267	535	1,069
70%	12	25	62	125	312	624	1,247
80%	14	29	71	143	356	713	1,426
90%	16	32	80	160	401	802	1,604
100%	18	36	89	178	446	891	1,782

Table 10.94: Operations and maintenance phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the breeding season.

Black-legged kittiwake Breeding	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
10%	3	6	15	30	74	148	296
20%	6	12	30	59	148	296	592
30%	9	18	44	89	222	444	888
40%	12	24	59	118	296	592	1,184
50%	15	30	74	148	370	740	1,481
60%	18	36	89	178	444	888	1,777
70%	21	41	104	207	518	1,036	2,073
80%	24	47	118	237	592	1,184	2,369
90%	27	53	133	266	666	1,332	2,665
100%	30	59	148	296	740	1,481	2,961

Table 10.95: Operations and maintenance phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms in the post-breeding season.

Black-legged kittiwake Post-breeding	Mortality level (% of displaced birds at risk of mortality)						
Displacement level (% at risk of displacement)	1%	2%	5%	10%	25%	50%	100%
10%	3	6	15	29	73	146	291
20%	6	12	29	58	146	291	582
30%	9	17	44	87	218	437	873
40%	12	23	58	116	291	582	1,164
50%	15	29	73	146	364	728	1,455
60%	17	35	87	175	437	873	1,746
70%	20	41	102	204	509	1,019	2,037
80%	23	47	116	233	582	1,164	2,328
90%	26	52	131	262	655	1,310	2,619
100%	29	58	146	291	728	1,455	2,910

Table 10.96: Operations and maintenance phase cumulative black-legged kittiwake mortality following displacement from offshore wind farms annually.

Black-legged kittiwake Annual		Mortality level (% of displaced birds at risk of mortality)						
		1%	2%	5%	10%	25%	50%	100%
Displacement level (% at risk of displacement)	10%	8	15	38	77	191	383	765
	20%	15	31	77	153	383	765	1,531
	30%	23	46	115	230	574	1,148	2,296
	40%	31	61	153	306	765	1,531	3,061
	50%	38	77	191	383	957	1,913	3,827
	60%	46	92	230	459	1,148	2,296	4,592
	70%	54	107	268	536	1,339	2,679	5,357
	80%	61	122	306	612	1,531	3,061	6,122
	90%	69	138	344	689	1,722	3,444	6,888
	100%	77	153	383	765	1,913	3,827	7,653

10.10.1.95 During the spring migration (pre-breeding) season the displacement from operation when using the displacement rate of 50% (range of 30 to 70%) and a mortality rate of 1% (range of 1 to 10%), results in an additional loss of nine (5 to 125) individuals (Table 10.94).

10.10.1.96 During the autumn migration season (post-breeding), displacement from operation results in a loss of 15 (9 to 204) individuals from the migratory population (Table 10.95).

10.10.1.97 The annual estimated mortality resulting from displacement during construction is 38 (23 to 536) individuals (Table 10.96).

10.10.1.98 Using the largest UK Western Waters BDMPS population of 911,586 individuals, with an average baseline mortality rate of 0.157 (population and rates taken from volume 6, annex 10.2: Offshore ornithology displacement assessment of the PEIR), the background predicted mortality would be 143,119. The addition of 38 (23 to 536) mortalities would increase the baseline mortality rate by 0.028 % (0.016% to 0.374%). The annual predicted mortality from the cumulative assessment is below the 1% threshold increase in baseline mortality.

10.10.1.99 The cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Sensitivity of the receptor

Common guillemot

10.10.1.100 Evidence of guillemot sensitivity to displacement from offshore wind farms is summarised from paragraph 10.10.1.55 onwards. Common guillemot is deemed to be of medium vulnerability, medium recoverability and medium value. Overall, based on evidence from post-construction studies and reviews, guillemot is deemed to be of medium vulnerability, medium recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Razorbill

10.10.1.101 Evidence of razorbill sensitivity to displacement from offshore wind farms is summarised from paragraph 10.10.1.68 onwards. Overall, based on evidence from post-construction studies and reviews, razorbill is deemed to be of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Atlantic puffin

10.10.1.102 Evidence of Atlantic puffin sensitivity to displacement from offshore wind farms is summarised from paragraph 10.10.1.77 onwards. Overall, based on evidence from post-construction studies and reviews, Atlantic puffin is deemed to be of medium vulnerability, low recoverability and high value. The sensitivity of the receptor is therefore, considered to be **high**.

Northern gannet

10.10.1.103 Evidence of Northern gannet sensitivity to displacement from offshore wind farms is summarised from paragraph 10.10.1.84 onwards. Based on evidence from operational wind farms demonstrating that Northern gannet show a high avoidance of offshore wind farms, Northern gannet is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Black-legged kittiwake

10.10.1.104 Evidence of black-legged kittiwake sensitivity to displacement from offshore wind farms is summarised from paragraph 10.10.1.92 onwards. For kittiwake, there is evidence from other operating offshore wind farm projects that displacement is not likely to occur to any significant level. However, due to low reproductive rates, black-legged kittiwake is deemed to be of low vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of effect

Common guillemot

10.10.1.105 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Razorbill

10.10.1.106 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

Atlantic puffin

10.10.1.107 Overall, the magnitude of the impact is deemed to be low and the sensitivity of the receptor is considered to be high. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Northern gannet

10.10.1.108 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

Black-legged kittiwake

10.10.1.109 Overall, the magnitude of the impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **negligible** adverse significance, which is not significant in EIA terms.

Decommissioning phase

10.10.1.110 During the decommissioning phase, cumulative disturbance and displacement of red-throated divers, guillemots and razorbills would only occur if these activities occur at the same time across wind farms. Disturbance effects during the decommissioning phase are anticipated to be like construction, if the decommissioning schedule of the Mona Offshore Wind Project will overlap with that for the other wind farms within the CEA study area. The magnitude of impact would be negligible, with significance ranging from **negligible** to **minor** depending on the species, which is not significant in EIA terms.

10.10.2 Collision risk

Tier 1 and Tier 2

Operations and maintenance phase

Magnitude of impact

10.10.2.1 The Mona Offshore Wind Project, together with other offshore wind farms in the Irish Sea, may contribute to cumulative collision risk, in the event the operations and maintenance phases of different projects overlap. Seabirds are highly mobile, therefore they can encounter different offshore wind farms, and be at risk of collisions, across large areas.

10.10.2.2 As stated, data used within the assessing cumulative collision risk is based on published information produced by the respective project developers. As such, the input parameters (e.g. avoidance rates) and the collision risk model used (e.g. deterministic) may vary from those put forward in this chapter.

The expected mean annual collision mortality has been compiled from relevant wind farms and is shown in Table 10.97.

Table 10.97: Expected annual collision mortality across relevant wind farms for the five species considered (KI = black-legged kittiwake, GB = great black-backed gull, LB = lesser black-backed gull, HG = herring gull, GX = northern gannet).

Project	KI collisions	GB collisions	LB collisions	HG collisions	GX collisions
Tier 1					
Barrow	unknown	unknown	unknown	unknown	unknown
Burbo Bank	unknown	unknown	2.0	unknown	unknown
Burbo Bank Extension	35.2	unknown	44.0	23.8	18.7
North Hoyle	unknown	unknown	1.0	unknown	unknown
Ormonde	5.0	unknown	22.1	3.3	10.3
Walney 1 + 2	unknown	unknown	28.6	unknown	unknown
Walney 3 + 4	187.6	28.2	28.3	54.5	37.4
West of Duddon Sands	unknown	unknown	26.2	unknown	unknown
Gwynt y Môr	unknown	unknown	5.0	unknown	unknown
Rhyl Flats	unknown	unknown	1.0	unknown	unknown
Robin Rigg	unknown	unknown	unknown	unknown	unknown
Arklow Bank Phase 1	unknown	unknown	unknown	unknown	unknown
Awel y Môr	93.7	9.8	unknown	4.0	36.3
Erebus	58.0	1.0	6.0	3.0	116.0
Tier 2					
Morgan Generation Assets	39.8	2.8	1.0	11.8	2.1
Morecambe Offshore Windfarm Generation Assets	unknown	unknown	unknown	unknown	unknown
North Irish Sea Array	unknown	unknown	unknown	unknown	unknown
Codling Wind Park	unknown	unknown	unknown	unknown	unknown
Dublin Array	unknown	unknown	unknown	unknown	unknown
Oriel	unknown	unknown	unknown	unknown	unknown
Arklow Bank Phase 2	unknown	unknown	unknown	unknown	unknown
Shelmalere	unknown	unknown	unknown	unknown	unknown
Llyr 1	unknown	unknown	unknown	unknown	unknown
Llyr 2	unknown	unknown	unknown	unknown	unknown
White Cross	unknown	unknown	unknown	unknown	unknown

Project	KI collisions	GB collisions	LB collisions	HG collisions	GX collisions
Inis Eagla Marine Energy Park	unknown	unknown	unknown	unknown	unknown
Total (minus the Mona Offshore Wind Project)	**419.3**	**41.8**	**165.2**	**100.4**	**220.8**
Mona Offshore Wind Project	37.1	7.4	1.9	2.0	2.5
Cumulative total (all projects)	**456.4**	**49.2**	**167.1**	**102.4**	**223.3**

Black-legged kittiwake

10.10.2.3 The estimated cumulative collision mortality of black-legged kittiwake from the relevant projects with available data is 456.4 per year (Table 10.97).

10.10.2.4 Using the largest UK Western Waters BDMPS population of 911,586 individuals, with an average baseline mortality rate of 0.157 (population and rates taken from volume 6, annex 10.3: Offshore ornithology non-migratory collision risk assessment of the PEIR), the background predicted mortality would be 143,119. The addition of 456.4 mortalities would increase the baseline mortality rate by 0.319%. The annual predicted mortality from the cumulative collision risk assessment is below the 1% threshold increase in baseline mortality.

10.10.2.5 The cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Great black-backed gull

10.10.2.6 The estimated cumulative collision mortality of great black-backed gull from the relevant projects with available data is 49.2 per year (Table 10.97).

10.10.2.7 Using the smallest BDMPS (UK southwest and Channel Waters BDMPS) of 17,742 individuals, with an average baseline mortality rate of 0.096 (population and rates taken from volume 6, annex 10.3: Offshore ornithology non-migratory collision risk assessment of the PEIR), the background predicted mortality would be 1,703. The addition of 49.2 mortalities would increase the baseline mortality rate by 2.889%.

10.10.2.8 Therefore, the operations and maintenance phase of the Mona Offshore Wind Project, combined with the operations phase of the surrounding wind farms in the Irish Sea could cumulatively cause a significant impact to great black-backed gull populations.

10.10.2.9 As the predicted increase in baseline mortality of the BDMPS populations for great black-backed gull exceeds an increase of 1% as a first step to understand if further mitigation is required, impacts were assessed in volume 6, annex 10.6: Offshore ornithology population viability analysis (PVA) of the PEIR.

10.10.2.10 The PVA revealed that the addition of great black-backed gull collision impacts from cumulative wind farms would reduce the growth rate of the smallest BDMPS population (UK South-West and English Channel BDMPS) by no more than 0.410%. The model also predicts a positive rate of growth for the population based on growth rate of 1.026 per annum at that level of impact, compared to 1.028 within the unimpacted population.

10.10.2.11 It is assumed that despite any additional mortality, the population is still expected to continue to grow and will be larger after 35 years than that what is currently recorded. The reduction in growth rate by 0.334% (LCI; 0.292 to UCI;0.410%) would not trigger a risk of population decline and would only result in a slight reduction in the growth rate currently seen in the BDMPS population.

10.10.2.12 Due to the minimal level of change to baseline conditions, the cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Herring gull

10.10.2.13 The estimated cumulative collision mortality of herring gull from the relevant projects with available data is 99.4 per year (Table 10.97).

10.10.2.14 Using the largest UK Western Waters BDMPS population of 173,299 individuals, with an average baseline mortality rate of 0.172 (population and rates taken from volume 6, annex 10.3: Offshore ornithology non-migratory collision risk assessment of the PEIR), the background predicted mortality would be 29,807. The addition of 99.4 mortalities would increase the baseline mortality rate by 0.343%. The annual predicted mortality from the cumulative collision risk assessment is below the 1% threshold increase in baseline mortality.

10.10.2.15 The cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Lesser black-backed gull

10.10.2.16 The estimated cumulative collision mortality of lesser black-backed gull from the relevant projects with available data is 161.1 per year (Table 10.97).

10.10.2.17 Using the largest UK Western Waters BDMPS population of 163,304 individuals, with an average baseline mortality rate of 0.124 (population and rates taken from volume 6, annex 10.3: Offshore ornithology non-migratory seabird collision risk assessment of the PEIR), the background predicted mortality would be 20,250. The addition of 161.1 mortalities would increase the baseline mortality rate by 0.825%. The annual predicted mortality from the cumulative collision risk assessment is below the 1% threshold increase in baseline mortality.

10.10.2.18 The cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low**.

Northern gannet

10.10.2.19 The estimated cumulative collision mortality of northern gannet from the relevant projects with available data is 107.3 per year (Table 10.97).

10.10.2.20 Using the largest UK Western Waters BDMPS population of 661,888 individuals, with an average baseline mortality rate of 0.187 (population and rates taken from volume

6, annex 10.3: Offshore ornithology non-migratory collision risk assessment of the PEIR), the background predicted mortality would be 123,773. The addition of 107.3 mortalities would increase the baseline mortality rate by 0.180%. The annual predicted mortality from the cumulative collision risk assessment is well below the 1% threshold increase in baseline mortality.

10.10.2.21 The cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low.**

Sensitivity of the receptor

Black-legged kittiwake

10.10.2.22 Black-legged kittiwake was rated as relatively highly vulnerable to collision impacts by Wade *et al*. (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight.

10.10.2.23 Despite a higher reproductive success (i.e. laying two eggs and breeding until four years old) than most seabird species (Robinson, 2005), the species is deemed to have a low recoverability given the continuing decline in abundance observed between 1986 and 2018 in the UK (JNCC, 2020). During this period, breeding productivity has declined as the result of food shortage, although it has stabilised in recent years (JNCC, 2020).

10.10.2.24 Black-legged kittiwake is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of medium value.

10.10.2.25 Black-legged kittiwake is deemed to be of high vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **high**.

Great black-backed gull

10.10.2.26 Great black-backed gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight.

10.10.2.27 The abundance of breeding great black-backed gull in the UK has changed relatively little between census (JNCC, 2020). The species is deemed to have a medium recoverability due to a low reproductive success and the stable trend in breeding abundance.

10.10.2.28 As great black-backed gull is a qualifying feature of interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a non-SPA colony within range, the species is considered to be of medium value.

10.10.2.29 Great black-backed gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

European herring gull

10.10.2.30 European herring gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al*. (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight.

10.10.2.31 As European herring gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range) with multiple non-SPA colonies within range, the species is considered to be of medium value.

10.10.2.32 Although European herring gull have a relatively high reproductive success, breeding abundance is declining in the coastal natural nesting population, and this may be indicative of decline in the entire UK breeding population (JNCC, 2020). There is evidence that the urban nesting gull population has increased in recent years, but census of these sites is lacking to derive a UK wide trend that includes both the urban and natural populations. The species is therefore deemed to be of medium recoverability.

10.10.2.33 European herring gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium.**

Lesser black-backed gull

10.10.2.34 Lesser black-backed gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al*. (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight.

10.10.2.35 As lesser black-backed gull is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with multiple non-SPA colonies within range, the species is considered to be of medium value.

10.10.2.36 Although lesser black-backed gull has a relatively high reproductive success, the species breeding abundance has exhibited a downward trend over the last 15-20 years in the UK (JNCC, 2020). It must be noted that this trend excludes urban nesting gulls from the sample and, therefore, may not be representative of trends in the entire UK population. The species is deemed to be of medium recoverability.

10.10.2.37 Lesser black-backed gull is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Northern gannet

10.10.2.38 Although the latest scientific guidance showed the species to display a high level of macro-avoidance (Peschko *et al*., 2021), the species is rated as relatively vulnerable to collision impacts by Wade *et al*. (2016).

10.10.2.39 Northern gannet is a qualifying interest for several SPAs likely to be connected to the Mona Array Area (within the mean-max + SD foraging range), with a large non-SPA colony within close proximity (Monreith Cliffs and Scar Rocks), the species is therefore considered to be of medium value.

10.10.2.40 Although Northern gannet has a low reproductive success, the species is deemed to have a medium recoverability given the consistent increasing trend in abundance since the 1990s (JNCC, 2020). It is of note that the species has suffered from the outbreak of avian flu during the 2022 breeding season. The species is deemed to be of medium recoverability

10.10.2.41 Northern gannet is deemed to be of high vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

10.10.2.42 Overall, the magnitude of the cumulative impact is low for all species (Table 10.98). Although sensitivity of the receptor varies from medium to high, the effect is expected to be of **minor** adverse significance for all species, which is not significant in EIA terms. For black-legged kittiwake, minor was selected from the minor to moderate range due to the impact not exceeding a 1% increase in baseline mortality and hence, was not regarded as a moderate significance of effect.

Table 10.98: Table summarising the significance of effect of collision from cumulative impacts during the operations and maintenance phase.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Black-legged kittiwake	Low	High	**Minor, not significant in EIA terms**
Great black-backed gull	Low	Medium	**Minor, not significant in EIA terms**
European herring gull	Low	Medium	**Minor, not significant in EIA terms**
Lesser black-backed gull	Low	Medium	**Minor, not significant in EIA terms**
Northern gannet	Low	Medium	**Minor, not significant in EIA terms**

10.10.3 Combined displacement and collision risk

Tier 1 and Tier 2

Operations and maintenance phase

Magnitude of impact

10.10.3.1 For species such as black-legged kittiwake and northern gannet that are both adversely affected by displacement and collision during the operations and maintenance phase, impacts must be combined in order for the true magnitude of impact to be understood.

10.10.3.2 It is recognised that assessing these two potential impacts together could amount to double counting, as birds that are subject to displacement would not be subject to potential collision risk as they are already assumed to have not entered the array area. Equally, birds estimated to be subject to collision risk mortality would not be able to be subjected to displacement consequent mortality as well. As a more refined method to consider displacement and collision together whilst reducing any double counting of impacts is not agreed with SNCBs the precautionary and highly unlikely approach is presented in this assessment.

10.10.3.3 Outputs from the combined impact from displacement and collision from the Mona Offshore Wind Project, together with other offshore wind farms in the Irish Sea are tabulated and presented in Table 10.99.

Table 10.99: Black-legged kittiwake and northern gannet combined displacement and collision cumulative impacts.

Species	Annual displacement mortality	Annual collision mortality	Total combined annual impact
Black-legged kittiwake	38 (23 to 536)	456.4	494.4 (479.4 to 992.4)
Northern gannet	16 (14 to 187)	223.3	239.3 (237.3 to 410.3)

Black-legged kittiwake

10.10.3.4 The combined mortality for black-legged kittiwake from displacement and collision for the relevant projects with available data is 494.4 (479.4 to 992.4) individuals per annum.

10.10.3.5 Using the largest UK Western Waters BDMPS population of 911,586 individuals, with an average baseline mortality rate of 0.157 (population and rates taken from volume 6, annex 10.3: Offshore ornithology non-migratory collision risk assessment of the PEIR), the background predicted mortality would be 143,119. The addition of 494.4 (479.4 to 992.4) mortalities would increase the baseline mortality rate by 0.345% (0.335 to 0.693%). The annual predicted mortality from the combined cumulative displacement and collision risk assessment is below the 1% threshold increase in baseline mortality.

10.10.3.6 The combined cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low.**

Northern gannet

10.10.3.7 The combined mortality for Northern gannet from displacement and collision for the relevant projects with available data is 239.3 (237.3 to 410.3) individuals per annum.

10.10.3.8 Using the largest UK Western Waters BDMPS population of 661,888 individuals, with an average baseline mortality rate of 0.187 (population and rates taken from volume 6, annex 10.3: Offshore ornithology non-migratory collision risk assessment of the PEIR), the background predicted mortality would be 123,773. The addition of 239.3 (237.3 to 410.3) mortalities would increase the baseline mortality rate by 0.193 % (0.191 to 0.331%). The annual predicted mortality from the cumulative collision risk assessment is below the 1% threshold increase in baseline mortality.

10.10.3.9 The cumulative effect is predicted to be of national spatial extent, long term duration, continuous and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **low.**

Sensitivity of the receptor

Black-legged kittiwake

10.10.3.10 As seen in displacement and collision, black-legged kittiwake is deemed to be of overall medium vulnerability, low recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Northern gannet

10.10.3.11 As seen in displacement and collision, northern gannet is deemed to be overall of medium vulnerability, medium recoverability and medium value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

Black-legged kittiwake

10.10.3.12 Overall, the magnitude of the combined displacement and collision cumulative impact is low, and the sensitivity of the receptor is medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

Northern gannet

10.10.3.13 Overall, the magnitude of the combined displacement and collision cumulative impact is low and the sensitivity of the receptor is considered to be medium. The effect will, therefore, be of **minor** adverse significance, which is not significant in EIA terms.

10.11 Transboundary effects

10.11.1.1 A screening of transboundary impacts has been carried out and any potential for significant transboundary effects with regard to offshore ornithology from the Mona Offshore Wind Project upon the interests of other states has been assessed as part of the EIA. The potential transboundary impacts assessed within sections 10.9 and 10.10 of this technical report are summarised below:

- Disturbance and displacement (including impacts on species which may have connectivity to UK SPAs) during the construction, operations and maintenance, and decommissioning phases. Overall, the effect will be of negligible adverse to minor adverse significance, which is not significant in EIA terms
- Indirect disturbance and displacement resulting from changes to prey and habitats (including impacts on species which may have connectivity to UK SPAs) during the construction, operations and maintenance, and decommissioning phases. Overall, the effect will be of minor adverse significance, which is not significant in EIA terms
- Collision risk (including impacts on species which may have connectivity to UK SPAs) during the construction, operations and maintenance, and decommissioning phases. Overall, the effect will be of negligible to minor adverse significance, which is not significant in EIA terms
- Barrier effect (including impacts on species which may have connectivity to UK SPAs) during the construction, operations and maintenance, and decommissioning phases. Overall, the effect will be of negligible adverse significance, which is not significant in EIA terms.

10.12 Inter-related effects

10.12.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the Mona Offshore Wind Project (construction, operations and maintenance, and decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three phases (e.g. subsea noise effects from piling, operational turbines, vessels and decommissioning)
- Receptor-led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on offshore ornithology, such as displacement/disturbance, collision and increased concentrations of suspended sediments, may interact to produce a different, or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects.

10.12.1.2 A description of the likely interactive effects arising from the Mona Offshore Wind Project on offshore ornithology is provided in volume 2, chapter 15: Inter-related effects of the PEIR.

10.13 Summary of impacts, mitigation measures and monitoring

10.13.1.1 Information on offshore ornithology within the Offshore Ornithology study area was collected through review of available literature, other offshore wind farm assessments, UK statutory guidance, detailed analysis of the data collected during the site-specific aerial surveys and intertidal surveys, and consultation with relevant stakeholders.

- Table 10.100 presents a summary of the potential impacts, measures adopted as part of the project and residual effects in respect to offshore ornithology. The impacts assessed include: disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure, indirect impacts from underwater sound affecting prey species, temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs), collision risk and barrier to movement. Overall it is concluded that there will be no significant effects arising from the Mona Offshore Wind Project during the construction, operations and maintenance, or decommissioning phases
- Table 10.101 presents a summary of the potential cumulative impacts, mitigation measures and residual effects. The cumulative impacts assessed include: disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure and collision risk. Overall it is concluded that there are no significant cumulative effects to any species from the Mona Offshore Wind Project alongside other projects/plans.
- Potential transboundary impacts have been identified in relation to offshore ornithology. Overall, it is concluded that there will be no significant transboundary effects arising from the Mona Offshore Wind Project.

Table 10.100: Summary of potential environmental effects, mitigation and monitoring.

[a] C=construction, O=operations and maintenance , D=decommissioning

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure	✓	✓	✓	EMP that will include measures to minimise disturbance to rafting birds from transiting vessels.	Common guillemot C: Negligible O: Negligible D: Negligible Razorbill C: Negligible O: Negligible D: Negligible Atlantic puffin C: Negligible O: Negligible D: Negligible Northern gannet C: Negligible O: Negligible D: Negligible Black-legged kittiwake C: Negligible O: Negligible D: Negligible Manx shearwater C: Negligible O: Negligible D: Negligible Common scoter C: Negligible O: Negligible D: Negligible Red-throated diver C: Negligible O: Negligible D: Negligible	Common guillemot C: Medium O: Medium D: Medium Razorbill C: Medium O: Medium D: Medium Atlantic puffin C: High O: High D: High Northern gannet C: Medium O: Medium D: Medium Black-legged kittiwake C: Medium O: Medium D: Medium Manx shearwater C: Medium O: Medium D: Medium Common scoter C: High O: High D: High Red-throated diver C: High O: High D: High	Common guillemot C: Negligible adverse O: Negligible adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Atlantic puffin C: Minor adverse O: Minor adverse D: Minor adverse Northern gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse Black-legged kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Manx shearwater C: Negligible adverse O: Negligible adverse D: Negligible adverse Common scoter C: Minor adverse O: Minor adverse D: Minor adverse Red-throated diver C: Minor adverse O: Minor adverse D: Minor adverse	None	Common guillemot C: Negligible adverse O: Negligible adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Atlantic puffin C: Minor adverse O: Minor adverse D: Minor adverse Northern gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse Black-legged kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Manx shearwater C: Negligible adverse O: Negligible adverse D: Negligible adverse	None

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
									Common scoter C: Minor adverse O: Minor adverse D: Minor adverse Red-throated diver C: Minor adverse O: Minor adverse D: Minor adverse	
Indirect impacts from underwater sound affecting prey species	×	✓	×	None	Auk species C: Negligible D: Negligible	Auk species C: Medium D: Medium	Auk species C: Negligible adverse D: Negligible adverse	None	Auk species C: Negligible adverse D: Negligible adverse	None
Temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs)	✓	✓	✓	None	All receptors C: Negligible O: Negligible D: Negligible	All receptors C: Medium O: Medium D: Medium	All receptors C: Negligible adverse O: Negligible adverse D: Negligible adverse	None	All receptors C: Negligible adverse O: Negligible adverse D: Negligible adverse	None

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Collision risk	×	✓	×	Increasing air draught to reduce bird collision	Black-legged kittiwake O: Low Great black-backed gull O: Low European herring gull O: Negligible Lesser black-backed gull O: Negligible Northern gannet O: Negligible Northern fulmar O: Negligible Manx shearwater O: No change Migratory birds (non-seabirds) O: Negligible	Black-legged kittiwake O: High Great black-backed gull O: Medium European herring gull O: Medium Lesser black-backed gull O: Medium Northern gannet O: Medium Northern fulmar O: Medium Manx shearwater O: Medium Migratory birds (non-seabirds) O: Medium	Black-legged kittiwake O: Minor adverse Great black-backed gull O: Minor adverse European herring gull O: Negligible adverse Lesser black-backed gull O: Negligible adverse Northern gannet O: Negligible adverse Northern fulmar O: Negligible adverse Manx shearwater O: No change Migratory birds (non-seabirds) O: Negligible adverse	None	Black-legged kittiwake O: Minor adverse Great black-backed gull O: Minor adverse European herring gull O: Negligible adverse Lesser black-backed gull O: Negligible adverse Northern gannet O: Negligible adverse Northern fulmar O: Negligible adverse Manx shearwater O: No change Migratory birds (non-seabirds) O: Negligible adverse	None
Barrier to movement	×	✓	×	EMP that will include measures to minimise disturbance to rafting birds from transiting vessels	All receptors O: Negligible	All receptors O: Medium	All receptors O: Negligible adverse	None	All receptors O: Negligible adverse	None

Table 10.101: Summary of potential cumulative environmental effects, mitigation and monitoring.

[a] C=construction, O=operations and maintenance , D=decommissioning

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Significant residual effect	Proposed monitoring
Tier 1 and Tier 2										
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure	✓	✓	✓	EMP that will include measures to minimise disturbance to rafting birds from transiting vessels	Common guillemot C: Negligible O: Low D: Negligible Razorbill C: Negligible O: Negligible D: Negligible Atlantic puffin C: Negligible O: Low D: Negligible Northern gannet C: Negligible O: Negligible D: Negligible Black-legged kittiwake C: Negligible O: Negligible D: Negligible	Common guillemot C: Medium O: Medium D: Medium Razorbill C: Medium O: Medium D: Medium Atlantic puffin C: High O: High D: High Northern gannet C: Medium O: Medium D: Medium Black-legged kittiwake C: Medium O: Medium D: Medium	Common guillemot C: Negligible adverse O: Minor adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Atlantic puffin C: Minor adverse O: Minor adverse D: Minor adverse Northern gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse Black-legged kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse	None	Common guillemot C: Negligible adverse O: Minor adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Atlantic puffin C: Minor adverse O: Minor adverse D: Minor adverse Northern gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse Black-legged kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse	None
Collision Risk	×	✓	×	Increasing air draught to reduce bird collision	Black-legged kittiwake O: Low Great black-backed gull O: Medium European herring gull O: Low Lesser black-backed gull O: Low Northern gannet O: Low	Black-legged kittiwake O: High Great black-backed gull O: Medium European herring gull O: Medium Lesser black-backed gull O: Medium Northern gannet O: Medium	Black-legged kittiwake O: Minor adverse Great black-backed gull O: Minor adverse European herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Northern gannet O: Minor adverse	None	Black-legged kittiwake O: Minor adverse Great black-backed gull O: Minor adverse European herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Northern gannet O: Minor adverse	None
Combined collision risk and disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure	×	✓	×	Increasing air draught to reduce bird collision	Black-legged kittiwake O: Low Northern gannet O: Low	Black-legged kittiwake O: Medium Northern gannet O: Medium	Black-legged kittiwake O: Minor adverse Northern gannet O: Minor adverse	None	Black-legged kittiwake O: Minor adverse Northern gannet O: Minor adverse	None

10.14 Next steps

10.14.1.1 Site-specific surveys within the Mona Array Area were available to inform this chapter for the purposes of the PEIR. The baseline description and impact assessments in this chapter will be updated with responses to consultation for the final Environmental Statement.

10.15 References

Andersson, M.H. (2011) Offshore Wind Farms - Ecological Effects of Noise and Habitat Alteration on Fish. PhD Thesis, Department of Zoology, Stockholm University.

BirdLife International, (2022) Seabird Tracking Database. http://seabirdtracking.org/, accessed July 2022.

Coull, K.A., Johnstone, R, and Rogers, S.I. (1998) Fisheries Sensitivity Maps in British Waters. UKOOA Ltd: Aberdeen.

Cleasby, I. R., Owen, E., Wilson, L., Wakefield, E. D., O'Connell, P., & Bolton, M. (2020) Identifying important at-sea areas for seabirds using species distribution models and hotspot mapping. Biological Conservation,241, 108375.

Bradbury, G., Trinder, M., Furness, B., Banks, A.N., Caldow, R.W. and Hume, D., (2014) Mapping seabird sensitivity to offshore wind farms.PloS one,9(9), p.e106366.

Cramp, S. and Simmons, K.E.L. (1983) The Birds of the Western Palearctic. Vol. III, Oxford University Press, Oxford.

Cranswick, PA, C Hall & L Smith. (2004) All Wales Common Scoter survey: report on 2002/03 work programme. WWT Wetlands Advisory Service report to Countryside Council for Wales, CCW Contract Science Report no 615.

Waggitt, J.J., Evans, P.G., Andrade, J., Banks, A.N., Boisseau, O., Bolton, M., Bradbury, G., Brereton, T., Camphuysen, C.J., Durinck, J. and Felce, T. (2020) Distribution maps of cetacean and seabird populations in the North‐East Atlantic. Journal of Applied Ecology, 57(2), pp.253-269.

Webb, A., McSorley, C.A., Dean, B.J., Reid, J.B., Cranswick, P.A., Smith, L. and Hall, C. (2006) An assessment of the numbers and distributions of inshore aggregations of waterbirds using Liverpool Bay during the non-breeding season in support of possible SPA identification. JNCC Report No. 373, JNCC, Peterborough.

Department of Energy and Climate Change (DECC) (2011a) Overarching National Policy Statements for Energy (NPS EN-1). Available: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf].

Department of Energy and Climate Change (DECC) (2011b) National Policy Statement for Renewable Energy Infrastructure. Available: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47856/1940-nps-renewable-energy-en3.pdf].

Dias, M.P., Martin, R., Pearmain, E.J., Burfield, I.J., Small, C., Phillips, R.A, Yates, O., Lascelles, B., Borboroglu, P.G. and Croxall, J.P (2019) Threats to seabirds: A global assessment. *Biological Conservation*, 237. 525-537.

Dierschke, V., Furness, R.W. & Garthe, S. (2016) Seabirds and offshore wind farms in European waters: avoidance and attraction. Biological Conservation, 202, 59-68.

Donovan, C. (2017) Stochastic Band CRM – GUI User manual. Marine Scotland. Available at: MergedFile (www.gov.scot)

Ellis, J.R., Milligan, S.P., Readdy, L.,Taylor, N. and Brown, M.J. (2012) Spawning and nursery grounds of selected fish species in UK waters. Sci. Ser. Tech. Rep., Cefas Lowestoft, 147: 56 pp.

Frederiksen, M., Anker-Nilssen, T., Beaugrand, G. and Wanless, S. (2013) Climate, copepods and seabirds in the Boreal Northeast Atlantic – Current state and future outlook. Global Change Biology, 19, 364-372.

Furness, Robert. (2015) Non-breeding season populations of seabirds in UK waters: Population sizes for Biologically Defined Minimum Population Scales (BDMPS). Natural England Commissioned Report. 164.

Frederiksen, M., Furness, R.W. and Wanless, S. (2007) Regional variation in the role of bottom-up and top-down processes in controlling sandeel abundance in the North Sea. Marine Ecology Progress Series, 337, 279-286.

Furness, B and Wade, H. (2012) Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report by MacArthur Green. Report for Marine Scotland Science.

Furness, R. W., Wade, H. M., & Masden, E. A. (2013) Assessing vulnerability of marine bird populations to offshore wind farms. *Journal of environmental management*, *119*, 56–66. https://doi.org/10.1016/j.jenvman.2013.01.025

Garthe, S. and Hüppop, O. (2004) Scaling Possible Adverse Effects of Marine Wind Farms on Seabirds: Developing and Applying a Vulnerability Index. Journal of Applied Ecology, 41(4), 724-734. https://doi.org/10.1111/j.0021-8901.2004.00918.x

Highways England, Transport Scotland, Welsh Government, Department for Infrastructure. (2019). Design Manual for Roads and Bridges (DMRB) LA 104, Environmental assessment and monitoring, Revision 1, Available at: https://www.standardsforhighways.co.uk/prod/attachments/0f6e0b6a-d08e-4673-8691-cab564d4a60a?inline=true Accessed April 2022.

Horswill, Cat & Robinson, Robert. (2015) Review of seabird demographic rates and density dependence.

JNCC, (2020) Seabird Population Trends and Causes of Change: 1986-2018 Report (https://jncc.gov.uk/our-work/smp-report-1986-2018) Joint Nature Conservation Committee. Updated 10 March 2020

Joint Nature Conservation Committee (JNCC) Natural England (2017). Joint SNCB Interim Displacement Advice Note. Report by Natural Resources Wales. Report for The Crown Estate.

Johnston, A., Cook, A. S. C. P., Wright, L. J., Humphreys, E. M. and Burton, N.H.K. (2014a) Modelling flight heights of marine birds to more accurately assess collision risk with offshore wind turbines. Journal of Applied Ecology 51, 31–41 doi: 10.1111/1365-2664.12191.

Johnston, A., Cook, A. S. C. P., Wright, L. J., Humphreys, E. M. and Burton, N.H.K. (2014b) Corrigendum. Journal of Applied Ecology, 51, 1126–1130 doi: 10.1111/1365-2664.12260.

Krijgsveld, K.L., Fijn, R.C., Japink, M., van Horssen, P.W., Heunks, C., Collier, M.P., Poot, M.J.M., Beuker, D. & Dirksen, S. (2011) Effect Studies Offshore Wind farm Egmond aan Zee. Final report on fluxes, flight altitudes and behaviour of flying bird. Bureau Waardenburg report 10-219, NZW-ReportR_231_T1_flu&flight. Bureau Waardenburg, Culemborg, Netherlands.

Lawson, J., Kober, K., Win, I., Allcock, Z., Black, J. Reid, J.B., Way, L. & O'Brien, S.H. (2016). An assessment of the numbers and distribution of wintering waterbirds and seabirds in Liverpool Bay/Bae Lerpwl area of search. JNCC Report No 576. JNCC, Peterborough.

Leopold, M.F., Bemmelen, R.V., & Zuur, A.F. (2013) Responses of Local Birds to the Offshore Wind Farms PAWP and OWEZ off the Dutch mainland coast.

Mackey and Giménez (2006). SEA678 Data Report for Offshore Seabird Populations. Coastal & marine resources centre environmental research institute university college cork.

Masden, E. A., Haydon, D. T., Fox, A. D., & Furness, R. W. (2010) Barriers to movement: Modelling energetic costs of avoiding marine wind farms amongst breeding seabirds. Marine Pollution Bulletin, 60(7), 1085-1091. https://doi.org/10.1016/j.marpolbul.2010.01.016

McGregor, R.M., King, S., Donovan, C.R., Caneco, B., and Webb, A. (2018) A Stochastic Collision Risk Model for Seabirds in Flight. Marine Scotland Report. Available at: https://tethys.pnnl.gov/sites/default/files/publications/McGregor-2018-Stochastic.pdf.

Mitchell, I., Daunt, F., Frederiksen, M. and Wade, K. (2020) Impacts of climate change on seabirds, relevant to the coastal and marine environment around the UK. MCCIP Science Review 2020, 382–399.

Natural England, (2022a) Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase I: Expectations for pre-application baseline data for designated nature conservation and landscape receptors to support offshore wind applications.

Natural England, (2022b) Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase II: Expectations for pre-application engagement and best practice guidance for the evidence plan process.

Natural England, (2022c) Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications.

Natural England (2022d) Highly Pathogenic Avian Influenza (HPAI) outbreak in seabirds and Natural England advice on impact assessment (specifically relating to offshore wind), September 2022

Mitchell, P.I., Newton, S.F., Ratcliffe, N. and Dunn, T.E. (2004) Seabird populations of Britain and Ireland. Poyser, London.

MMO, (2021) North West Inshore and North West Offshore Marine Plan, June 2021.

Peschko, V., Mendel, B., Mercker, M., Dierschke, J., & Garthe, S. (2021) Northern gannets (Morus bassanus) are strongly affected by operating offshore wind farms during the breeding season. Journal of Environmental Management, 279, 111509.

Robinson, R.A. (2005) BirdFacts: profiles of birds occurring in Britain & Ireland (BTO Research Report 407). BTO, Thetford (http://www.bto.org/birdfacts, accessed on 15/09/2022).

Sigray, P. and Andersson, M. (2011). Particle Motion Measured at an Operation Wind Turbine in Relation to Hearing Sensitivity in Fish. The Journal of the Acoustical Society of America. 130. 200-7.

Stanbury, A., Eaton, M., Aebischer, N., Balmer, D., Brown, A., Douse, A., Lindley, P., McCulloch, N., Noble, D., and Win I. (2021) The status of our bird populations: the fifth Birds of Conservation Concern in the United Kingdom, Channel Islands and Isle of Man and second IUCN Red List assessment of extinction risk for Great Britain. British Birds 114: 723-747. Available online at https://britishbirds.co.uk/content/status-our-bird-populations.

Skov, H., Heinanen, S., Norman, T., Ward, R., MendezRoldan, S., & Ellis, I. (2018) ORJIP Bird Collision and Avoidance Study. Final report - April 2018

The Planning Inspectorate (2017). Advice Note ten, Habitat Regulations Assessment relevant to Nationally Significant Infrastructure Projects. Version 8. Available: https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-ten/. Accessed April 2022.

Wade H.M., Masden. E.A., Jackson, A.C. and Furness, R.W. (2016) Incorporating data uncertainty when estimating potential vulnerability of Scottish seabirds to marine renewable energy developments. Marine Policy 70, 108–113. Available online at doi:10.1016/j.marpol.2016.04.045Welsh Government (2019) Welsh National Marine Plan. Cardiff, UK: The Welsh Government.

Votier, S.C., Furness, R.W., Bearhop, S., Crane, J.E., Caldow, R.W.G., Catry, P., Ensor, K., Hamer, K.C., Hudson, A.V., Kalmback, E., Klomp, N.I., Pfeiffer, S., Phillips, R.A., Prieto, I. and Thompson, D.R. (2004) Changes in fisheries discard rates and seabird communities. Nature, 427(6976), pp. 727-730.

Woodward, I., Thaxter, C.B., Owen, E. and Cook, A.S.C.P. (2019) Desk-based revision of seabird foraging ranges used for HRA screening. BTO Report 724 for The Crown Estate.