LLŶR FLOATING OFFSHORE WIND PROJECT

Llŷr 1 Floating Offshore Wind Project

Environmental Statement

Volume 3: Chapter 22 – Marine Ornithology

August 2024

Prepared by: Llŷr Floating Wind Ltd

Document Status

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Acronyms and abbreviations

Acronym, Abbreviation or Unit	Definition	Acronym, Abbreviation or Unit	Definition
%	Percentage	JNCC	Joint Nature Conservation Committee
AOB	Apparently Occupied Burrow	km	Kilometre
AON	Apparently Occupied Nest	km^2	Square kilometre
AOS	Apparently Occupied Site	LMP	Lighting and Marking Plan
BDMPS	Biologically Defined Minimum Population Scales	m	metre
BTO	British Trust for Ornithology	NERC	Natural Environment and Rural Communities
CI	Confidence Interval	nm	Nautical mile
CRoW	Countryside and Rights of Way	NPS	National Policy Statement
DAS	Digital video Aerial Survey	NRW	Natural Resources Wales
dB re µPa	Sound pressure level	NRW (A)	Natural Resources Wales Advisory
EEC	European Economic Community	PDE	Project Design Envelope
EIA	Environmental Impact Assessment	RIAA	Report to Inform Appropriate Assessment
ES	Environmental Statement	sCRM	Stochastic Collision Risk Model
ESAS	Analyses of European Seabirds at Sea	SD	Standard Deviation
EU	European Union	SMP	Seabird Monitoring Programme
FLOW	Hywind offshore wind farm	SNCB	Statutory Nature Conservation Body
HiDef	HiDef Aerial Surveying Ltd	SPA	Spatial Protection Area
HRA	Habitats Regulations Appraisal	SSSI	Site of Special Scientific Interest
Hz	Hertz	UK	United Kingdom
IPC	Infrastructure Planning Commissions	UK BAP	United Kingdom Biodiversity Action Plan
IUCN	International Union for Conservation of Nature	UXO	Unexploded Ordnance

Glossary of project terms

Term	Definition
The Applicant	The developer of the Project, Llŷr Floating Wind Limited.
Array	All wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the Array Area, as defined, when considered collectively, excluding the offshore export cable(s).
Array Area	The area within which the wind turbine generators, inter array cables, mooring lines, floating sub-structures and supporting subsea infrastructure will be located.
Floventis Energy	A joint venture company between Cierco Ltd and SBM Offshore Ltd of which Llŷr Floating Wind Limited is a wholly owned subsidiary.
Landfall	The location where the offshore export cable(s) from the Array Area, as defined, are brought onshore and connected to the onshore export cables (as defined) via the transition joint bays (TJB).
Llŷr 1	The proposed Project, for which the Applicant is applying for Section 36 and Marine Licence consents. Including all offshore and onshore infrastructure and activities, and all project phases.
Marine Licence	A licence required under the Marine and Coastal Access Act 2009 for marine works which is administered by Natural Resources Wales (NRW) Marine Licensing Team (MLT) on behalf of the Welsh Ministers.
Offshore Development Area	The footprint of the offshore infrastructure and associated temporary works, comprised of the Array Area and the Offshore Export Cable Corridor, as defined, that forms the offshore boundary for the S36 Consent and Marine Licence application.
Offshore Export Cable	The cable(s) that transmit electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OfECC)	The area within which the offshore export cable circuit(s) will be located, from the Array Area to the Landfall.
Onshore Development Area	The footprint of the onshore infrastructure and associated temporary works, comprised of the Onshore Export Cable Corridor and the Onshore Substation, as defined, and including new access routes and visibility splays, that forms the onshore boundary for the planning application.
Onshore Export Cable(s)	The cable(s) that transmit electricity from the landfall to the onshore substation.
Onshore Export Cable Corridor (OnECC)	The area within which the onshore export cable circuit(s) will be located.
proposed Project	All aspects of the Llŷr 1 development (i.e. the onshore and offshore components).
Onshore Substation	Located within the Onshore Development Area, converts high voltage generated electricity into low voltage electricity that can be used for the grid and domestic consumption.
Section 36 consent	Consent to construct and operate an offshore generating station, under Section 36 (S.36) of the Electricity Act 1989. This includes deemed planning permission for onshore works.

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22. MARINE ORNITHOLOGY

22.1 Introduction

1. Llŷr Floating Wind Limited (hereafter the Applicant) is proposing to develop the Llŷr 1 Floating Offshore Wind Farm (hereafter referred to as the proposed Project), located approximately 35 km off the coast of Pembrokeshire in the Celtic Sea.
2. The proposed Project is a test and demonstration wind farm development, comprising up to 10 wind turbine generators (WTGs). The proposed Project will make landfall at Freshwater West before connecting into Pembroke Dock power station and the national grid network.
3. The Applicant is seeking a Section 36 consent and Marine Licences for the proposed Project, and this chapter forms part of the Environmental Statement (ES) which is submitted in support of those consent applications. This chapter describes the potential impacts and effects of the proposed Project on marine ornithology receptors during the construction, operation and maintenance and decommissioning phases. It includes mitigation, monitoring and good practice measures to reduce the impacts of the proposed Project on marine ornithology receptors.
4. **Section 22.5** and **Section 22.8.4** of this ES chapter set out the existing baseline and scope of the marine ornithological impact assessment, identifying the key seabird species for assessment, as follows:
    - Black-legged kittiwake *Rissa tridactyla*, hereafter 'kittiwake';
    - Lesser black-backed gull *Larus fuscus*;
    - Common guillemot *Uria aalge*, hereafter 'guillemot';
    - Razorbill *Alca torda*;
    - Atlantic puffin *Fratercula arctica*, hereafter 'puffin';
    - Northern gannet (*Morus bassanus*), hereafter 'gannet';
    - Manx shearwater *Puffinus puffinus*;
    - Balearic shearwater *Puffinus mauretanicus*; and
    - European storm petrel *Hydrobates pelagicus*, hereafter 'storm petrel'.
5. All other ornithological receptors, including wildfowl and waders are addressed in **Chapter 08: Ecology and Biodiversity**.
6. **Section 22.8** reports the impact assessment that has been undertaken against these receptors including a summary of any residual significant effects following consideration of proposed mitigation measures. **Section 22.11** assesses the potential impacts of the proposed Project when considered cumulatively with other plans and projects.
7. The assessment presented in this chapter should be read in conjunction with following linked and supporting chapters:
    - **Chapter 02: Regulatory and Planning Policy Context;** provides further background on policy and guidance relevant to assessment (referenced in **Section 22.2**).
    - **Chapter 04: Description of the Project;** provides detail on the project design parameters.
    - **Chapter 05: EIA Approach and Methodology;** sets out the principles of the EIA impact assessment methodology adopted in this ES (as referenced in **Section 22.4**).

- **Chapter 19: Benthic Ecology;** provides relevant information on the prey species of the marine ornithological receptors under consideration.
- **Chapter 20: Fish and Shellfish Ecology;** also provides relevant information on the prey species of the marine ornithological receptors under consideration.
- **Chapter 25: Shipping and Navigation**; describes the baseline of vessel activity in the area and provides details on vessel requirements for the proposed Project.
- **Chapter 31: Inter-related Effects Assessment**; covers inter-related effects that could affect marine ornithological receptors.
- **Appendix 5A: Approach to Cumulative Effects Assessment;** sets out the over-arching approach to cumulative effects assessment and presents the full long list of all projects and plans considered across all receptor groups.
- **Appendix 8D: HRA Screening**; determines which qualifying interests of European sites may experience ‘likely significant effect’ (LSE).
- **Appendix 8E: HRA RIAA**; assesses the risk of adverse effects on site integrity (AEOSI) for European sites where LSE has been determined for one or more of the qualifying interests.

8. The key marine ornithological information and impact modelling appendices (all located in **Volume 6**) which supports the assessment presented within this chapter is as follows:

- **Appendix 22A: Marine Ornithology Baseline.**
- **Appendix 22B: Marine Ornithology Colony Apportioning.**
- **Appendix 22C: Marine Ornithology Collision Risk Modelling.**
- **Appendix 22D: Marine Ornithology Displacement Assessment.**
- **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios.**
- **Appendix 22F: Marine Ornithology Population Modelling.**

9. The assessment has been undertaken by HiDef Aerial Surveying Ltd, and personnel details are provided in **Appendix 1A: Statement of Competence**.

22.2 Legislation, Policy and Guidance

10. The following sections identify legislation, policy and guidance that is applicable to the assessment of marine ornithology. Further detail on the wider legislation, policy and guidance relevant to this ES is provided in **Chapter 02: Regulatory and Planning Policy Context**.

22.2.1. Legislation

11. The Planning Act 2008, Marine Works (Environmental Impact Assessment; EIA) Regulations 2017 (as amended), the Infrastructure Planning (EIA) Regulations 2017 (collectively referred to as ‘the EIA Regulations’), and the Environment Act 1995 have been considered in this chapter, along with legislation relevant to marine ornithological receptors as detailed below:

- **Conservation of Habitats and Species Regulations (as amended) 2017,** which transposes the Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC) into UK national legislation[1], covering the marine environment to 12 nm offshore;

[1] Following Brexit, the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (known as the ‘Habitats Regulations’) provide amendments to the 2017 Habitats Regulations to transfer functions from the European Commission to the appropriate UK Authorities.

- **Conservation of Offshore Marine Habitats and Species Regulations 2017** also transposes the Habitats Directive (92/43/EEC) into UK national legislation[1], covering the marine environment beyond 12 nm offshore;
- **Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention; 1979),** which aims to ensure conservation and protection of wild plant and animal species and their natural habitats;
- **The Environment (Wales) Act 2016**, which provides a framework for sustainable management and protection of the environment in Wales, including measures for biodiversity conservation, climate change mitigation, and promoting the well-being of future generations;
- **Marine and Coastal Access Act 2009**, which provides the legal mechanism to help ensure clean, healthy, safe and productive and biological diverse oceans and seas;
- **UK Post-2010 Biodiversity Framework**, superseding the UK Biodiversity Action Plan (UKBAP), the UK Government's response to the Convention on Biological Diversity (CBD) 1992;
- **The Wildlife and Countryside Act 1981** (as amended), which includes provisions relating to nature conservation;
- **The Countryside and Rights of Way (CRoW) Act 2000** (as amended) which protects wildlife in the UK, including birds; and
- **The Natural Environment and Rural Communities (NERC) Act 2006** (as amended).

22.2.2. National Planning Policy

12. Key national (UK) plans and policies relevant to the assessment of the proposed Project impacts on marine ornithology receptors include:

- **Overarching National Policy Statement (NPS) for Energy (EN-1),** updated March 2023 (DESNZ, 2023a) which sets out national policy for certain energy infrastructure and affects decisions by the Infrastructure Planning Commissions (IPC) on applications for energy developments falling within the scope of the NPSs;
- **NPS for Renewable Energy Infrastructure (EN-3),** updated March 2023 (DESNZ, 2023b), which provides the primary basis for decisions made by the IPC on applications it receives for nationally significant renewable energy infrastructure; and
- **UK Marine Policy Statement** which aims to achieve sustainable development in the UK marine area.

13. National Policy Statements (NPS) on Energy have been designated by the UK government to guide decision making on Nationally Significant Infrastructure Projects (NSIPs) consented under the Planning Act 2008. Given that the NPSs only applies to offshore wind projects that exceed 350 MW in capacity, they would not directly guide decision making on the proposed Project. However, because they were written to guide decision making on offshore wind projects, they are considered relevant as material considerations.

Table 22-1. A summary of national planning policy relevant to marine ornithology

NPS Ref.	Summary of policy	How and where it is considered in the chapter
The Overarching NPS for Energy (EN-1)		
Para. 5.4.7	Many Sites of Special Scientific Interest (SSSIs) are also designated as sites of international importance and will be protected accordingly. Those that are not, or those features of SSSIs not covered by an international designation, should be given a high degree of protection. Most National Nature Reserves are notified as SSSIs.	SSSIs are addressed in **Section 22.5.1** and taken forward for assessment where required. Where a SSSI underpins an SPA, it is noted in the baseline but not separately assessed in this Chapter. SPAs are assessed under HRA, see **Appendix 8D: HRA Screening** and **Appendix 8E: HRA RIAA.**
Para. 5.4.8	Development on land within or outside a SSSI, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. The only exception is where the benefits (including need) of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of SSSIs.	
Para. 5.4.16	Many individual wildlife species receive statutory protection under a range of legislative provisions. Other species and habitats have been identified as being of principal importance for the conservation of biodiversity in England and Wales, as well as for their continued benefit for climate mitigation and adaptation and thereby requiring conservation action.	All relevant policy and legislation, as listed in **Section 22.2** has been considered in the assessment of offshore ornithology.
Para. 5.4.17	Where the development is subject to EIA the applicant should ensure that the ES 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, including irreplaceable habitats.	As set out above, SSSIs are included for assessment within this Chapter. SPAs are referenced in the baseline section of this chapter but are addressed under HRA as reported in **Appendix 8D: HRA Screening** and **Appendix 8E: HRA RIAA**.
Para. 5.4.22	The design of Energy National Significant Infrastructure Project (NSIP) proposals will need to consider the movement of mobile / migratory species such as birds, fish and marine and terrestrial mammals and their potential to interact with infrastructure. As energy infrastructure could occur anywhere within England and Wales, both inland and onshore and offshore, the potential to affect mobile and migratory species across the UK and more widely across Europe (transboundary effects) requires consideration, depending on the location of development.	The potential transboundary effects from the proposed Project on offshore ornithology are considered in **Section 22.13** of this chapter. The potential for the offshore infrastructure to cause barrier effects specifically is considered in **Section 22.8.2.**

<table>
<tr><th>NPS Ref.</th><th>Summary of policy</th><th>How and where it is considered in the chapter</th></tr>
<tr><td>Para. 5.4.24</td><td>In Wales, applicants should consider the guidance set out in Section 6.4 of Planning Policy Wales and the relevant policies in the Wales National Marine Plan.</td><td>As detailed in Sections 22.2.2 and 22.2.3, the Welsh National Marine Plan, Future Wales – The National Plan and the Planning Policy Wales have all been considered.</td></tr>
<tr><td>Para. 5.4.35</td><td>Applicants should include appropriate avoidance, mitigation, compensation and enhancement 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;
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; and
Opportunities will be taken to enhance existing habitats rather than replace them, and where practicable, create new habitats of value within the site landscaping proposals.
Where habitat creation is required as mitigation, compensation, or enhancement the location and quality will be of key importance. In this regard habitat creation should be focused on areas where the most ecological and ecosystems benefits can be realised.</td><td>Section 22.7 presents the proposed good practice measures and embedded mitigation relevant to marine ornithology.</td></tr>
<tr><td>Para. 5.4.46</td><td>Development proposals provide many opportunities for building-in beneficial biodiversity or geological features as part of good design. The Secretary of State* should give appropriate weight to environmental and biodiversity enhancements, although any weight given to gains provided to meet a legal requirement (for example under the Environment Act 2021) is likely to be limited.</td><td>Section 22.7 presents the proposed good practice measures and embedded mitigation relevant to marine ornithology.</td></tr>
<tr><td colspan="3">The Overarching NPS for Renewable Energy Infrastructure (EN-3)</td></tr>
<tr><td>Para. 2.8.104</td><td>Applicants should consult at an early stage of pre-application with relevant statutory consultees, as appropriate, on the assessment methodologies, baseline data collection, and potential avoidance, mitigation and compensation options should be undertaken.</td><td>Consultations with relevant statutory and non-statutory stakeholders have been conducted throughout the proposed Project, as outlined in Section 22.3.</td></tr>
</table>

NPS Ref.	Summary of policy	How and where it is considered in the chapter
Para. 2.8.136	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 / maintenance vessels and piling; • Displacement during the operational 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; • Impacts upon prey species and prey habitat; and • Impacts on protected sites.	Assessment of impacts on offshore ornithological receptors is conducted in **Sections 22.8.1, 22.8.2,** and **22.8.3.**
Para. 2.8.138 and 2.8.139	The applicant must ensure any draft consents include provisions to define the final 'as built' parameters (which may not then be exceeded). These parameters must be used in future cumulative impact assessments. In parallel the government will look to explore opportunities to reassess ornithological impact assessment of historic consents to reflect their 'as built' parameters.	Parameters are provided in **Chapter 04: Description of the Project** with cumulative and in-combination impacts addressed in **Section 22.11.**
Para. 2.8.140	Any ornithological 'headroom' assessed to exist between the effects defined in the 'as built' parameters and Rochdale Envelope parameters can then be released, with SNCB agreement.	Noted. Should consent be granted, post-consent discussions will take place with NRW (A) and JNCC in relation to the 'as built' parameters and environmental headroom.
Para. 2.8.141 and 2.8.142	Applicants are encouraged to make appropriate applications for amendments to development consent to secure reduced parameters and ornithological impacts. Government will also consider the potential applicability of these principles to other consent parameters.	Noted. Should consent be granted the Applicant will continue to reduce environmental impacts wherever possible through post-consent design.
Para. 2.8.143	Applicants should discuss the scope, effort and methods required for ornithological surveys with the relevant statutory advisor, taking into consideration baseline and monitoring data from operational wind farms.	Consultation and pre application discussions, including ornithology surveys are presented in **Table 22-4** and **Table 22-5.**
Para. 2.8.144	Applicants must undertake collision risk modelling, as well as displacement and population viability assessments for certain species of birds. Applicants are expected to seek advice from SNCBs.	These matters are addressed in these supporting appendices: **Appendix 22C: Marine Ornithology Collision Risk Modelling**

NPS Ref.	Summary of policy	How and where it is considered in the chapter
		Appendix 22D: Marine Ornithology Displacement Assessment. **Appendix 22F: Marine Ornithology Population Modelling.**
Para. 2.8.145	Where necessary, applicants should assess collision risk using survey data collected from the site at the pre-application EIA stage.	Digital aerial survey data has been used to inform the assessment of collision risk. Full collision risk assessment is presented in **Appendix 22C: Marine Ornithology Collision Risk Modelling.**
Para. 2.8.240	Aviation and navigation lighting should be minimised and/or on demand (as encouraged in EN-1 Section 5.5) to avoid attracting birds, taking into account impacts on safety. Subject to other constraints, WTGs should be laid out within a site, in a way that minimises collision risk.	Aviation and navigation lighting is assessed in **Section 22.8.2** and mitigation proposed in **Table 22-18.**
Para. 2.8.241	Turbine parameters should also be developed to reduce collision risk where the assessment shows there is a significant risk of collision (e.g., altering rotor height).	Full collision risk assessment is presented in **Appendix 22C: Marine Ornithology Collision Risk Modelling**, with no significant risks identified for any of the focal species
Para. 2.8.242	Construction vessels and post-construction maintenance vessel traffic associated with offshore wind farms and offshore transmission should, where practicable and compatible with operational requirements and navigational safety, avoid rafting seabirds during sensitive periods and follow agreed navigation routes to and from the site and minimise the number of vessel movements overall.	Vessel management is detailed in **Chapter 25: Shipping and Navigation** and mitigation relevant to marine ornithology presented in in **Section 22.7** (**Table 22-18**) below.
Para. 2.8.315	The Secretary of State must be satisfied that the collision risk and displacement assessments have been conducted to a satisfactory standard having had regard to the advice from the relevant statutory advisor.	Pre-application consultation and dialogue with NRW(A) and JNCC is presented in **Table 22-5**. **Appendix 22C** presents collision risk modelling and **Appendix 22D** the displacement assessment.
Para. 2.8.316	The conservation status of seabirds is of relevance and the Secretary of State should take into account the views of the relevant statutory advisors and be satisfied that cumulative and in-combination impacts on seabird species have been considered.	Cumulative and in-combination impacts are addressed in **Section 22.11** of this chapter and in **Appendix 8E: HRA RIAA**.

NPS Ref.	Summary of policy	How and where it is considered in the chapter
Para. 2.8.106	Any relevant data that has been collected as part of post-construction ecological monitoring from existing, operational offshore wind farms should be referred to where appropriate.	Relevant post-construction monitoring data is considered in **Section 22.8**
Para. 2.11.40	Applicants should assess the potential of their proposed development to have net positive effects on marine ecology and biodiversity, as well as negative effects.	Both potential positive and negative effects are assessed in **Section 22.8**
Para. 2.8.213	Applicants must always employ the mitigation hierarchy, to avoid as far as is possible the need to find compensatory measures for coastal, inshore and offshore developments affecting HRA sites and / or MCZs. It is essential that applicants involve SNCBs and Defra as early as possible in the planning process to enable discussions of what is and isn't a significant and / or adverse effect, subsequent implications, and if required, mitigation and / or compensation.	Noted. Consultation and pre application discussions are presented in **Table 22-4** and **Table 22-5** with mitigation proposed in **Table 22-18** and supporting information for HRA presented in **Appendix 8E: HRA RIAA**.
Para. 2.8.83 to 2.8.85	Where requested by the Secretary of State, applicants are required to undertake environmental monitoring (e.g. ornithological surveys, geomorphological surveys, archaeological surveys) prior to and during construction and operation. Monitoring must measure and document the effects of the development and the efficacy of any associated mitigation or compensation. This will enable an assessment of the accuracy of the original predictions and improve the evidence base for future mitigation and compensation measures enabling better decision-making in future EIAs and HRAs.	The applicant is happy to discuss and implement any required marine ornithological monitoring, as determined under any consent or licence conditions (**Section 22.9**).

22.2.3. Welsh Planning Policy

14. Key Welsh plans and policies relevant to the assessment of the proposed Project impacts on marine ornithology receptors include:

- **Welsh National Marine Plan –** which sets out a single framework for sustainable development within Wales marine area, including considering cumulative effects on highly mobile seabird species**.**
- **Planning Policy Wales** – highlights the importance of biodiversity for natural services, sustainability and the Welsh economy. Although it does not explicitly mention marine ornithology receptors, it includes objectives to achieve efficient use and protection of natural resources and enhancing biodiversity.
- **Future Wales – The National Plan 2040** is Wales' national development framework, which aims to set the direction for development in Wales to 2040. Whilst it does not specifically relate to marine ornithology, it is a development plan with a strategy for addressing key national priorities through the planning system, including sustaining and developing a vibrant economy, achieving decarbonisation and climate-resilience, developing strong ecosystems and improving the health and well-being of Wales' communities.

- **Nature Recovery Action Plan** – the biodiversity strategy for Wales (Wales Biodiversity Partnership 2022).

Table 22-2. A summary of Welsh planning policy relevant to marine ornithology

WNMP Ref.	Summary of policy	How and where it is considered in the chapter
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 ton designated sites that are not part of the MPA network.	Marine Special Protection Areas (SPAs) for seabirds are addressed in **Appendix 8D: HRA Screening** and in **Appendix 8E: HRA RIAA**. There are no other MPAs relevant to consider in relation to marine ornithology.
ENV_05	**Underwater noise:** Proposals should demonstrate that they have considered man-made noise impacts on the marine environment and, in order of preference: a. avoid adverse impacts; and / or b. minimise impacts where they cannot be avoided; and / or c. 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.	The potential impact of underwater noise on diving birds has been qualitatively assessed in **Section 22.8**.
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 should demonstrate how they, in order of preference: a. avoid adverse impacts on those areas; and / or b. minimise adverse impacts where they cannot be avoided; and / or c. 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 impacts on fish species are assessed in **Chapter 20: Fish and Shellfish Ecology**. This assessment has been used to inform the assessment of indirect effects on seabirds through impacts to prey species in **Section 22.8**.
GOV_01	**Cumulative effects:** Proposals should demonstrate that they have assessed potential cumulative effects and should, in order of preference: a. avoid adverse effects; and / or b. minimise effects where they cannot be avoided; and / or c. mitigate effects where they cannot be minimised. If significant adverse effects cannot be avoided, minimised or mitigated, proposals must present a clear and convincing case for proceeding.	Potential cumulative impacts on seabirds have been assessed in **Section 22.11**.

22.2.4. *Local Planning Policy*

15. Local planning policy that is applicable to the assessment of marine ornithology receptors is summarised below.

- **Pembrokeshire Coast National Park Development Plan**, which sets out policies for local developments in Pembrokeshire to support decision making for planning applications; and
- **South West Wales Area Statement,** which includes identification of the key risks, opportunities and priorities for building resilient ecosystems, reverse the decline of biodiversity and support sustainable management of the natural resources.

22.2.5. *Guidance*

16. HiDef have taken account of the following good practice guidance for marine ornithological impact assessment (alongside the advice provided directly by NRW (A) and JNCC during pre-application dialogue):

Table 22-3. A summary of guidance relevant to marine ornithological impact assessment

Summary of Guidance	How and where it is considered in the chapter
Guidelines on the approach to Environmental Impact Assessment (EIA) (CIEEM 2018).	Guides the overall consideration of approach to the chapter.
Delivering Proportionate EIA - A Collaborative Strategy for Enhancing UK Environmental Impact Assessment Practice (IEMA, 2017).	Guides the overall consideration of approach to the chapter.
PINS Advice Note Seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects.	Guides the overall consideration of approach to the cumulative effects assessment presented in **Section 22.11**.
NRW guidance note (2022): At sea ornithological survey guidance.	Referenced in **Appendix 22A: Marine Ornithology Baseline.**
Analysis of seabird species sensitivity to offshore wind farms (Furness *et al.* 2013).	Presented in **Appendix 22A: Marine Ornithology Baseline.**
Definition of seabird foraging ranges (Woodward *et al*. 2019).	Used for screening designated sites into apportioning calculations (**Table 22-10**).
Report on biologically defined minimum population scales (BDMPS), (Furness 2015).	Used to define seasonality (**Table 22-11**) and wintering reference populations (**Table 22-13**).
Guidance on collision risk modelling for seabirds in flight. Used to estimate the risk that a bird will collide fatally with the blades of an offshore turbine (Band 2012; McGregor *et al.* 2018).	Used for the seabird impact assessment presented in **Section 22.8** and **Appendix 22C: Marine Ornithology Collision Risk Modelling**.
NatureScot's Guidance to support Offshore Wind Applications: Marine Ornithology - Advice for assessing collision risk of marine birds. Note 7. (Nature Scot, 2023)	Using during collision risk assessment, see **Appendix 22C: Marine Ornithology Collision Risk Modelling.**
References for SeabORD modelling developed by CEH; used to explore the energetic consequences of displacement / barrier effects to seabirds from offshore wind farms (Searle *et al.* 2014; 2018).	Presented in **Annex C** of **Appendix 22D: Marine Ornithology Displacement Assessment** and used to inform HRA displacement assessment as presented in **Appendix 8E: HRA RIAA**.

Summary of Guidance	How and where it is considered in the chapter
Joint SNCB advice on undertaking displacement assessment (SNCB, 2022). Matrices are used to consider the risk that birds will be displaced from an operational wind farm and to estimate the potential mortality that may arise as a result.	Displacement assessment presented in **Section 22.8** and **Appendix 22D: Marine Ornithology Displacement Assessment.**
Natural England guidance on population modelling, used where the level of predicted impact is high enough that it may affect a species' population status (Searle *et al*. 2019).	As presented in **Appendix 22F: Marine Ornithology Population Modelling.**

22.3 Stakeholder Engagement and Consultation

17. Consultation with statutory and non-statutory organisations is a key element of the EIA process. Consultation with regards to marine ornithology has been undertaken to inform the approach to, and scope of, the assessment.

18. The Project EIA Scoping Report was submitted to NRW (Marine Licensing Team) on 6 April 2022, who then circulated the report to relevant statutory bodies and key stakeholders. The Scoping Opinion was received on 5 July 2022. Comments from the Scoping Opinion which are relevant to offshore ornithology have been summarised in **Table 22-4**, in addition to a high-level response on how these comments have been addressed and a reference to the location of the relevant information within this ES Chapter.

19. Stakeholders for the proposed Project include the statutory consultees (NRW (A)) and JNCC), landowners, local communities and other sea users. For marine ornithology, pre-application dialogue with NRW (A)) and JNCC and the non-statutory stakeholders is detailed in **Table 22-5**.

22.3.1. *Summary of Stakeholder Consultations*

Table 22-4. Summary of marine ornithological scoping advice and how it's been addressed

Consultee and Comment raised		How the issue has been addressed and location of response in chapter	
Scoping Opinion (05 July 2022)			
NRW (A)	NRW (A) advise that all designated sites with named features whose foraging ranges fall within the mean max foraging range +1 SD in Woodward *et al* 2019, should be included for scoping as it is not possible to know what sites might be affected until the surveys show what species are present, and key work such as apportioning has been completed.	All sites have been scoped in as advised by NRW (A).	**Appendix 22B: Marine Ornithology Colony Apportioning** and **Appendix 8D: HRA screening**.
NRW (A)	There is, however, the possibility that using this approach could miss out some colonies; a sense check will also need to be performed to ensure that all colonies for which there is a potential for likely significant effect are included at the screening stage.	A sense check has been performed as requested to ensure that all colonies for which there is a potential for LSE are included in screening.	As above: **Appendix 22B: Marine Ornithology Colony Apportioning** and **Appendix**

	Consultee and Comment raised	How the issue has been addressed and location of response in chapter	
			8D: HRA screening.
NRW (A)	The list of species to be included in scoping will need to be expanded to include all marine birds listed as features of designated sites within mean max +1SD foraging ranges (Woodward *et al.* 2019).	The list has been expanded based on this scoping advice and further dialogue with NRW (A) and JNCC (**Table 22-5**).	**Appendix 22A: Marine Ornithology Baseline** and **Appendix 22B** (as above).
NRW (A)	In addition to digital aerial surveys, we would advise that additional data be reviewed to inform the EIA and HRA assessments e.g. tracking data and colony monitoring data	Colony count data and other colony monitoring data was reviewed and checks undertaken of available tracking data (**Table 22-5**).	**Table 22-12, Appendix 22A** and **22B.**
NRW (A)	We agree with the 4km buffer for the Array Area and OfECC being applied for the two years of digital aerial surveys. The applicant should provide details on survey design and coverage so we can comment on whether or not it is sufficient. We would welcome early engagement regarding survey requirements.	'Survey summary paper' issued to NRW on 20 January 2023 for review and discussion (**Table 22-5**).	The full survey design is detailed in **Appendix 22A: Marine Ornithology Baseline.**
NRW (A)	Flight height analysis from digital aerial footage has not yet been proven or accepted by SNCBs so generic flight heights from Johnston et al. (2014) should also be used in assessing collision risk… Discussions between the SNCBs and digital aerial providers are ongoing, but in the interim, until these investigations are completed, use of Johnston et al. (2014), is considered appropriate.	Assessment of collision risk is based on Option 2 in the model which uses the Johnston *et al.* (2014) collation of flight height data.	**Appendix 22C: Marine Ornithology Collision Risk Modelling.**
NRW (A)	Direct creation of roosting habitat for birds due to the presence of floating platforms and associated infrastructure: The rationale for this impact pathway notes that "The introduction of floating platforms and associated infrastructure presents the opportunity for new roosting habitat which may be utilised by foraging birds." NRW (A) consider that the introduction of platforms should also be assessed with regards the potential increased collision risk.	The possibility of increased collision risk is acknowledged and considered alongside the potential use of floating platforms by seabird species.	**Section 22.8**

	Consultee and Comment raised	How the issue has been addressed and location of response in chapter	
NRW (A)	"Initial Screening of Other Development Projects and Allocations. The list of other relevant major developments to be considered as part of the inter-project effects assessment will be developed in parallel with undertaking the EIA considering temporal scope, shared receptors or pathways for effects." Developments which have already been constructed and have ongoing effects on marine birds and /or SPAs e.g. operational wind farms should also be included.	All relevant projects including operational wind farms are considered in the cumulative effects assessment.	**Section 22.11** supported by **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios.**
NRW (A)	Cumulative assessment search area extents: Developments which are within the foraging ranges (see Woodward et al 2019) of all SPAs scoped in for LSE should be included within this cumulative assessment	All relevant development within the Western waters (and Channel) BDMPS is included in the cumulative assessment alongside Irish projects within seabird mean max + 1SD foraging ranges.	**Section 22.11** supported by **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios.**
NRW (A)	This 'long list' will need to be expanded to include all sites identified as potential LSE during screening, noting our comments relating to Table 30-1 above.	Addressed as noted to expand long list to include all sites identified as potential LSE.	As well as the preceding references, also see **Appendix 8D: HRA Screening.**
JNCC	The screening exercise for Special Protected Areas (SPA) at potential Likely Significant Effect (LSE), as part of Habitats Regulations Assessment (HRA), is incomplete and needs additional work.	Full HRA Screening including SPAs for breeding seabird colonies and marine SPAs has been done.	**Appendix 8D: HRA Screening.**
JNCC	The long list of projects to be included within an in-combination assessment is far from complete and needs additional work. This may be best undertaken after a screening exercise has identified the SPAs which may be impacted upon, including in-combination impacts.	Addressed subsequent to scoping (during pre-application dialogue) as noted above.	Presented in **Section 22.11** supported by **Appendix 22E: Marine Ornithology Project Alone and**

	Consultee and Comment raised		How the issue has been addressed and location of response in chapter
			Cumulative Impact Scenarios.
JNCC	Table 23-1. Mean maximum foraging range plus 1 standard deviation for species that have a foraging range greater than 100km (Woodward *et al.* 2019). Please note that for common guillemot outside of the Northern Isles, we recommend a foraging range of 95.2km, which excludes data from Fair Isle collected during years in which the species was thought to show unusual foraging ranges due to lack of food. For razorbill outside of the Northern Isles, we recommend a foraging range of 122.2km, which excludes data from Fair Isle collected during years in which the species was thought to show unusual foraging ranges due to lack of food. For northern gannet at Grassholm SPA we recommend a foraging range of 516.7km based on site-specific tracking data. These foraging ranges will identify SPAs which should be screened in for further consideration as part of the HRA process.	JNCC's refinements were adopted as requested in the determination of 'connectivity' between breeding seabird colonies and the proposed Project.	**Appendix 22B: Marine Ornithology Colony Apportioning** and **Appendix 8D: HRA screening**.
JNCC	Table 23-2. There are many SPAs which have features with foraging ranges which overlap the project Array Area, and which are not included in this table. The exercise should be repeated. For example, some missing SPAs include the Isles of Scilly SPA (European Storm Petrel, and assemblage which includes Manx shearwater, northern fulmar and Atlantic puffin as named components) and several SPAs including Manx shearwater as a feature across the western UK. It is not clear why this table does not include many more SPAs.	Noted and addressed as discussed above.	As above: **Appendix 22B** and **Appendix 8D: HRA screening**
JNCC	Section 23.4. Baseline We would strongly urge data in addition to project DAS be reviewed as it can be informative to several aspects of the screening, EIA and HRA assessments. For example; • Tracking data to demonstrate use of the Array Area and colony of origin, which is likely available for several species/colonies of relevance (e.g. gannet at Grassholm SPA, several Manx shearwater colonies). This may	Colony count data and other colony monitoring data was reviewed, and checks undertaken of available tracking data (**Table 22-5**). Collision risk modelling using the 13.1ms^{-1} gannet flight speed	**Table 22-12, Appendix 22A: Marine Ornithology Baseline, Appendix 22C: Marine Ornithology Collision Risk Modelling**

	Consultee and Comment raised	How the issue has been addressed and location of response in chapter	
	potentially also inform flight height and flight speed parameters for use within collision risk modelling (noting that discussion with SNCBs would be required in advance of relying on such information that is not currently included within SNCB advice around generic parameters). • Colony monitoring to inform demographic parameters for use in Population Viability Analysis (PVA) (e.g. Skomer common Guillemot long-term monitoring study).	derived from tracking data (Langley and Votier, 2021) has been provided for context. Using the Skomer guillemot adult survival rate derived from monitoring (Birkhead, 2021) was proposed, however, NRW (A) and JNCC advised using the rate from the NE PVA tool in preference.	and **Appendix 22F Marine Ornithology Population Modelling**
JNCC	Table 23-3. Potential impacts of the proposed Project on seabirds Construction of decommissioning Project Phase; Mortality effects resulting from displacement of diving birds due to underwater noise (e.g. UXO detonations) cannot be excluded at this stage, because we don't know enough about this.	Potential effects of underwater noise on diving seabirds are acknowledged and addressed qualitatively.	**Section 22.8**
JNCC	Table 23-3 goes on to mention creation of roosting habitat as a positive but should also note potential increase in collision risk as a result of this increased attraction for certain species. Related to this, benthic community structures may change as a result of floating wind infrastructure, and this could potentially increasing presence of some seabird species putting them at risk of increased collision.	The possibility of this increased collision risk is acknowledged and addressed qualitatively.	**Section 22.8**
JNCC	Section 23-7. Assessment Methodology We are content with the 4km array buffer proposed, given the species present in this area. There is no detail provided on survey design, coverage etc so we cannot comment on whether coverage is sufficient. There is no mention of density surface modelling; is this intended to be undertaken to inform density and spatial distributions?	The 'Survey summary paper' was forwarded to JNCC on 4 May 2023 for further discussion (**Table 22-5**).	The full survey design is detailed in **Appendix 22A: Marine Ornithology Baseline.**
JNCC	Note that JNCC are not satisfied with regard to accuracy of flight heights estimated from DAS data. As such, generic flight heights (from Johnston *et al.* (2014)) should be used in collision assessments (site specific flight heights can be included for context).	Assessment of collision risk is based on Option 2 in the model which uses the Johnston *et al.* (2014) collation of flight height data.	**Appendix 22C: Marine Ornithology Collision Risk Modelling.**

	Consultee and Comment raised	How the issue has been addressed and location of response in chapter	
JNCC	Volume 4 – Project Wide Effects Section 30.3. Approach to Cumulative Assessment Developments which have been constructed and have ongoing effects on marine birds and/or SPAs should be included. This may include operational wind farms for example.	All relevant projects within the Western waters (and Channel) BDMPS are included in the cumulative assessment, alongside Irish projects within the identified seabird foraging ranges.	**Section 22.11** supported by **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios.**
JNCC	Table 30-1. Developments within foraging range of those SPAs scoped in for LSE should be included within the in-combination assessment. This may include developments beyond the extents indicated in Table 30-1.	As above.	**Section 22.11** and **Appendix 8E: HRA RIAA** supported by **Appendix 22E** (as above).
JNCC	Table 30-2. Developments with the potential for cumulative impacts ('long list') We are pleased to see that various sectors/activity types have been considered and not only wind farms (e.g. Greenlink Interconnector cable project). However, this list is far from complete. We would add Round 4 preferred projects, Burbo Bank OWF, Burbo Bank Extension, Gwynt y Môr, Awel y Môr, Rhyl Flats, Robin Riggs, Walney, Arklow Bank, Celtic Interconnector (cable project). Additional projects may be relevant (including from other sectors/activities), we have not undertaken a full assessment but this needs to be undertaken based on sites identified as at potential risk of LSE from screening exercise.	The list of projects to include for marine ornithological cumulative assessment has been updated, as above.	As above.
RSPB	The scoping area for the EIA should be denoted by mean-maximum foraging ranges from seabird SPAs and SSSIs. We note the applicant's reference to Thaxter et al (2012), the initial standard of mean-maximum foraging ranges based on seabird tracking data and more recent studies, Future of the Atlantic Marine Environment (FAME) and Seabird Tracking and Research (STAR) projects. Wakefield et al, 2017 should be used with caution when applied to Lundy.	Addressed under connectivity and HRA screening exercise.	**Appendix 22A: Marine Ornithology Baseline, Appendix 8D HRA Screening** and **Appendix 22B: Marine Ornithology Colony Apportioning**

Consultee and Comment raised		How the issue has been addressed and location of response in chapter	
RSPB	There is one notable absence in the seabird species listed in the Ornithology section, Balearic shearwater and appropriate SPAs allocated/designated for this species. This is Europe's only critically endangered seabird which occurs in Welsh waters including the Celtic Sea.	Balearic shearwater is included for consideration.	Species accounts in **Section 22.5** and assessment in **Section 22.8**
RSPB	The list of designated sites presented in Table 23-2 appears incomplete and there are a number of anomalies regarding the ornithological features of SSSIs. We recommend the following international sites should be considered: • Aberdaron Coast and Bardsey Island SPA • Isles of Scilly SPA • Great Saltee SPA (Republic of Ireland) Furthermore, the ornithological section omits SPAs for Balearic shearwater.	Noted, the suggested SPAs are included, and Balearic shearwater are also included for qualitative assessment.	**Appendix 8D: HRA screening** and **Appendix 22B: Marine Ornithology Colony Apportioning** Balearic shearwater are addressed in **Section 22.5** and **Section 22.8**.
RSPB	Offshore survey methods must comply with contemporary guidance, the most appropriate being detailed in NatureScot (2020) Marine Bird Impact Assessment Guidance Workshop Report. There are limitations associated with aerial surveys including the timing of flights being confined to limited hours of daytime owing to visibility and logistics. Thus, it is crucial to consider the nocturnal and crepuscular activity patterns for all seabirds, especially given the high prevalence of nocturnal species.	Reference has been made to NRW's 'At sea ornithological survey guidance' (2022).	The full survey design is detailed in **Appendix 22A: Marine Ornithology Baseline.** Please also see **Section 22.6.2** on Assessment Assumptions and Limitations.
RSPB	There is up to date information on the populations of cliff nesting seabirds on Lundy in 2021. The RSPB can provide this information, which is not yet published. It should also be noted that evidence for the importance of the Celtic Sea for some species (e.g. Wakefield et al, 2017 which covered four species, kittiwake, shag, guillemot and razorbill) should be used with caution based on the age of the colony data used in the modelling. Where modelling is based upon	Noted. Data sources referenced are listed and include more recent information than Wakefield et al, 2017, such as the updated density surface modelling undertaken for The Welsh Atlas.	Data sources referenced are listed in **Table 22-12**.

Consultee and Comment raised		How the issue has been addressed and location of response in chapter	
	old datasets and where the populations of seabirds at colonies such as Lundy have changed significantly since, re-modelling should be undertaken to use the latest census data.		
RSPB	The evidence-base for some food prey species such as sand eel, sprats or herring is either old or there is a lack of data and we therefore recommend that appropriate surveys of these species are included within the site or areas where cumulative impacts could occur.	The advice from RSPB is noted.	See **Chapter 20: Fish and Shellfish Ecology** and **Chapter 26: Commercial Fisheries**.
RSPB	Nocturnal seabirds may be attracted to the offshore project infrastructure lighting causing them to become disorientated and/or increase their risk of collision with the offshore arrays. The ongoing proposed Project offshore bird surveys being carried out will provide information to inform which species are present in the area. It has to be clarified that there is no uncertainty about the attraction of fledgling shearwaters to light sources in general but only about the magnitude of this effect from offshore WTGs. It should be highlighted that the assessment of this sensitivity will be made more difficult by the temporal limitations of the survey method and therefore the tracking data will be of value to gain the best possible understanding without any direct assessment.	The advice from RSPB is noted. The potential impacts of seabird attraction to infrastructure lighting associated with the proposed Project is addressed qualitatively.	Assessed in **Section 22.8**.
RSPB	We will be happy to discuss mitigation and feasibility of potential options with the developer once the baseline is established.	The Applicant is fully committed to feasible mitigation and welcomes the opportunity to discuss options with RSPB and other stakeholders should the proposed Project be consented.	**Section 22.7** addresses embedded mitigation and proposed management plans.
RSPB	Furthermore, we consider there is a requirement for a thorough monitoring plan, to include monitoring of seabird behaviour in and around the turbines to identify displacement and avoidance behaviours.	The Applicant is also fully committed to project monitoring and welcomes the opportunity to discuss options.	**Section 22.9.1** discusses project monitoring.

Consultee and Comment raised		How the issue has been addressed and location of response in chapter	
RSPB	The list of projects and plans in section 30.3 (Vol 4) is incomplete, for example neighbouring floating offshore wind projects in the Celtic Sea have been omitted, including: • Llywelyn • Gwynt Glas • White Cross • Petroc There are also several offshore wind proposals within 200 km in Irish territorial waters of the Celtic Sea, for example the Emerald Project. In addition to the sources identified in section 30.3.3 (Volume 4), Initial Screening of Other Development Projects and Allocations, we advise that relevant projects and plans for consideration may also be found within: • The Developments of National Significance Register. • Planning Policy e.g. Local Development Plans, Transport Plans (National and Local) and National Policy Statements.	The advice from RSPB is noted. All relevant developments lying within the Western waters (and Channel) BDMPS are included in the cumulative assessment, alongside Irish projects within seabird mean max + 1SD foraging ranges.	Addressed in **Section 22.11**, as supported by **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios.**

Table 22-5. Pre-application consultation undertaken for marine ornithology

Consultation / Consultee	Date	Summary of key information and decisions
Paper issued to NRW (A)	20 January 2023	‘Survey summary paper’ outlining the methods and results from the site-specific DAS undertaken, in addition to proposed method for availability bias correction.
Meeting with NRW (A)	8 February 2023	Meeting to discuss the ‘Survey summary paper’. Topics covered were: • Survey methodology and design; • Survey effort; • Species to scope in for quantitative assessment; • Proposed methodology for survey data analysis; • Availability bias; • Species seasonality; and • Input data for quantitative assessment.
NRW (A) advice note	17 February 2023	NRW (A) advice on survey data analysis following the meeting held on 8 February 2023.

Consultation / Consultee	Date	Summary of key information and decisions
NRW (A) advice note	17 February 2023	NRW (A) advice on marine ornithology assessment approaches.
Paper issued to NRW (A)	22 February 2023	Marine ornithology proposed assessment methodology including: • Approach to overlap in impact assessment process (HRA/EIA); • Forward view of avian flu considerations; • Species for assessment; • Approach to assessment in the breeding and non-breeding season; • Age class apportioning; • CRM, displacement and population modelling; and • Cumulative/ in-combination impacts.
Paper issued to NRW (A)	2 March 2023	Appendix D to the 22 February paper which presents design-based density and abundance estimates of 17 seabird species.
Meeting with NRW (A)	7 March 2023	Meeting following on from the 22 February and 2 March papers to discuss each topic included in the paper.
Paper issued to NRW (A)	16 March 2023	'Design and model-based analysis methods, HiDef advice to NRW' outlining the proposed method for using inlabru for calculation of model-based density and abundance estimates from DAS.
NRW advice note	5 April 2023	NRW (A) Marine Ornithology Proposed Assessment Methodology Advice.
Email from NRW (A)	6 April 2023	Advice in response to the 'Design and model-based analysis methods' sent out by HiDef on 16 March. Comment on the inlabru approach and additional comments on the report.
Paper issued to NRW (A)	12 May 2023	Reissue of the 'Marine ornithology proposed assessment methodology' updated to address the comments received from NRW (A) in their advice notes of 17 February and 5 April.
Meeting with JNCC	18 May 2023	Briefing for JNCC following agreement of their *Discretionary Advice Service* to update them on the pre-application liaison with NRW (A) undertaken to date. All relevant papers forwarded.
Meeting with NRW (A) and JNCC	24 May 2023	Meeting with NRW (A) and JNCC ornithology advisors to introduce and outline the proposed method for using inlabru for calculation of model-based density and abundance estimates from DAS.
Paper issued to NRW (A) and JNCC	9 June 2023	Survey summary paper re-issued updated with non-ID bird records as requested by NRW (A) and JNCC at the meeting on 24 May.
Email from NRW (A)	9 June 2023	Circulation of new Welsh Cetacean and Seabird Atlas.
Paper issued to NRW (A) and JNCC	14 June 2023	Paper on 'Comparison of Model (inlabru) and Design-Based Estimates from Digital Aerial Survey Work' for Marine Ornithological receptors.

Consultation / Consultee	Date	Summary of key information and decisions
Advice note from NRW (A) and JNCC	15 June 2023	Joint advice on EIA seabird reference populations to use in assessment.
Non-statutory stakeholder briefing	7 July 2023	Meeting covering an introduction to the proposed Project, introduction to the work by HiDef, marine ornithology and marine mammal assessment, post construction monitoring.
Meeting with the Wildlife Trust	10 July 2023	Meeting covering all topics that were discussed with other stakeholders at the briefing on the 7 July 2023.
Email from NRW (A) and JNCC	17 July 2023	Email in response to the inlabru paper issued on the 14 June, agreeing to the use of inlabru for Llŷr.
Email from JNCC	4 August 2023	JNCC comments providing any outstanding advice and an account of advice provided thus far.
Papers issued to NRW (A) and JNCC	15 August 2023	Short papers issued in advance of the meeting the following day: • Calculation of 1% of EIA (BDMPS) baseline mortalities and of 1% of SPA baseline mortalities for Grassholm SPA, SSSP SPA and Castlemartin SSSI; • Summary of project alone collision and displacement impacts; • Summary of auk displacement mortality estimates for Erebus project-alone, using matrices.
Meeting with NRW (A) and JNCC	16 August 2023	Meeting to provide an update on marine ornithology covering: • Update to the proposed Project boundary (Array Area); • Displacement assessment and EIA requirements; • 1% baseline mortality threshold; and • Population Viability Analysis (PVA).
HiDef email to NRW (A) and JNCC	24 October 2023	HiDef check of available tracking data.
NRW (A) forwarding a paper from Natural England (NE)	14 November 2023	NE suggestion for 'gap-filling' cumulative and in-combination assessments for displacement and collision.
Teams call with NRW (A) and JNCC	16 November 2023	General discussion on the treatment of uncertainty in ornithology impact assessment for offshore wind farms.
NRW (A) and JNCC advice note	8 December 2023	NRW (A) and JNCC advice on treatment of uncertainty in relation to Mean Seasonal Peak (MSP) estimates for use in displacement matrices and choice of density input into stochastic CRM.

Consultation / Consultee	Date	Summary of key information and decisions
NRW (A) letter	30 January 2024	NRW (A) advice on the approach to cumulative effects assessment (CEA), including some specific advice in relation to marine ornithology. Addressed for this Chapter in **Section 22.11 Cumulative Effects of the Project**.
Papers issued to NRW (A) and JNCC	12 March 2024	Technical papers to investigate survey coverage (12.5% *cf*. 25%) and treatment of uncertainty in marine ornithological assessment as requested at the meeting on 16 August 2023, and Teams call of 16 November 2023 respectively. Provided to NRW (A) and JNCC in advance of submission and included in **Annex B** of **Appendix 22A: Marine Ornithology Baseline**.
Email from NRW (A) and JNCC	28 March 2024	NRW (A) and JNCC providing summary comments on the technical papers to investigate survey coverage (12.5% *cf*. 25%) and treatment of uncertainty; noting that full comments will be provided following review of the submitted application.

22.4 Approach to Assessment

22.4.1. Assessment Methodology

20. **Chapter 05: EIA Approach and Methodology** provides a summary of the general impact assessment methodology applied in this ES. The following sections provide further detail on the specific methodology used to assess the potential impacts on marine ornithology receptors.

21. The approach to the assessment of cumulative impacts, transboundary impacts and inter-related effects is provided in **Sections 22.11**, **22.12** and **22.13**.

22. The significance of potential effects has been evaluated using a systematic approach together with the expert judgement of the specialist consultant. The systematic approach is based upon the identification of the importance/value of receptors and their sensitivity to the proposed Project together with the predicted magnitude of the potential impact.

22.4.2. Significance Criteria

23. The significance of an effect has been determined using a two-stage process: by assessing the ‘magnitude’ of the impact, defined for marine ornithology in

24. **Table 22-6**, and the ‘sensitivity’ of the receptor to the impact, as defined in **Table 22-7**. These are then combined in a matrix to determine the impact significance (**Table 22-8**).

25. The magnitude and sensitivity criteria used for marine ornithology vary from the example criteria presented in **Chapter 05, EIA Approach and Methodology** as they have been developed specifically for the assessment of seabirds, based on specialist knowledge and experience from HiDef as the chapter authors.

Magnitude of Impact

26. The criteria for defining magnitude of impact for the purpose of the marine ornithological assessment are provided in **Table 22-6.**

Table 22-6. Magnitude criteria for offshore ornithology receptors

Offshore Ornithology Magnitude Criteria	Definition
Large	**Displacement / collision risk:** Predicted mortalities are predicted to be more than 10% of regional numbers. **Other impacts:** Size or extent of distribution of the relevant biogeographic population is altered resulting in irreversible/permanent change such that the long-term viability of the population is affected. Recovery from that change not predicted (permanent) or may be achieved in the long-term (>10 years) once the activity has ceased.
Medium	**Displacement / collision risk:** Predicted mortalities are predicted to be between 5% and 10% of regional numbers. **Other impacts:** Size or extent of distribution of the relevant biogeographic population is altered, but the long-term viability of the population is not affected. Recovery from that change predicted to be achieved in the medium-term (2-10 years) once the activity has ceased.
Small	**Displacement / collision risk:** Predicted mortalities are predicted to be between 1% and 5% of regional numbers. **Other impacts:** Size or extent of distribution of the relevant biogeographic population is altered at a small-scale with no long-term deterioration of the population. Recovery from that change predicted to be achieved in the short-term (≤1 year) once the activity has ceased.
Negligible	**Displacement / collision risk:** Predicted mortalities are predicted to be less than 1% of regional numbers. **Other impacts:** Size or extent of distribution of the relevant biogeographic population may undergo an immeasurable or very slight change. Recovery from that change predicted to be rapid (e.g. ≤6 months or within a single season) once the activity has ceased.

Sensitivity of the receptor

27. The criteria for defining receptor sensitivity for the purpose of the marine ornithological assessment are provided in **Table 22-7**. Please also see **Table 22-14** which provides further detail on species sensitivity specifically to disturbance/displacement and collision risk impact pathways[2], based on the species sensitivity scorings given in Furness *et al.* (2013).

Table 22-7. Sensitivity criteria for offshore ornithology receptors

Receptor Sensitivity Criteria	Definitions
Very High	**Displacement / collision risk:** Bird species has very high vulnerability to displacement or collision risk impacts. **Other impacts:** Bird species has no ability to adapt and / or tolerate the effect, so that survival and reproductive rates are highly likely to be affected. Bird species has no ability to recover from the effect (permanent, more than 10 years).
High	**Displacement / collision risk:** Bird species has high vulnerability to displacement or collision risk impacts.

[2] The full list of impact pathways scoped in for assessment is presented later in the Chapter, in **Table 22-15**.

Receptor Sensitivity Criteria	Definitions
	Other impacts: Bird species has limited ability to adapt and / or tolerate the effect, so that survival and / or reproductive rates may be affected. Bird species has a limited ability to recover from the effect (e.g. 2-10 years)
Medium	**Displacement / collision risk:** Bird species has moderate vulnerability to displacement or collision risk impacts. **Other impacts:** Bird species is able to adapt and / or tolerate the effect, so that reproductive rates may be affected but without a significant effect on survival rates. Bird species able to recover within a short-term (e.g. 1 year).
Low	**Displacement / collision risk:** Bird species has low vulnerability to displacement or collision risk impacts. **Other impacts:** Bird species is able to adapt and / or tolerate the effect, so that there is no effect on survival or reproductive rates. Bird species is able to return to their previous behavioural state or activity once the impact has ceased.
Negligible	No perceptible effect on the behaviour of the receptor.

Significance of Effect

28. As set out in **Chapter 05** an Impact Assessment Matrix (IAM) is used to determine the significance of effect which is a function of the sensitivity of the receptor and the magnitude of the impact, as shown in **Table 22-8.**

29. The matrix provides a framework for the consistent and transparent assessment of predicted effects across all receptor topics, however, it is important to note that the IAM acts as a guide and that assessments also allow for the application of expert judgement.

Table 22-8. Significance matrix for offshore ornithology receptors

		Value / Sensitivity				
		Very High	**High**	**Medium**	**Low**	**Negligible**
Magnitude	**Large**	Major	Major	Moderate	Moderate	Minor
	Medium	Major	Moderate	Moderate	Minor	Negligible
	Small	Moderate	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Minor	Negligible	Negligible	Negligible

30. The IAM provides levels of effect significance ranging from major to negligible. Assignment of significance is carried out with consideration of embedded mitigation measures relevant to Offshore Ornithology. Embedded mitigation measures (including project design measures and best practice) are presented within **Section 22.3.1**. Details on additional mitigation measures and associated definitions can be found in **Section 22.9**.

31. For the purposes of this assessment, Moderate and Major levels of significance are defined as significant, and where relevant additional mitigation measures may be required, whilst Negligible or Minor impacts are defined as not significant.

Table 22-9. A summary of the definitions of each significant of effect criteria

Significance Category	Definitions	Significant / Not Significant Effect
Major	A large and detrimental change to a valuable / sensitive receptor; likely or apparent exceeding of accepted (often legal) threshold. Or A large and beneficial change, resulting in improvements to the baseline result in previously poor conditions being replaced by new legal compliance or a major contribution being made to national targets. These effects may represent key factors in the decision-making process. Potentially associated with sites and features of national importance or likely to be important considerations at a regional or district scale. Major effects may relate to resources or features which are unique and which, if lost, cannot be replaced or relocated.	Significant
Moderate	A medium scale change which, although not beyond an acceptable threshold, is still considered to be generally unacceptable, unless balanced out by other significant positive benefits of a project. Likely to be in breach of planning policy rather than a legal statute. Or A positive moderate effect is a medium scale change that is significant in that the baseline conditions are improved to the extent that guideline targets (e.g. UK BAP targets) are contributed to. These effects, if adverse, are likely to be important at a local scale and on their own could have a material influence on decision making.	Significant (unless otherwise specified)
Minor	A small change that, whilst adverse, does not exceed legal or guideline standards. Unlikely to breach planning policy. Or A small positive change, but not one that is likely to be a key factor in the overall balance of issues. These effects may be raised as local issues and may be of relevance in the detailed design of a project but are unlikely to be critical in the decision-making process.	Not Significant
Negligible	A very small change that is so small and unimportant that it is considered acceptable to disregard. Effects which are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error. These effects are unlikely to influence decision making irrespective of other effects.	Not Significant

22.4.3. Study Area

32. For seabird interests, the study areas are species and season specific. During the breeding season, seabirds are central-based foragers, nesting in colonies on cliffs and islands and travelling out to sea each day to feed. For each species, all breeding populations within foraging range (mean maximum plus one standard deviation; SD as set out in Woodward et al. (2019) have been considered (**Table 22-10**).

33. In the non-breeding season, birds are not constrained by the requirements of breeding and will travel over large distances and mix freely in offshore waters. For the UK, biologically defined minimum population scales (BDMPS) have been defined for key species in the non-breeding season in Furness (2015). These identify non-breeding populations of seabird species occurring in UK waters during migration and winter: BDMPS are defined on a species-by-species basis for each period and are used for reference against which to consider non-breeding season impacts from offshore wind development (**Table 22-11**).

Table 22-10. Mean maximum foraging ranges (km) from Woodward et al. (2019)

Species	Mean maximum foraging range (km)	Standard deviation (km)	Mean maximum foraging range + 1 SD (km)	Alternative mean maximum foraging range + 1 SD (km) recommended by JNCC
Kittiwake	156.1	144.5	300.6	-
Lesser black-backed gull	127.0	109.0	236.0	-
Guillemot	73.2	80.5	153.7	95.2**
Razorbill	88.7	75.9	164.6	122.2**
Atlantic puffin	137.1	128.3	265.4	-
Manx shearwater	1,346.8	1,018.7	2,365.5	-
Northern gannet	315.2	194.2	509.4	516.7*

**For gannets at Grassholm Spatial Protection Area (SPA)*

***For guillemots and razorbills outside of the Northern Isles*

Table 22-11. Marine ornithology receptors breeding and non-breeding season (Furness, 2015).

Species	UK breeding season	Adjusted BDMPS		
		Autumn migration	Non-breeding	Spring migration
Kittiwake	Mar – Aug	Sep – Dec	-	Jan – Feb
Lesser black-backed gull	Apr – Aug	Sep – Oct	Nov – Feb	Mar
Guillemot	Mar – July	-	Aug – Feb	-
Razorbill	Apr – July	Aug – Oct	Nov – Dec	Jan – Mar
Puffin	Apr – Aug	-	Sep – Mar	-
Manx shearwater	Apr – Aug	Sep – Oct	-	Mar
Gannet	Mar – Sep	Oct – Nov	-	Dec – Feb

22.4.4. *Data Sources*

34. A detailed baseline characterisation for offshore ornithology receptors is given in **Appendix 22A: Marine Ornithology Baseline**, informed by a desk-based review of existing data sources in addition to site-specific surveys.

Digital Aerial Surveys

35. Site-specific high-resolution digital video aerial surveys (DAS) were conducted by HiDef to determine the seabird (and marine mammal) species present within the proposed Project Array Area. As described in **Appendix 22A**, a total of 24 monthly surveys were flown between March 2020 and March 2022 over the 640 km^2 survey area, along 2 km-spaced survey transects (**Figure 22-1**). These surveys provided coverage of the Array Area (44.90km^2) and specified 2 km buffer (119.19 km^2), analysed to inform the baseline and to derive the necessary density and abundance (population) estimates for use in assessment.

36. **Appendix 22A** includes details of the DAS methodology and analysis of video footage, with the key findings for each focal species summarised in the **Species Accounts** in **Section 22.5.**

37. While survey design was not agreed with NRW (A) or JNCC prior to survey completion, it follows NRW's At Sea Ornithological Survey Guidance, as published (NRW, 2022). HiDef, on behalf of the Applicant, have also undertaken all additional analyses and studies requested by NRW (A) and JNCC during pre-application consultation (**Table 22-5**). These studies are presented in **Appendix 22A**: **Annex B – Technical Notes on Survey Design and Data Analysis**.

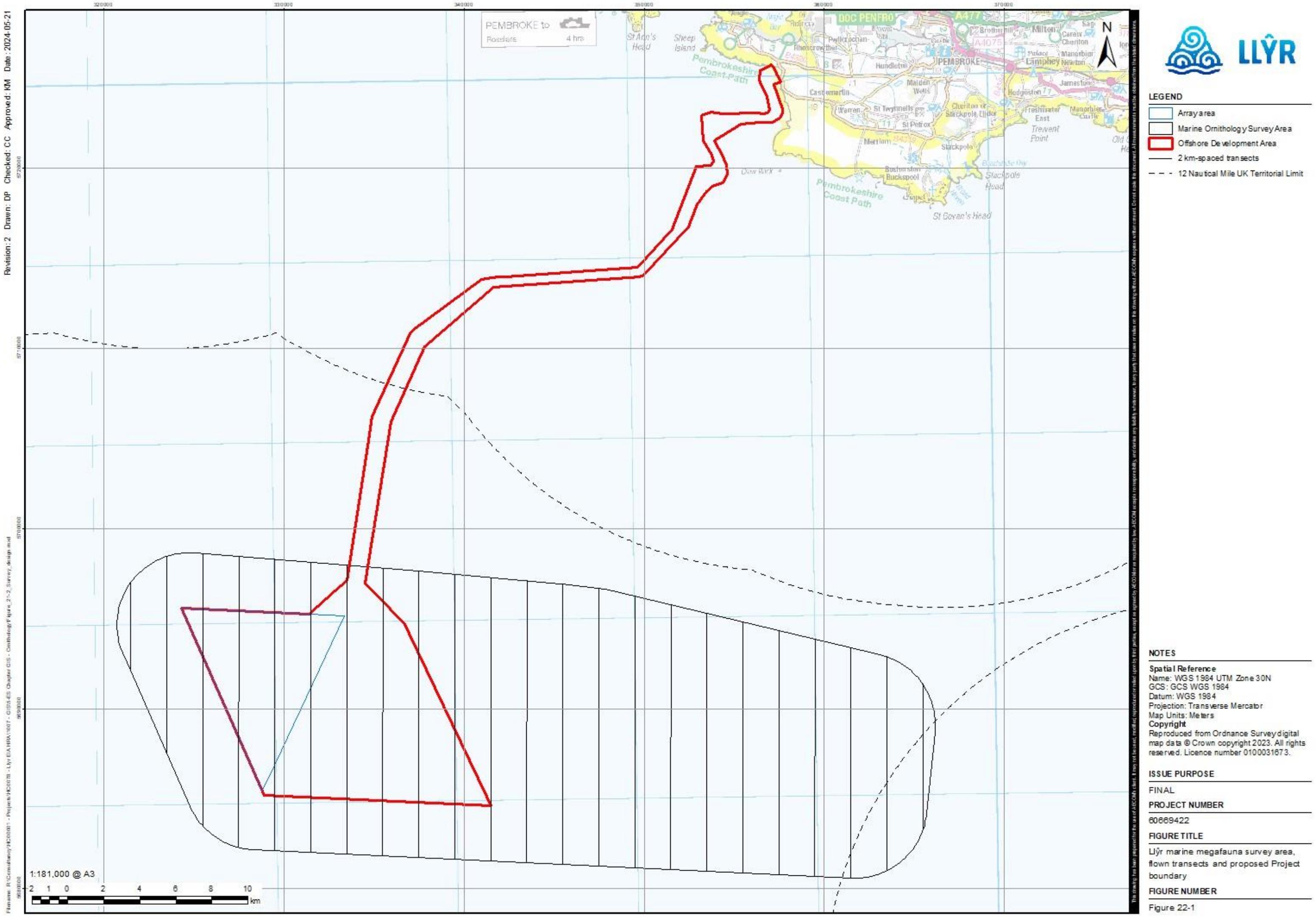

Figure 22-1. Llŷr 1 Offshore Development Area, showing the marine ornithology survey area and flown transects

Desk Study

38. A comprehensive desk-based review was undertaken to inform the marine ornithological baseline. Key data sources used to inform the assessment are set out in **Table 22-12**.

Table 22-12. Data sources used to inform the baseline characterisation marine ornithology

Data source	Year(s)	Brief description	Reference
Site-specific Digital video Aerial Surveys (DAS) for the proposed Project	2020 –2022	Site-specific digital aerial surveys for the proposed Project recording ornithological and marine mammal activity	Pavat *et al*.
The Birds of Wales	2021	Contextual information	Pritchard *et al.*
The Seabird Monitoring Programme (SMP) Database	Various	Colony data to determine breeding seabird populations with potential connectivity to the proposed Project. Also used in reference to any colony-specific PVA modelling requirements (i.e., Castlemartin SSSI guillemot population).	British Trust for Ornithology (BTO)
The status of our bird populations: the fifth birds of conservation Concern in the UK, Channel Islands and Isle of Man and second IUCN red list assessment of extinction risk for Great Britain	2021	Assesses and assigns 245 species to updated Red, Amber and Green lists of conservation concern	Stanbury *et al.*
Desk-based revision of seabird foraging ranges used for Habitats Regulation Assessment (HRA) screening	2019	Updated foraging ranges for 25 seabird species (including key species) in the UK	Woodward *et al.*
Non-breeding season populations of seabirds in UK waters	2015	Reviews and defines species-specific non-breeding season seabird populations at biologically defined minimum population scales (BDMPS) in the UK	Furness
Spatial Protection Area (SPA) citations and conservation objectives	Various	SPA information (primarily relevant to HRA)	NRW (A) and JNCC

Data source	Year(s)	Brief description	Reference
Assessing vulnerability of marine bird populations to offshore wind farms	2013	Provides a species sensitivity index to key offshore wind impacts on marine ornithological receptors (collision risk and disturbance/ avoidance)	Furness *et al*.
The Welsh Atlas Modelled Distributions and Abundance of Cetaceans and Seabirds of Wales and Surrounding Waters	2023	Distribution maps of cetacean and seabird species regularly occurring within the Irish Sea, Bristol Channel and parts of the Celtic Sea (Celtic Deep)	Evans and Waggitt
Distribution of seabirds in the North-East Atlantic	2020	Species Distribution Model (SDM) maps illustrating predicted densities of seabirds (including key species kittiwake, puffin, guillemot, fulmar, gannet and razorbill) around the British Isles	Waggitt *et al*.
Analyses of European Seabirds at Sea (ESAS) data	2024	A database of offshore monitoring data on seabirds and marine mammals in the North Sea and Northeastern Atlantic	ESAS database (hosted by ICES)
Project Erebus Environmental Statement (ES), Supplementary Environmental Information and associated appendices	2022	Environmental statements and appendices (including collision risk and displacement) from the neighbouring Project Erebus. Used for context and also included in the cumulative assessment.	Marine Space
Awel y Mor, White Cross, Morlais tidal and Twin Hub project ES, RIAAs and planning information	Various	The other key projects included in cumulative assessment	Various

22.5 Baseline

39. This section provides information on the regional populations, colonies and designated sites related to the assessed seabird species, as well as a summary of the apportioning of seabird species to these colonies.

22.5.1. Existing Baseline

40. **Appendix 22A: Marine Ornithology Baseline** provides a detailed characterisation of the baseline relating to marine ornithology receptors, which should be read in conjunction with this Chapter.

41. The seabird species to be addressed in marine ornithological assessment for the proposed Project were agreed with NRW (A) and JNCC at the meeting on 9 May 2023 (**Table 22-5**). These are the species recorded in most abundance within the survey area during the two-year DAS programme.

- Kittiwake;
- Lesser black-backed gull;
- Guillemot;
- Razorbill;
- Puffin;
- Gannet; and
- Manx shearwater.

Two additional species were included for qualitative assessment at the request of NRW (A) and JNCC (at the 9 May 2023 meeting), as well as by RSPB (at the stakeholder briefing held on 7 July 2023):

- Balearic shearwater; and
- Storm petrel.

42. NRW (A) also requested that design-based density estimates be presented for great black-backed gull (*Larus marinus*) and herring gull (*Larus argentatus*) and this has been done in **Appendix 22A: Marine Ornithology Baseline**, where these two species are further discussed. (See **Appendix 22A: Annex D – Design-Based Estimates** for the estimates themselves.)

43. Within the Llŷr marine ornithology survey area and Array Area, a total of 17 and 12 seabird species were recorded during the digital aerial surveys, amounting to a total of 46,921 and 3,620 birds, respectively. Aggregation of birds and usage of the proposed Project Array Area varied throughout the seasons, but with the greatest numbers of most species recorded during non-breeding periods. Further details are given in the **Species Accounts** below.

Seabird Colonies and Designated Sites

44. Seabirds are central place foragers, and as such, they will leave their coastal or island breeding colonies during the breeding season to feed at sea and provide for their offspring. For each focal species considered in assessment, the individuals recorded within the proposed Project Array Area may have originated from a variety of colonies located within foraging-range. The breeding populations of seabirds at these colonies are usually afforded protection, with the colonies designated as Special Protection Area (SPAs) and/or Sites of Special Scientific Interest (SSSIs).

45. **Appendix 8D: HRA Screening** and **Appendix 22B: Marine Ornithology Colony Apportioning** together set out the long list of SPAs and SSSIs screened for assessment. These represent the designated sites which lie within foraging range of the proposed Project for at least one of more of their qualifying breeding seabird interests (**Table 22-10**).

46. In addition to these protected breeding colonies, areas of sea that are designated as important for foraging seabirds (i.e., marine SPAs) have also been considered and included in the HRA screening process (**Appendix 8D**).

47. The screening which has been undertaken (as reported in **Appendix 8D** and **Appendix 22B** noted above) identifies the following key designated sites to address under HRA and EIA:

- *Skomer, Skokholm and Seas off Pembrokeshire (SSSP) SPA*; designated for the protection of its breeding seabird assemblage, as well as internationally important populations of puffin, lesser black-backed gull, storm petrel and Manx shearwater (JNCC, 2017).
- *Grassholm SPA*; designated for the protection of an internationally important population of gannet, being the third largest gannetry in the world and supporting 12.5% of the breeding North Atlantic population (JNCC, 2015a).
- *Irish Sea Front SPA;* a marine SPA designated as an important feeding area for Manx shearwater, with the birds from a numbers of different breeding colonies travelling to use the site (JNCC, 2016).
- *Castlemartin Range SSSI;* designated to protect guillemots as well as supporting other breeding seabirds.

48. The SPAs are addressed under HRA as reported in Appendix 8E: HRA RIAA while Castlemartin SSSI is included for colony-specific EIA assessment in relation to guillemot in **Section 22.8**.

49. As reported in **Appendix 22B**, there are 11 Welsh SSSIs which were included in screening as being within foraging range of the proposed Project for their breeding seabird interests; Castlemartin Range (as noted above), Aberarth Carreg Wylan, Carreg y Llam, Pen y Gogarth / Great Ormes Head, Creigiau Rhiwledyn / Little Ormes Head, Ramsey Island, Flat Holm, Gower Coast: Rhossili to Porteynon, Ynysoedd Y Gwylanod and Gwylan Islands, and the Skerries.

50. Whilst these SSSIs are referenced for context, where relevant in the Species Accounts below, it is only for the guillemot population at Castlemartin Range SSSI that a colony-specific EIA assessment is necessary. Of the other nine sites, the six marked with an asterisk underpin an SPA designation and are therefore addressed in **Appendix 8E: HRA RIAA** and are not separately assessed in this Chapter.

51. The remaining three Welsh SSSIs which are not further progressed are those where the colony apportioning weightings are so low that negligible impacts would be assigned against their breeding populations (**Appendix 22B: Marine Ornithology Colony Apportioning**).

52. This is also true for the two additional SSSIs located outside Welsh waters; Lundy Island and the Isles of Scilly; and therefore these are not taken forward to assessment in this chapter.

Regional Populations

53. **Table 22-13** presents the regional populations advised by NRW (A) and JNCC in their advice note of 15 June 2023, against which to assess impacts under EIA (breeding/non-breeding). The populations against which to consider total annual impacts are shaded grey in the table.

Table 22-13. Regional baseline populations for breeding and non-breeding seasons

Species	Breeding season BDMPS reference population*	Autumn/ post-breeding BDMPS**	Winter/ non-breeding BDMPS**	Spring/ pre-breeding BDMPS**	Relevant BDMPS and Tables from Appendix A of Furness (2015) used
Kittiwake	245,234	911,586	-	691,526	Western waters and Channel, Tables 48/50
Lesser black-backed gull	240,750	163,304	41,159	163,304	Western waters, Tables 37/41
Guillemot	1,145,528	-	1,139,220	-	Western waters, Table 63
Razorbill	198,969	606,914	341,422	606,914	Western waters Table 65
Puffin	1,482,791	-	304,557	-	Western waters, Table 69
Manx shearwater	1,821,544	1,580,895	-	1,580,895	Western waters and Channel, Table 13
Gannet	522,888	545,954	-	661,888	Western waters, Tables 15/17

**Sum of adults and immatures at all relevant colonies*
*** Non-breeding season BDMPS from Furness (2015)*

Species Sensitivity

54. **Table 22-14** (as also presented in **Appendix 8D: HRA Screening**) provides a summary of species sensitivity to disturbance/displacement and collision risk impact pathways[3], based on the species sensitivity scorings given in Furness *et al.* (2013). This is the information referenced in the **Species Accounts** sections below and used within the impact assessment (**Section 22.8**) for marine ornithology receptors.

55. For displacement/disturbance, Furness *et al.* (2013) suggest species with an index value below eight (**Displacement/Disturbance, Species concern index value in Table 22-14**) are 'very unlikely' to be affected by this impact. However, post-construction monitoring data does suggest that gannet, Manx shearwater and storm petrel may be sensitive to displacement and barrier effects from offshore wind farms (SNCB, 2022, Krijsveld, *et al*., 2011, Vanermen *et al*., Wade *et al.,* 2016 so they are also addressed in relation to this impact (**Section 22.8**).

56. For collision risk, species with a total risk score of 100 or more (**Collision, Total risk score in Table 22-14**) have been screened in for further consideration under this impact pathway.

[3] The full list of impact pathways scoped in for assessment is presented later in the Chapter, in **Table 22-15**.

Table 22-14. Species sensitivity scoring as outlined in Furness et al. (2013)

Species	Displacement / Disturbance				Collision				
	Conservation importance score	Disturbance by ship and helicopter traffic	Habitat use flexibility	Species concern index value	Flight % at blade height	Flight agility	% of time flying	night flight	Total risk score
Kittiwake	14	2	2	**6**	16	1	3	3	**523**
Lesser black-backed gull	16	2	1	**3**	30	1	2	3	**960**
Guillemot	16	3	3	**14**	1	4	1	2	**37**
Razorbill	16	3	3	**14**	1	4	1	1	**32**
Puffin	16	2	3	**10**	1	3	1	1	**27**
Storm petrel	17	1	1	**2**	2	1	3	4	**91**
Manx shearwater	17	1	1	**2**	0	3	3	3	**0**
Gannet	17	2	1	**3**	16	3	3	2	**725**

Species Accounts

57. This section provides a summary account for each of the focal seabird species in assessment, covering behavioural ecology, conservation value, context (from the range of data sources noted in **Table 22-12**) and key information about usage of the proposed Project Array Area as derived from the DAS survey observations reported in **Appendix 22A: Marine Ornithology Baseline**. A summary of likely species occurrence specifically in relation to the **Offshore Export Cable Corridor** is included at the end of these species' accounts.

Kittiwake

58. Of the gull species, kittiwake is the most numerous globally (JNCC, 2021a). Kittiwakes occupy coastal colonies during the breeding season, the majority of which are situated on vertical rocky cliffs (JNCC, 2021a). They feed on a wide range of prey; high-energy fish species such as sandeels, immature herring, and sprats are especially important during the breeding season (BirdLife International, 2021a; JNCC, 2021a). The species has been declining over the last 20 years and this is mainly caused by shortages of their prey species (Evans and Waggitt, 2023).

59. Less is known about UK kittiwake abundance outside of the breeding season. Furness (2015) reported large variation in kittiwake numbers in the UK Western Waters BDMPS, with a total of 911,586 individuals estimated in this region during the autumn (August-December) migration and 691,526 during the spring (January-April) migration (292,074 and 362,814 from the UK population respectively). Although the cause of this variation is not known, food availability and weather conditions are thought to be important drivers (Furness, 2015).

60. Kittiwakes are of high conservation importance in the UK, red-listed as a Bird of Conservation Concern and classified as vulnerable under the International Union for Conservation of Nature (IUCN) Red list (JNCC, 2021a). Kittiwake are also listed in the EC Birds Directive as a migratory species as well as an OSPAR Threatened and / or Declining Species (Stanbury *et al.*, 2021).

61. Kittiwake was the third most abundant bird species recorded in the proposed Project Array Area during the non-breeding season, with a peak modelled population estimate of 588 individuals (95% CI 485 – 709) [13.10birds/km^2 (95% CI 10.80 – 15.79)] in October 2020 (autumn migration) (**Appendix 22A**).

62. The species distribution model produced by Evans and Waggitt (2023) shows the highest predicted densities of kittiwake in the Celtic and Irish seas to be around the colonies off Pembrokeshire and off County Wexford and County Dublin in Ireland. The NRW guidance note shows a similar general pattern with hotspots off Ireland and Pembrokeshire, just north of the Array Area. The NRW guidance suggests the Array Area is utilised by kittiwake less than the northwest areas of both the Celtic and Irish seas. The predictions of Evans and Waggitt (2023) suggest the Array area is likely to have the greatest kittiwake densities between January and March, and the lowest densities between July and September.

63. Kittiwakes present a relatively moderate foraging range compared to other seabird species, with a mean maximum range of 156.1 km ±144.5 SD (Woodward et al., 2019).

64. The SSSI sites that were considered for kittiwake include: Lundy Island, Aberarth Carreg Wylan, Carreg y Llam, Pen y Gogarth / Great Ormes Head, Ramsey Island, and Creigiau Rhiwledyn / Little Ormes Head (**Appendix 22B**). Lundy Island was the SSSI with the highest apportioned weighting of 0.056 and Creigiau Rhiwledyn / Little Ormes Head had the lowest apportioned rating of 0.003. Due to these low apportioning weightings to each of the SSSIs, they were not taken forward to assessment.

65. Following advice received from NRW and JNCC (note of 15th June 2023), assessment will be carried out for total annual impacts considered against the largest BDMPS. For kittiwakes, this will, therefore, be assessed against the autumn/post-breeding BDMPS season of 911,586 individual birds (**Table 22-13**; Furness, 2015).

66. According to Furness *et al.* (2013), and as agreed with NRW (A), kittiwakes are considered to be of high sensitivity to collision impacts and assessed on this basis (**Appendix 22C**). Although kittiwake are not considered to be particularly sensitive to displacement, information on kittiwake displacement has been included in **Appendix 22D** as requested by JNCC. Kittiwake species sensitivity is presented in **Table 22-14**.

Lesser Black-Backed Gull

67. Lesser black-backed gulls nest in a range of environments, in both natural and manmade settings, often alongside herring gulls (Banks and Murphy et al., 2023). Lesser black-backed gulls also have varied diets and are able to switch between food sources depending on the surrounding availability (Thaxter et al., 2015 as referenced in Banks and Murphy, 2023). Lesser black-backed gulls live for an average of 15 years, begin breeding at around 4 years old and lay an average of 3 eggs per breeding season (Banks and Murphy et al., 2023; BTO, 2023).

68. Lesser black-backed gulls are of high conservation status in the UK; listed in the EC Birds Directive as a migratory species and amber listed as a Bird of Conservation Concern as the UK is home to over 40% of the European population (Eaton *et al*., 2015; Stanbury *et al.,* 2021; JNCC, 2021b). Despite this, European populations continue to grow and some individuals even remain in the breeding areas becoming year-round residents throughout their breeding range, where they build nests in colonies that they frequently share with herring gulls (BirdLife International, 2021b; JNCC, 2020b).

69. The species lives mainly around coastal and inland waters but venture further out at sea to feed Kim *et al*., 2006). They have a relatively moderate foraging range compared to other seabird species, with a mean maximum range of 127 km ±109 SD (Woodward *et al.,* 2019).

70. Lesser black backed gulls begin migrating in the second half of July and rapidly move away from the northern-most colonies. Despite this, their numbers in the Celtic and Irish Seas remain fairly high throughout the winter (Furness, 2015). Furness (2015) estimated the total

number of lesser black-backed gulls in UK Western Waters BDMPS region during winter (Nov-Feb) to be 41,159 (33,533 from the UK population)

71. In the Array Area, lesser black-backed gulls were recorded in greater numbers during the breeding season with a peak modelled population estimate of 8 individuals (95% CI 5 – 13) [0.18 birds/km^2 (95% CI 0.11 – 0.29)] in June 2020 (**Appendix 22A**).

72. The SSSI sites that were considered for lesser black-backed gull include: Flat Holm, Aberarth Carreg Wylan, and Ramsey Island (**Appendix 22B**). Flat Holm was the SSSI with the highest apportioned weighting of 0.020, while Aberarth Carreg Wylan and Ramsey Island SSSIs had the lowest apportioned rating of 0.008 and 0.007, respectively. Due to these low apportioning weightings to each of the SSSIs, they were not taken forward to assessment.

73. During the Seabird 2000 census (1998 – 2002) the Welsh regional population of lesser black-backed gull reached 20,722 AONs (JNCC, 2021b). The Welsh breeding population is provisionally estimated at 10,190 AONs along the coast and more than 3,244 on inland rooftops (Evans and Waggitt, 2023). Following advice received from NRW and JNCC (note of 15th June 2023), assessment will be carried out for total annual impacts considered against the largest BDMPS. For lesser black-backed gull, the total predicted annual impact should therefore, be assessed against the breeding BDMPS season of 240,750 individuals (**Table 22-13**; Furness, 2015).

74. Lesser black-backed gulls are considered to be highly sensitive to collision impacts (Furness *et al.,* 2013) and as agreed with NRW (A), have been assessed on this basis (**Appendix 22C**). Furness *et al.* (2013) do not consider lesser black-backed gulls to be particularly sensitive to displacement, and this impact has therefore not been scoped in for assessment. Species sensitivity is outlined in **Table 22-14**.

Guillemot

75. Guillemot is one of the most numerous seabird species recorded in the UK. Adults spend most of their time at sea, spending time on land only to nest where they will lay a single egg between mid-April/May, with incubation lasting 33-34 days. Their young leave the colony 20 days after hatching (Gilbert *et al.,* 2011) and remain in the care of the adult male at sea from the end of June to August. During this time both adults and chicks are flightless.

76. Guillemots are pursuit divers and routinely forage to depths of 60 m (Robinson, 2005). They feed on a wide range of prey; high-energy fish species such as sandeels, immature herring, and sprats are especially important (Anderson *et al*., 2014). During the non-breeding season, tagged guillemot on the Isle of May, Scotland, were recorded diving as deep as 118 m (Dunn *et al*., 2019).

77. Guillemot often remain close to their colonies year-round with juveniles tending to disperse further than adults. It is considered likely that seasonal movements are linked to the abundance and distribution of prey, which also effects guillemot overwinter survival (Furness, 2015). According to Furness (2015) the number of guillemots in UK Western Waters BDMPS region during the non-breeding season (Aug-Feb) is 1,139,220 in total (1,105,020 from the UK population).

78. Guillemots are of high conservation status in the UK; they are amber-listed as a Bird of Conservation Concern and are listed in the EC Birds Directive as a migratory species (Stanbury *et al*., 2021; JNCC, 2021c).

79. In the Array Area, guillemot was the most abundant bird species, recorded in all months with a peak absolute modelled population estimate of 8,953 individuals (95% CI 8,304 – 9,517)

[184.54 birds/km^2 (95% CI 165.54 – 207.38)] in October 2020 (during the non-breeding season) (**Appendix 22A**).

80. The species distribution model produced by Evans and Waggitt (2023) shows that predicted guillemot densities are generally higher in the Irish Sea than the Celtic Sea, in particular off County Wexford and County Dublin, as well as areas off the west coast of Wales. Around the Array Area there is a gradient of high densities around the colonies in the northeast and lower densities moving southwest, this is most evident in July – September (Evans and Waggitt, 2023).

81. NRW guidance shows a similar pattern around the colonies, with guillemot utilising areas off Country Wexford and County Dublin (NRW, 2022). However, the NRW guidance suggests greater utilisation of large area off Pembrokeshire, extending out towards the Array Area, as well as high utilisation of other areas along the Welsh coast. Additionally, outside of the colonies it does not indicate that the Irish Sea has greater guillemot utilisation than the Celtic Sea (NRW, 2022).

82. Guillemots present a relatively small foraging range compared to other seabird species, with a mean maximum range of 73.2 km ±80.5 SD (Woodward *et al.,* 2019). A summary of the SPAs and SSSIs within foraging range for which the species is a protected feature is provided in **Appendix 22B**. Of these protected areas, most impacts are to be apportioned against the Skomer, Skokholm and the Seas Off Pembrokeshire SPA and Castlemartin Range SSSI.

83. The SSSI sites that were considered for guillemot include: Castlemartin Range, Lundy Island, Ramsey Island, and Gower Coast: Rhossili to Porteynon (**Appendix 22B**). Castlemartin Range was the SSSI with the highest apportioned weighting of 0.360 and Gower Coast: Rhossili to Porteynon had the lowest apportioned rating of 0.001. Due to the relatively high apportioning weighting of the Castlemartin Range SSSI, this was the only SSSI taken forward to assessment.

84. Following advice received from NRW and JNCC (note of 15th June 2023), assessment will be carried out for total annual impacts considered against the largest BDMPS. Thus for guillemot, this will be assessed against the breeding BDMPS of 1,145,528 individual birds (**Table 22-13**; Furness, 2015).

85. Guillemot are considered to be highly sensitive to displacement impacts (Furness *et al.,* 2013) and, as agreed with NRW, were assessed on this basis (**Appendix 22D**). Furness *et al.* (2013) do not consider guillemot to be particularly sensitive to collision risk as only 1% fly at turbine blade height. The species has, therefore, not been scoped in for this impact. Species sensitivity is outlined in **Table 22-14**.

Razorbill

86. Razorbills breed commonly around the UK and are often found in dense concentrations at sea associated with guillemots. In UK waters, the species is most abundant during the summer and autumn months and disperses southwards during the winter. Like guillemots, the species becomes flightless between July and August when the male parent accompanies its chick out to sea. Razorbills, like guillemots and puffins are pursuit divers and feed on a range of prey including krill, sprat and sandeels (Nettleship, 1996 as referenced in BirdLife International, 2021c; Mitchell *et al.*, 2004).

87. Razorbills generally migrate southwards in the autumn, but adults and juveniles remain closer to colonies than immatures (Furness, 2015). According to Furness (2015) the number of razorbills in UK Western Waters BDMPS region during the non-breeding season (Nov-Dec) is 341,422 in total (53,063 from the UK population). During the migration periods (Aug-Oct and Jan-Mar) the numbers is estimated at 606,914 (190,035 from the UK population).

88. Razorbills are of high conservation status in the UK; amber listed as a Bird of Conservation Concern and listed in the EC Birds Directive as a migratory species (Stanbury *et al*., 2021; JNCC, 2021d).

89. In the Array Area, razorbill was the fourth most abundant bird species, recorded in greater numbers during the large non-breeding season with a peak absolute modelled population estimate of 602 individuals (95% CI 472 – 764) [12.62 birds/km^2 (95% CI 8.36 – 18.38)] in October 2020 and 859 individuals (95% CI 702 – 1035) [10.94 birds/km^2 (95% CI 6.99 – 16.73)] in October 2021 (**Appendix 22A**).

90. The species distribution model produced by Evans and Waggitt (2023) shows for razorbills the highest predicted densities around the colonies off Pembrokeshire, County Wexford and Country Dublin (Evans and Waggit, 2023). There is large variation throughout the year, although the densities are generally higher in the Irish Sea compared to the Celtic Sea.

91. The highest densities around the Array area would be expected in January to March and the lowest densities July to September (Evans and Waggitt, 2023). The NRW guidance shows a similar pattern with higher utilisation of the Irish Sea in general, as well as around colonies off Pembrokeshire, County Wexford and County Dublin (NRW, 2022). Both maps also show high use around Lundy (NRW, 2022; Evans and Waggitt, 2023).

92. Razorbills present a relatively small foraging range compared to other seabird species, with a mean maximum range of 88.7 km ±75.9 SD (Woodward *et al.,* 2019). A summary of the SPAs and SSSIs within foraging range for which the species is a protected feature is provided in **Appendix 22B**. Of these protected areas, most impacts are to be apportioned against the Skomer, Skokholm and the Seas Off Pembrokeshire SPA and Castlemartin Range SSSI.

93. The other SSSI sites that were considered for razorbill include: Lundy Island, Ramsey Island, and Gower Coast: Rhossili to Porteynon (**Appendix 22B**).

94. Following advice received from NRW and JNCC (note of 15th June 2023), assessment will be carried out for total annual impacts considered against the largest BDMPS. Thus for razorbill, this will be assessed against the autumn/post-breeding and spring/pre-breeding BDMPS of 606,914 individual birds (**Table 22-13**; Furness, 2015).

95. Razorbill are considered to be highly sensitive to displacement impacts (Furness *et al.,* 2013) and, as agreed with NRW (A) and JNCC were assessed on this basis (**Appendix 22D**). Furness *et al.* (2013) do not consider razorbill to be particularly sensitive to collision risk with turbine blades as they do not fly high enough. The species has, therefore, not been scoped in for this impact. Species sensitivity is outlined in **Table 22-14**.

Puffin

96. Puffins are one of the most iconic species in the UK, particularly recognisable with its coloured bill. Unlike other auk species, puffins nest in burrows and are therefore vulnerable to terrestrial predators such as rats, but also other seabirds such as gulls. To avoid such conflict, puffins often breed on offshore islands and steep coastal cliffs.

97. Puffins are pursuit divers and commonly feed on sandeel, but will also hunt for sprat, herring and a wide range of small juvenile gadoid fish. Puffins are migratory; in Welsh waters they are most abundant during the spring and summer months and then disperse mainly westwards during the winter (Pritchard *et al*., 2021).

98. Puffins migrate away from colonies out to sea where they disperse widely. A study of a Welsh colony showed westward movement during the migration with most moving to waters in between Newfoundland and Iceland (Guildford *et al.,* 2011 as referenced in Furness, 2015).

According to Furness (2015) the number of puffins in UK Western Waters BDMPS region during the non-breeding season (mid Aug-Mar) is 304,557 in total.

99. Puffins are of high conservation status in the UK; red listed as a Bird of Conservation Concern, listed in the EC Birds Directive as a migratory species and classified as vulnerable under the IUCN Red list (Stanbury *et al*., 2021; JNCC, 2021e).

100. In the Array Area, puffins were recorded in relatively moderate numbers, mainly recorded during the non-breeding season with a peak absolute modelled population estimate of 444 individuals (95% CI 343 – 539) [9.89 birds/km^2 (95% CI 7.64 – 7.64)] in March 2020 (**Appendix 22A**).

101. The species distribution model produced by Evans and Waggitt (2023) shows the highest predicted puffin densities are off Pembrokeshire, extending up into the Irish sea, this is particularly the case in July-September (Evans and Waggitt, 2023). Predictions show it is likely that there are more puffins around the Array Area than most parts of the Celtic Sea to the south and the west (Evans and Waggitt, 2023).

102. Puffins present a relatively moderate foraging range compared to other seabird species, with a mean maximum range of 137.1 km ±128.3 SD (Woodward *et al.,* 2019). A summary of the SPAs and SSSIs within foraging range for which the species is a protected feature is provided in **Appendix 22B**. Of these protected areas, most impacts are to be apportioned against the Skomer, Skokholm and the Seas Off Pembrokeshire SPA.

103. The SSSI sites that were included for puffin include: Lundy Island, Ynysoedd Y Gwylanod, Gwylan Islands, The Skerries, Ramsey Island and Castlemartin Range (**Appendix 22B**). Lundy Island was the SSSI with the highest apportioned weighting of 0.011 and Castlemartin Range had an apportioned weighting of zero. Due to these low apportioning weightings to each of the SSSIs, they were not taken forward to assessment.

104. Following advice received from NRW and JNCC (note of 15 June 2023), EIA assessment will be carried out for total annual impacts considered against the largest BDMPS. For puffins, this will, therefore, be assessed against the breeding BDMPS season of 1,482,791 individual birds (**Table 22-13**; Furness, 2015).

105. Puffin are considered to be highly sensitive to displacement impacts (Furness *et al.,* 2013) and, as agreed with NRW (A) and JNCC, have been assessed on this basis (**Appendix 22D**). Furness *et al.* (2013) do not consider puffin to be particularly sensitive to collision risk as only 1% fly at turbine blade height. The species has, therefore, not been scoped in for this impact (see **Section 22.6**). Species sensitivity is outlined in **Table 22-14**.

Gannet

106. The UK hosts the largest number of northern gannets in the world, with the Grassholm colony, in the vicinity of the Project, the third's largest colony in the UK. Large gannet colonies are found on the mainland but are primarily predominant on offshore islands (BirdLife International, 2021d). This maritime species feeds on high-energy shoaling species such as sandeels, immature herring, mackerel and sprat. Gannets are deep diving seabirds, diving up to 20 m (BirdLife International, 2021d; JNCC, 2021h) and are typically found scavenging in close proximity to fishing vessels. In the last few years, it has become clear that gannets have been particularly impacted by the highly pathogenic avian influenza virus although it is not fully understood the reason for this (Lane *et al*., 2023).

107. Adult gannets may initially migrate to areas with abundant food sources prior to heading to wintering areas between the Norst Sea and off West Africa (Furness, 2015). Furness (2015) estimated the total number of gannets in UK Western Waters BDMPS region during the

autumn migration (Sep-Nov) to be 545,954 (482,605 from the UK population) and 661,888 during the spring migration (Jan- Apr) (596,185 from the UK population).

108. Gannets are of high conservation status in the UK; they are amber-listed as a Bird of Conservation Concern and listed in the EC Birds Directive as a migratory species (Stanbury *et al*., 2021; JNCC, 2021h).

109. Gannet were recorded in relatively moderate numbers within the Array Area, primarily during the breeding season and autumn migration season with a peak modelled population estimate of 277 individuals (95% CI 202 - 381) [6.17 birds/km^2 (95% CI 4.50 – 8.49)] in October 2021 (during the autumn migration). Throughout the whole Llŷr Marine Ornithology Survey Area, a total of five dead gannets were recorded in February, May, June and July 2021 (**Appendix Report 22A**). Gannet were the only species in which dead individuals were recorded.

110. The species distribution model produced by Evans and Waggitt (2023) shows for gannets the highest predicted densities around the colonies off Pembrokeshire, extending southwards into the Celtic Sea. The Celtic Sea has greater density predictions of gannets than the Irish Sea and densities around the Array Area are likely to be higher in April-June and July-September (Evans and Waggitt, 2022).

111. Gannets present a relatively large foraging range compared to other seabird species, with a mean maximum range of 315.2 km ±194.2 SD (Woodward *et al.,* 2019). A summary of the SPAs and SSSIs within foraging range for which the species is a protected feature is provided in **Appendix 22B**. Of these protected areas, most impacts are apportioned against Grassholm.

112. Following advice received from NRW and JNCC (note of 15 June 2023), EIA assessment will be carried out for total annual impacts considered against the largest BDMPS. For gannets, this will, therefore, be assessed against the spring / pre-breeding BDMPS season of 661,888 individuals (**Table 22-13**; Furness, 2015).

113. Gannet are considered to be sensitive to both collision risk and displacement impacts (Furness *et al*., 2013; SNCB, 2022) and, as agreed with NRW (A) and JNCC have been assessed on this basis (**Appendix 22C** and **Appendix 22D**). Species sensitivity is outlined in **Table 22-14**.

Manx Shearwater

114. Similar to puffins and storm petrels, Manx shearwaters are vulnerable to land predators and therefore, breed on offshore islands. To avoid predation risk from other birds, Manx shearwaters can only be found onshore during the night, where they nest in burrows during the breeding season (JNCC, 2021g). The species is mainly present in the UK during the summer months.

115. Outside of the breeding season they spend their time at sea, migrating to the coast of South America for the winter and travelling back to the UK in late February and March. Over 50% of the world's population of Manx shearwater can be found in Wales, primarily within the Skomer, Skokholm and the Seas Off Pembrokeshire SPA (Evans and Waggitt, 2023). Manx shearwaters generally prey on small schooling fish species such as sandeels, immature herring and sprat (Carboneras *et al*., 2014 as referenced in BirdLife International, 2021e).

116. The vast majority of the birds present in UK waters during the migration period are considered to originate from British colonies (Furness, 2015). Furness (2015) estimated the number of Manx shearwaters in UK Western Waters plus channel BDMPS region during the migration seasons (Aug- early Oct and late Mar-May) to be 1,580,895 (1,569,800 from the UK population).

117. Manx shearwaters are of high conservation status in the UK; amber-listed as a Bird of Conservation Concern and listed in the EC Birds Directive as a migratory species (Stanbury *et al*., 2021; JNCC, 2021g).

118. In the Array Area, Manx shearwaters were mainly recorded during the spring migration and UK breeding season with a peak modelled population estimate of 1,375 individuals (1,189 – 1,592) [30.62 birds/km^2 (95% CI 26.48 – 26.48] in March 2022 (during spring migration) (**Appendix 22A**).

119. The species distribution model produced by Evans and Waggitt (2023) shows the highest predicted Manx shearwater densities are around colonies off Pembrokeshire as well as Bardsey Island. Around the Array Area there is a gradient of high densities around the colonies in the northeast and lower densities moving southwest. There is large variation in Manx shearwater densities over the year, although in general there are greater number within the Irish Sea compared to the Celtic Sea (Evans and Waggitt, 2023).

120. Manx shearwaters present a large foraging range compared to other seabird species, with a mean maximum range of 1346.8 km ±1018.7 SD (Woodward *et al.,* 2019). A summary of the SPAs and SSSIs within foraging range for which the species is a protected feature is provided in the **Appendix 22B**. Of these protected areas, most impacts are to be apportioned against the Skomer, Skokholm and the Seas Off Pembrokeshire SPA.

121. The SSSI sites that were included for Manx shearwater include: Lundy Island and Ramsey Island (**Appendix 22B**). Both SSSIs had a very low apportioned weighting of 0.006 and were therefore not taken forward to assessment.

122. Following advice received from NRW and JNCC (note of 15 June 2023), EIA assessment will be carried out for total annual impacts considered against the largest BDMPS. Total predicted annual impact for Manx shearwaters should be assessed against the breeding BDMPS season of 1,821,544 individuals.

123. While Manx shearwaters are not considered to be particularly sensitive to displacement impacts (Furness *et al*., 2013) they have been included for assessment here (**Appendix 22D**) based on advice received from NRW (A), JNCC, RSPB and the Wildlife Trusts (**Table 22-5**). Species sensitivity is outlined in **Table 22-14**.

Balearic Shearwater

124. Balearic shearwater are the Mediterranean cousin of Manx shearwater, nesting solely in burrows and caves on the islands of Mallorca, Menorca and Ibiza however, there is some evidence that between 2% and 23% of the global population utilise the Celtic Sea front each year as they disperse from the Mediterranean in the post-breeding season (Davies *et al*. 2021).

125. Balearic shearwaters start breeding after about three years and only lay one egg per breeding season (Oro et al., 2004 as referenced in BirdLife International 2021f). Balearic shearwaters feed mainly on small fish, crustaceans and squid (del Hoyo *et al.* 2014 as referenced in BirdLife International 2021f).

126. The species is of high conservation status in the UK; they are red-listed as a Bird of Conservation Concern in addition to being classified as critically endangered under the IUCN Red list (Stanbury *et al*., 2021; IUCN, 2018).

127. No Balearic shearwater were recorded in the Llŷr Marine Ornithology Survey Area throughout the survey period (**Appendix 22A**).

128. There were too few Balearic shearwaters for Evans and Waggitt (2023) to be able to produce density models however, it is mentioned that most recordings of Balearic shearwaters

occurred mainly in the Bristol Channel (roughly 30 km east of the Array Area at its nearest point) and Celtic Deep (which is a similar distance to the west of the Array Area).

129. While Balearic shearwaters are not a species addressed in the available sensitivity scores they have been included for assessment in relation to displacement based on advice received from NRW (A), JNCC, RSPB and the Wildlife Trusts (**Table 22-5**). As there were no observations of this species at any point during the digital aerial survey programme, only qualitative assessment is possible.

Storm Petrel

130. Storm petrel is the smallest breeding seabird in the UK and Ireland, spending the vast majority of its life at sea during the non-breeding season. As the species is particularly vulnerable to land predators such as rats, it breeds almost exclusively on remote rocky islands (Evans and Waggitt, 2023). Over 80% of the UK population is found in Scotland, with smaller numbers recorded in western Wales and the Isles of Scilly.

131. Storm petrels feed on small fish and zooplankton up to five metres below the surface with foraging trips lasting between one to three days (Hughes and Perkins, 2023; Bolton, 2021). Storm petrels live an average of around 11 years and begin breeding at about the age of four (BTO, 2023).

132. Storm petrels are of high conservation importance in the UK; they are amber-listed as a Bird of Conservation Concern and are listed in the EC Birds Directive as a migratory species and Annex I species (Stanbury *et al*., 2021; JNCC, 2021f).

133. Due to the low numbers observed during site specific DAS, modelling could not be undertaken, therefore, only design-based estimates are available for the species. In the Array Area, storm petrels were only recorded in May S02 2021, with an estimated population of 9 individuals (95% CI 0 – 20) [0.16 individuals/km^2 (95% CI 0.00 – 0.39)] (**Appendix 22A**). During the Seabird 2000 census (1998 – 2002) the Welsh regional population of storm petrel reached 2,805 AOSs (JNCC, 2021f).

134. The species distribution model produced by Evans and Waggitt (2023) shows the highest predicted storm petrel densities are to the southwest in the Celtic Sea. Between July and September, a high intensity area is present in the middle of the Irish Sea however, there is avoidance of large parts of the coastline year-round. There is potential for there to be relatively high storm petrel densities around the Array Area during summer months with a gradient of higher densities to the southwest and lower densities to the northeast.

135. While Storm petrels are not considered to be particularly sensitive to displacement impacts (Furness *et al*., 2013) they have been included for assessment here (**Appendix 22D**) based on advice received from NRW (A), JNCC, RSPB and the Wildlife Trusts (**Table 22-5**). The low number of observations means that the species can only be qualitatively assessed as agreed with NRW (A) and JNCC. Due to their low flight height, storm petrel are not considered particularly sensitive to collision risk with turbine blades (Furness *et al.*, 2013) and therefore have not been scoped in for this impact. Species sensitivity is outlined in **Table 22-14**.

Offshore Export Cable Corridor

136. The location of the Offshore Export Cable Corridor (OfECC) is shown on **Figure 22-1**, connecting the Array Area to the landfall location. From this, it can be seen that the proposed route passes through the marine section of SSSP SPA and so it is to be expected that the protected seabird interests nesting on the SPA islands (Skomer, Skokholm and Middleholm)

will likely be using the designated marine area for their foraging and maintenance behaviours, as identified in the SPA conservation objectives and assessed in **Appendix 8E: HRA RIAA**.

137. For EIA assessment (as presented in **Section 22.8**), the specific impact pathways associated with the 'at sea' section of the OfECC relate to potential long-term loss of habitat (supporting seabird prey species) through placement of cable protection, as well as possible disturbance impacts to prey and/or directly to seabirds themselves from cable installation activities. Assessment of potential ornithological impacts arising from the activities proposed at the proposed Project landfall is undertaken in **Chapter 08: Ecology and Biodiversity** as such impacts are primarily terrestrial rather than marine.

Summary of the Baseline Environment

138. **Table 22-15** summarises the key marine ornithological receptors assessed for potential impacts from the proposed Project.

Table 22-15. Key assessed marine ornithological receptors

Receptor	Conservation status	Summary
Kittiwake	• Red listed as a UK Bird of Conservation Concern • Vulnerable species in IUCN red list • SPA qualifying interest	• In the Array Area, kittiwake was the third most abundant species, almost exclusively recorded during the non-breeding season, with sightings peaking in October 2020. • Scoped in for collision risk based on Furness *et al*. (2013). Displacement matrices for this species are provided at JNCC request.
Lesser black-backed gull	• Amber listed as a UK Bird of Conservation Concern • SPA qualifying interest	• In the Array Area, lesser black-backed gulls were recorded in relatively low numbers and almost exclusively during the breeding season (peak in June 2020). • Scoped in for collision risk based on Furness *et al*. (2013)
Guillemot	• Amber listed as a UK Bird of Conservation Concern • SPA qualifying interest	• In the Array Area, guillemot was the most abundant species, peaking in October 2020. • Scoped in for displacement assessment based on Furness *et al*. (2013)
Razorbill	• Amber listed as a UK Bird of Conservation Concern • SPA qualifying interest	• In the Array Area, razorbill was the fourth most abundant species, observed almost exclusively during the non-breeding season. • Scoped in for displacement assessment based on Furness *et al*. (2013)
Puffin	• Red listed as a UK Bird of Conservation Concern • Vulnerable species under IUCN red list • SPA qualifying interest	• In the Array Area, puffins were recorded in relatively low numbers, with a marked peak in March 2020. • Scoped in for displacement assessment based on Furness *et al*. (2013).
Gannet	• Amber listed as a UK Bird of Conservation Concern • SPA qualifying interest	• In the Array Area, gannets were recorded in relatively small fluctuating numbers, with sightings peaking in October 2021. • Scoped in for collision risk based on Furness *et al*. (2013) and for displacement based on post-construction monitoring data.

Receptor	Conservation status	Summary
Manx shearwater	• Amber listed as a UK Bird of Conservation Concern • SPA qualifying interest	• In the Array Area, Manx shearwaters were mostly recorded during spring migration. • Scoped in for displacement assessment based on post-construction monitoring data.
Balearic shearwater	• Red listed as a UK Bird of Conservation Concern • Critically endangered under IUCN red list	• Balearic shearwaters were not recorded in the Llŷr Marine Ornithology Survey Area • Scoped in for qualitative displacement assessment as requested by NRW (A), JNCC and RSPB.
Storm petrel	• Amber listed as a UK Bird of Conservation Concern • Annex I species • SPA qualifying interest	• In the Array Area, storm petrels were only recorded in May 2021. • Scoped in for displacement assessment based on post-construction monitoring data.

22.5.2. Future Baseline

Climate Change and Ecosystem Effects

139. Climate change is leading to dramatic changes in ecosystem structure, through effects on ocean temperature, water stratification and nutrient availability. This is leading to changes in the abundance and diversity of communities at all trophic levels, from primary producers to top predators. As top predators in the marine environment, seabirds are sensitive to changes to the wider ecosystem which propagate through the food chain (Lynam *et al*. 2017). In the UK, declines of 20-30% in the abundance of breeding seabirds since the early 1990s have been driven by climate change (Mitchell *et al*., 2020).

140. Climate change primarily affects seabirds indirectly, through changes in prey availability, diversity and quality (Mitchell *et al*., 2020). In the North Sea, the lesser sandeel is an important prey species to seabirds such as puffin, razorbill, shag and kittiwake (Wanless *et al*, 2018). However, since 2000, climate change related factors have led to a decline in the abundance and nutritional quality of sandeel and other small planktivorous prey fish (e.g., sprat) (MacDonald *et al*., 2015; Clausen *et al*., 2017; Wanless *et al*., 2018; MacDonald *et al*., 2019).

141. Generalist seabird species that feed on a wide range of prey types will be more resilient to changing prey availability than more specialist species (Furness and Tasker, 2000). Water column feeders, such as auks, forage from the seabed (depending on water depth) to the surface and can feed on pelagic and demersal fish and invertebrates such as squid and zooplankton. Surface feeders, including kittiwake and terns, are restricted to prey available within the upper 1-2m of the surface, such as small fish, zooplankton and other invertebrates.

142. Therefore, changes to prey distribution within the water column resulting from changes to stratification or temperature, for example, will affect surface feeding species differently to water column feeding species. Typically, species feeding within the water column are adapting better to changes in prey availability rather than those feeding at the sea surface (Mitchell *et al*., 2020). Additionally, those species with a limited foraging range may not be able to compensate and adapt to changing prey distributions (Mitchell *et al*., 2020; Sadykova *et al*., 2020; Searle *et al*., 2022).

143. Climate change can also directly impact seabirds through increased frequency of extreme weather. Strong winds increase energy expenditure during flying and foraging, affecting body condition (Kogure *et al.* 2016). During the breeding season, storms can chill eggs, kill nestlings,

and prevent adequate foraging to feed chicks, resulting in widespread breeding failures (Frederiksen, 2008; Mitchell *et al*., 2020). Climate change contributes to mass mortality events, such as in winter 2021/22 when large numbers of auks were washed up on coasts of eastern UK and starvation was likely a contributing factor (Fullick *et al*., 2022).

144. Longer-term projections of change to seabird populations in light of human-induced climate change are not fully known at this stage, however, the proposed Project does have a role to play in helping to transition from reliance on the more carbon-intensive energy supplies giving rise to this effect (see **Chapter 29: Climate Change**).

145. The proposed Project has the potential to save up to *150,000 tonnes* of carbon dioxide per year. Further to this, as the proposed Project is a test and demonstrator project, the technologies and learnings it facilitates will assist in the development of floating offshore wind farm projects, including possible future projects in the Celtic Sea.

Avian Influenza

146. Avian influenza (commonly referred to as 'avian flu' or 'bird flu') is a virus that causes disease in birds, affecting the respiratory, digestive and/or nervous system of many species. Typically, infections are from a low pathogenic viral strain which causes mild illness however, strains can mutate from low to high, which cause severe symptoms, often with high mortality rates and may spread quickly causing an outbreak. The virus has become a disease of global significance due to poultry intensification creating conditions favourable for highly pathogenic strains. Globalisation of the poultry market has created pathways of transmission globally and increased domestic-wild bird interactions due to changing land use (Gilbert and Xiao, 2008).

147. In the summer of 2021, a new strain of highly pathogenic avian flu (H5N1) was identified in the UK. Since then, 120 further locations of infection in captive birds and poultry, have been identified across the UK, and 354 separate locations of infection across wild birds of 63 species have been identified across 76 countries worldwide (DEFRA, 2022). This has been the highest recent occurrence of highly pathogenic avian flu in the UK with 90 cases of outbreak, compared with 28 in winter 2016/17 and 13 in 2020/21 (Lean *et al*., 2022). The greatest proportion of infections has been observed in Anseriformes (swans, geese and ducks) who form a natural reservoir of the virus. Charadriiformes (waders, gulls and auks) and Accipitriformes (hawks, eaglesand kites) have also shown a high occurrence (DEFRA, 2022).

148. In Wales, one of the key concerns was the effect of HPAI at Grassholm SPA. On 3 August 2022, the RSPB confirmed that bird flu had been recorded on the island and it is now estimated that approximately 5,000 gannets have died, a decline of ~54% (Tremlett *et al.,* 2024). At Skomer and Skokholm, lesser black-backed gull populations are estimated to have declined by ~24%.

22.6 Scope of the Assessment

Potential Impacts Requiring Assessment

149. An EIA Scoping Report for the proposed Project was submitted to NRW Marine Licensing Team (MLT) in April 2022. The Scoping Report was also shared with relevant consultees, inviting comment on the proposed approach adopted by the Applicant. A Scoping Opinion was provided to the Applicant by NRW MLT in July 2022. Based on the Scoping Opinion received (as addressed in Table 22-4 above) and further consultation undertaken (Table 22-5), the potential impacts on marine ornithological receptors scoped into the assessment are listed below (for each phase of the proposed Project) and addressed in **Table 22-16**. Impacts scoped out of the assessment are listed in **Table 22-17**.

Construction and Decommissioning Phases:

- Disturbance and / or displacement associated with vessels and other offshore activities;
- Effects of underwater noise on diving seabirds; and
- Indirect effects due to changes in habitat and / or prey availability and distribution.

Operation and Maintenance Phase:

- Disturbance and / or displacement due to the presence of WTGs and associated maintenance activities;
- Barrier effects due to presence of WTGs;
- Collision risk with WTGs;
- Entanglement with mooring lines and cables;
- Attraction of nocturnal seabirds to project infrastructure lighting;
- Creation of roosting habitat for birds due to presence of floating platforms; and
- Indirect effects due to changes in habitat and / or prey availability and distribution.

150. The potential impacts during decommissioning are expected to be analogous with or less than that during construction (as detailed in **Table 22-16** below and in **Section 22.8.3**).

Key Parameters for Assessment

151. The proposed Project has adopted a 'precautionary approach' whereby impact assessments are based on realistic 'worst case' scenarios to ensure that the maximum design scenario or maximum design parameter that would have the greatest impact has been fully assessed. Key parameters from the PDE which are relevant to marine ornithology receptors are presented in **Table 22-16**.

152. As set out in **Section 22.4** this assessment considers the design parameters of the proposed Project which are predicted to result in the greatest environmental impact, known as the 'realistic worst case scenario'. The realistic worst case scenario represents, for any given receptor and potential impact on that receptor, various options in the Design Envelope that would result in the greatest potential for change to the receptor in question. Given that the realistic worst case scenario is based on the design option (or combination of options) that represents the greatest potential for change, confidence can be held that the development of any alternative options within the design parameters will give rise to effects no greater or worse than those included in this impact assessment.

Table 22-16. Design Scenario considered for the assessment

Potential Impact	Design scenario	Justification
Construction		
Disturbance and / or displacement associated with vessels and other offshore activities	Assessment is qualitative, based on the literature and application of expert judgement, informed by the following key information on the proposed Project construction activities for installation of up to ten WTGs; *Driven Pile Anchors:* • Eight driven pile anchors per WTG (80 piles max) • Maximum pile diameter 3 m • Maximum hammer energy 800 kJ • Piling in one location at a time (no concurrent piling) • Maximum four hours to drive one pile to the maximum penetration depth of 9-32m • Max 10 piling days within 20 months of offshore installation Maximum numbers of construction vessels on-site at any one time: 12 vessels.	These maximum design parameters during construction represent the maximum potential for construction disturbance / displacement impacts.
Effects of underwater noise on diving seabirds	Underwater noise methodologies focus on marine mammals and fish because diving birds spend much less time underwater that these other receptor groups and so this impact pathway is of lesser concern for marine ornithology. Assessment is qualitative, based on the literature and application of expert judgement. The WCS is Installation of up to ten WTG (see disturbance and / or displacement impact above).	These maximum design parameters during construction represent the maximum potential for release of underwater noise.
Indirect effects due to changes in habitat and / or prey availability and distribution	Potential impacts which are applicable to fish and shellfish (which represent many ornithological prey species) may have an indirect effect on offshore ornithological receptors. Therefore, the assessment is based on the worst-case parameters presented in **Chapter 20: Fish and Shellfish Ecology**.	
Operation and maintenance		
Disturbance and / or displacement due to the presence of WTGs and associated maintenance activities	Assessment of seabird displacement impacts (including barrier effects) is based on the Array Area +2km buffer (SNCB, 2022). See **Appendix 22D: Marine Ornithology Displacement Assessment**. Disturbance may arise from wind farm operation and maintenance activities, including associated vessel movements.	In terms of assessment, potential disturbance impacts are subsumed by displacement which uses ‘worst case’

Potential Impact	Design scenario	Justification
Barrier effects due to presence of WTGs	Maintenance will be required for: • Up to ten WTGs, floating substructures, up to 11 associated inter array cables and up to eight moorings per WTG; • Up to 80 driven pile anchors (eight per WTG); • Up to two offshore export cables along a distance of up to 49 km; and • Up to 5 cable repairs for the operational life of the proposed Project. Planned maintenance (scheduled services) includes general inspection and servicing, oil sampling / change, cleaning of equipment, investigation of faults and minor fault rectification, as well as replacement of consumables. Such maintenance will generally take place during the summer months. Unplanned maintenance covers fault rectification, unexpected minor repairs and major component replacements/repairs. As these can't be foreseen, they may take place at any time of the year and may require urgent intervention to rectify any critical issues as quickly as possible.	rates of displacement and mortality (following NRW (A) and JNCC advice) uniformly applied across the entire Array Area +2km buffer, and across seasons.
Collision risk with WTGs	Assessment of seabird collision risk is detailed in **Appendix 22C: Marine Ornithology Collision Risk Modelling** for which the key WTG parameters are as follows: • 10 WTGs (each with 3 blades); • 142.5 m rotor radius; • 22 m air gap; and • 63,794 m^2 rotor swept area.	Two scenarios are modelled; for which the only difference is number of WTGs (7 and 10) and all other parameters are the same. Therefore 10 WTG acts as worst case.
Entanglement with mooring lines and cables	• 10 WTGs (minimum spacing 1,140m); • Maximum 8 mooring lines per turbine; and • 17.6 km total inter-array cables length. NB. There is no potential for entanglement with the offshore export cable as this will be buried or laid along the seabed and subject to cable protection.	The maximum scale of the mooring lines and inter-array cables represents the maximum potential for entanglement.
Attraction of nocturnal seabirds to project infrastructure lighting	All ten WTGs (maximum) will be fitted with MOD accredited aviation lighting as detailed in **Chapter 17: Aviation and Radar.** They will also be fitted with marine navigation lighting as detailed in **Chapter 25: Shipping and Navigation.**	The specified WTG lighting is legally required (for human health & safety) and therefore acts as worst case.

Potential Impact	Design scenario	Justification
Creation of roosting habitat for birds due to presence of floating platforms and associated infrastructure	Assessment is qualitative, based on the literature and application of expert judgement. The WCS is up to ten WTG with associated floating platforms.	Ten is the maximum number of WTGs and therefore acts as worst case.
Indirect effects due to changes in habitat and / or prey availability and distribution	Loss of supporting habitat or other potential impacts on prey species (particularly arising from cable protection for the OfECC and/or turbine anchorage) may indirectly affect marine ornithological receptors. Prey species may also be disturbed by the vessel movements associated with operational and maintenance activities. On both aspects, assessment is based on the worst-case parameters presented in **Chapter 20: Fish and Shellfish Ecology**.	
Decommissioning		
The impacts during the decommissioning of the proposed Project are anticipated to be analogous with, or likely less than, those of the construction phase as decommissioning of proposed project infrastructure will be similar to construction but in reverse. The decommissioning phase is expected to be complete within 12 months. As a worst case scenario all infrastructure will be removed. A decommissioning plan will be required in consultation with NRW.		

22.6.1. *Impacts scoped out of assessment*

153. A number of impacts have been scoped out of the assessment for marine ornithology during EIA scoping. These impacts are outlined, together with the justification for scoping them out, in **Table 22-17**.

Table 22-17. Potential impacts scoped out the assessment for marine ornithology

Potential impact	Justification
Operation and maintenance	
Displacement or disturbance due to vibration from offshore arrays during operation to all ornithological receptors.	This impact pathway was scoped out in the scoping report for the proposed Project, as consulted upon with NRW (A) and JNCC to which they raised no objection (scoping responses dated 23 May 2022 and 18 May 2022 respectively)
Disturbance and / or displacement due to the presence of WTGs and associated maintenance activities to lesser black-backed gulls and kittiwake	Species scoped out of assessment are considered not to be particularly sensitive to displacement impacts (considering post-construction monitoring data as well as the sensitivity scoring in Furness *et al.*, 2013). Displacement matrices are provided for kittiwake at the request of JNCC, included in **Appendix 22D: Marine Ornithology Displacement Assessment.**
Collision risk with WTGs to guillemot, razorbill, puffin, shearwater species, storm petrel.	Species scoped out of collision risk modelling are considered not to be particularly sensitive to collision impacts (Furness *et al.*, 2013).

22.6.2. *Assessment Assumptions and Limitations*

154. There are several limitations of using DAS to characterise the baseline for ornithological features for offshore developments. They provide a 'snapshot' of bird activity during daylight hours, thus potentially missing birds using the site outside of the time when the survey was conducted. Despite this, monthly surveys are considered to be representative of general activity on-site and provide the best available data to inform impact assessments.

155. The DAS has also been supplemented by other available information including tracking studies of birds from the key colonies under consideration as well as the 'at sea' seabird density surface modelling undertaken for The Welsh Atlas and other contextual information (**Table 22-12** and referenced within the **Species Accounts)** .

156. Flight heights for all assessed species are taken from Johnston *et al*. (2014a; 2014b). Whilst this is the standard reference to use (as advised by the SNCBs) the collated data is now relatively old, from early offshore wind farm projects located closer to shore compared to current proposed developments such as the proposed Project. It continues to be assumed that Johnston *et al*. (2014a; 2014b) is representative of seabird flight heights in more offshore locations, but this is a known assumption that is accepted by the SNCBs in the absence of any more recent collation.

22.7 Embedded Mitigation, Management Plans and Best Practice

157. As part of the proposed Project design process, a number of designed-in measures have been proposed to reduce the potential for impacts on offshore ornithology (**Table 21.18**). The design of the proposed Project therefore includes embedded mitigation measures and reference to various management plans that will be produced as conditions of consent, and which will further mitigate potential impacts.

158. This approach has been employed in order to demonstrate commitment to mitigation measures by including them in the design of the proposed Project and as such, these measures have been considered within the assessment presented in **Section 22.8** below.

Table 22-18. Mitigation measures, management plans and best practice to be adopted relevant to marine ornithology

Embedded Mitigation Measures, Management Plans and Best Practice	Justification
Design Embedded Measures	
Project Design	There are no specific design embedded measures relevant to marine ornithology, although the reduction in size of Array Area does reduce likely magnitude of displacement and barrier effects.
Management Plans	
Project Environmental Management Plan (PEMP)	An overarching document which includes all Project considerations and method statements in accordance with those assessed within the Environmental Statement. Details the methods to avoid, minimise and mitigate potential environmental effects during the operational stage of the proposed Project.

Embedded Mitigation Measures, Management Plans and Best Practice	Justification
Construction Environmental Management Plan (CEMP)	Specifies the overarching principles and detailed measures to minimise / mitigate the effects of the installation activities associated with the proposed Project on the surrounding environment. An Outline CEMP is provided in **Appendix 4A: Outline CEMP**.
Marine Pollution Contingency Plan (MPCP)	Outlines procedure to protect personnel working on the proposed Project and to safeguard the marine environment. Further details are provided the Outline CEMP (as above).
Invasive Non-Native Species (INNS) Management Plan	Enables marine operators and contractors to understand and minimise the risks posed by activities which could introduce and spread of marine INNS. See **Appendix 4B: Outline INNS Plan**.
Vessel Management Plan (VMP)	Best practice vessel handling protocols will be adopted to minimise the potential for any impact on marine wildlife, including marine mammal receptors. For example, the Codes of Conduct provided by the WiSe Scheme, Scottish Marine Wildlife Watching Code and / or Best Practice for Watching Marine Wildlife will be adopted, as to be discussed and agreed with NRW (A) and JNCC.
Lighting and Marking Management Plan	A Lighting and Marking Management Plan will be prepared and agreed with relevant stakeholders post-consent. See **Chapter 25: Shipping and Navigation** and **Chapter 27: Aviation and Radar**
Decommissioning Plan	Plan to retire the facilities of the proposed Project agreed with Natural Resources Wales (NRW) at the relevant time prior to the start of offshore decommissioning.

22.8 Assessment of Environmental Effects

159. The impacts and effects associated with the construction, operation and decommissioning of the proposed Project are outlined in the sections below. Assessment takes into account the embedded mitigation measures described in the preceding section.

22.8.1. Construction Effects

Disturbance and / or Displacement Associated with Vessels and Other Offshore Activities

160. During the construction phase of the proposed Project, installation of semi-submersible flotation platforms, associated moorings, inter-array cables and offshore export cable, as well as vessel movement may cause disturbance and / or displacement of seabirds (**Table 22-16** worst case). This may result in energetic consequences associated with flushing or disturbance from the area, and temporary habitat loss for feeding, resting/loafing and moulting (Garthe and Huppop, 2004).

161. Seabird sensitivity to vessel and construction activities may vary based on the species and / or species group (Furness and Wade, 2012; Garthe and Huppop, 2004; Bradbury *et al*., 2014). According to this literature, shearwater species, storm petrel, gannet and gulls have **negligible sensitivity** to disturbance from vessel activity. Auks were assessed to present a **moderate sensitivity** to vessel activity with regular escape response to vessel presence.

162. Consequently, **sensitivity** of all ornithological receptors to displacement and / or disturbance from construction activities is judged as **medium**.

163. Vessel activities during the construction phase of the Project are detailed in **Chapter 04: Description of the Project** and **Chapter 25: Shipping and Navigation**. Up to 12 project vessels may be on site simultaneously during the construction phase. This will include Restricted in Ability to Manoeuvre (RAM) vessels. It is assumed that construction vessels will be on-site throughout the duration of the construction phase.

164. Construction vessels are predicted to be present temporarily, only within a short time frame and within a localised area. Potential impacts from the presence of vessels are, therefore, reversible in nature, limiting the disturbance and displacement to seabirds. The use of a Vessel Management Plan will further reduce the potential effect of increased vessel activity during the construction period.

165. Consequently, the risk of disturbance and / or displacement associated with vessels and other offshore activities during the construction phase to all marine ornithological receptors is of **negligible magnitude**. The overall effect on seabirds from this impact is considered to be **minor** and **not significant**. Adoption of a CEMP and VMP (**Table 22-18**) is proposed as embedded mitigation and will further reduce any associated risks to marine ornithological receptors from this impact pathway. No additional mitigation is needed.

166. Note that the OfECC is proposed to pass through SSSP SPA and therefore any potential impacts in relation to the qualifying interests of this SPA are addressed in **Appendix 8E: HRA RIAA.**

Table 22-19. Summary of significance conclusion for construction disturbance / displacement

	Magnitude	Sensitivity	Consequence	Impact significance
Disturbance and/or displacement				
All marine ornithology receptors	Negligible	Moderate	Minor	**Not significant**

Effects of Underwater Noise on Diving Seabirds

167. The OfECC is proposed to pass through SSSP SPA. This is the only site that is likely to be impacted by the underwater noise along OfECC and is addressed in **Appendix 8E: HRA RIAA.**

168. For considering this impact pathway, diving seabird species are defined as species diving deeper than a few meters as part of their foraging behaviour which includes gannet, Manx shearwater, guillemot, razorbill and puffin. These species spend regular and intermittent periods underwater and are, therefore, susceptible to the effects of potential underwater noise during construction activities. This underwater noise production may result in displacement, disturbance or complete exclusion of seabirds within the construction activity area resulting in a temporary loss of habitat.

169. Underwater noise may be generated by a range of construction activities, including geophysical surveys, unexploded ordnance (UXO) clearance, piling and less noisy activities such as cable lay and drilling, as well as by construction vessels. An assessment of underwater noise from the proposed Project is presented in **Appendix 21C: Marine Mammal Underwater Noise Assessment**, which determined that the highest levels of underwater noise during construction are likely to occur from UXO clearance and piling (**Table 22-16** worst case).

170. The effects of underwater noise on seabirds are poorly understood with little data available (Crowell *et al*., 2015). Crowell *et al*. (2015) assessed that gannet, as well as red-throated diver and several duck species, showed greatest hearing sensitivity at 1,000 – 3,000 Hz using

auditory brainstem response techniques. Hansen *et al*. (2016) showed similar hearing sensitivity in great cormorant. Hansen *et al*. (2020) recorded behavioural reactions to underwater noise in guillemot from 110 dB re 1 μPa, which increased with higher received noise levels. However, there are no studies which quantify the potential for disturbance, injury or mortality in seabirds from underwater noise.

171. Studies indicated that auks spend up to 29% of their time at sea underwater, each dive for periods typically less than a couple of minutes (Spencer *et al*., 2010; Thaxter *et al*., 2010). Therefore, exposure to underwater noise is limited to the short durations in which individuals are underwater. Birds are also likely to be able to tolerate some level of underwater noise, or forage in alternative areas. However, due to current limitations in available research on the sensitivities of diving birds to underwater noise, the **sensitivity** of this impact has conservatively been assessed as **medium**.

172. Given the sensitivity of seabirds to disturbance, it is likely that the presence of construction vessels and airborne noise associated with construction activities will deter birds from foraging areas, thus reducing the potential for exposure to underwater noise. It is also expected that, should birds still forage in the area, dives would be aborted in the presence in noise levels, further limiting the duration of exposure to underwater noise. Furthermore, the construction activities which generate underwater noise will be short-term, intermittent and / or localised, comprising only a very small portion of the habitat available to foraging birds. Therefore, the magnitude of impact is assessed as being **negligible**.

173. Therefore, the significance of the effect from underwater sound is concluded to be of **negligible significance,** which is **not significant** in EIA terms.

174. Adoption of a CEMP and VMP (**Table 22-18**) is proposed as embedded mitigation and will further reduce any associated risks to marine ornithological receptors from this impact pathway. No additional mitigation is needed.

Table 22-20. Summary of significance conclusion for construction underwater noise

	Magnitude	Sensitivity	Consequence	Impact significance
Underwater noise during construction				
All marine ornithology receptors	Negligible	Medium	Negligible	**Not significant**

Indirect Effects Due to Changes in Habitat and / or Prey Availability and Distribution

175. Alteration to the presence, availability, or distribution of seabird prey species during construction may result in an indirect impact on seabirds by affecting seabirds foraging within the proposed Project site and surrounding waters. The ability of seabirds to tolerate changes in prey availability and distribution is dependent on the prey species affected in relation to their diet and their flexibility in habitat use.

176. Construction activities may potentially disturb prey species of seabirds, via underwater noise impact (vessel noise, piling, UXO clearance) and / or habitat change (seabed disturbance and suspended sediments) (**Table 22-16** worst case). The potential effects of such activities on prey species are assessed in **Chapter 20 Fish and Shellfish Ecology**.

177. The OfECC is proposed to pass through SSSP SPA and so may affect the prey species of the SPA qualifying seabird interests; please refer to **Appendix 8E: HRA RIAA.**

178. Seabird species present different affinity for certain prey species and various level of foraging range and flexibility. Auks are pursuit foragers with a wide range of typical prey species which mainly include Ammodytidae (lesser sandeels), Clupeidae (sprats or young Atlantic herring

(*Clupea harengus*)) and Gadidae (young whiting (*Merlangius merlangus*), saithe (*Pollachius virens*) or cod (*Gadus morhua*)). Additionally, auks present relatively medium foraging ranges, making them relatively flexible foragers.

179. Kittiwakes are also considered moderately sensitive to temporary changes in prey due to their surface feeding behaviour and dependence on the lesser sandeel during summer months (Furness and Tasker, 2000). The breeding success of kittiwake is considered highly vulnerable to reduced availability of food near the breeding colonies (Furness and Tasker, 2000). However, the species has a moderate foraging range (Woodward *et al*., 2019) and during winter months, forage for a diversity of small fish species (including herring) in pelagic waters of the continental shelf (Wade *et al*., 2016) and are considered less sensitive to prey changes during this time.

180. The population of key prey species for seabirds, including Atlantic herring, sprat, sandeel and mackerel are anticipated to be affected only temporarily. It was concluded in **Chapter 20, Fish and Shellfish Ecology** that disturbance or damage to sensitive benthic and fish and shellfish species due to underwater noise generated from construction activities would have a low impact on herring, sandeels and other fish and shellfish species. Construction activities will be temporary, short term (within two years) and localised. Furthermore, the mobility of the majority of prey species allows for avoidance behaviour during the potential underwater noise disturbance period, and sediment movements are likely to be limited to a single tidal cycle.

181. All other seabirds screened in for assessment (gannet, lesser black-backed gull, storm petrel, Balearic shearwater and Manx shearwater) are considered to be of **low sensitivity** to the disturbance of their prey species as they either present large foraging ranges (Woodward *et al*., 2019) or are flexible foragers (Wade *et al*., 2016).

182. The **magnitude** of impact for all receptors is therefore judged to be **low** with the overall effect considered to be **negligible** and **not significant**.

183. Adoption of a CEMP and VMP (**Table 22-18**) is proposed as embedded mitigation and will further reduce any associated risks to marine ornithological receptors from this impact pathway.

Table 22-21. Summary of significance conclusion for construction changes in habitat and prey availability

	Magnitude	Sensitivity	Consequence	Impact significance
Indirect Effects Due to Changes in Habitat and / or Prey Availability and Distribution				
Kittiwake	Low	Moderate	Low	**Not significant**
All other marine ornithological receptors	Low	Low	Negligible	**Not significant**

22.8.2. *Operational And Maintenance Impacts*

Displacement/Disturbance Due to the Presence of WTGs and Associated Maintenance Activities

184. **Appendix 22D: Marine Ornithology Displacement Assessment** should be referred to for the detailed assessment of displacement impacts (seabird avoidance around operational wind turbines) for the relevant marine ornithological receptors (**Table 22-14**).

185. Worst case parameters in respect of possible disturbance to marine ornithological receptors arising from operations and maintenance procedures at the proposed Project (including associated vessel activity) are presented in **Table 22-16**. In terms of assessment, any such operational disturbance impacts are subsumed within the greater assessed magnitude of

displacement, predicated on use of 2 km displacement buffer around the Array Area, against which the advised displacement rates are applied to the identified populations for this full area (the mean seasonal peaks, as discussed below).

186. For this assessment 'displacement' refers to both displacement and barrier effects. Displacement is considered by Furness et al. (2013) and Bradbury et al. (2014) to be 'a reduced number of birds occurring within or immediately adjacent to an offshore wind farm'. Birds that would normally utilise the Array Area and surrounding sea may be disturbed or displaced from the area due to the presence of the WTGs, resulting in an effective loss of available habitat for sensitive species.

187. Barrier effects may occur when birds that would have previously flown through an area (e.g. on the way to feeding, resting or nesting areas) either have to cease flying, or alter their flight paths due to the presence of an offshore wind farm which may affect energetic costs (Masden *et al.,* 2010).

188. For displacement, the mean seasonal peaks (MSPs) for the Array Area plus a 2 km buffer were calculated from the DAS results (**Appendix 22A: Marine Ornithology Baseline**) and used to derive matrices of displacement impacts as recommended in SNCB guidance (SNCB, 2022).

189. Full displacement matrices are set out in **Appendix 22D** with **Table 22-22** presenting the mortality estimates for the upper and lower displacement and mortality rates (defining the upper and lower limtis of the 'impact range' for each species) as advised by NRW (A) and JNCC.

Table 22-22. Annual displacement mortalities (number of birds) for the Array Area plus 2 km buffer

	Displacement rate	Mortality rate	
		1%	10%
Guillemot *Regional EIA*	30%	45.11	451.05
	70%	105.25	1,052.45
Guillemot *Castlemartin*	30%	2.89	28.91
	70%	6.75	67.45
Razorbill	30%	7.98	79.77
	70%	18.61	186.13
Puffin	30%	2.23	22.32
	70%	5.21	52.08
Manx shearwater	10%	4.73	47.28
	50%	23.64	236.4
Gannet	60%	6.16	61.56
	80%	8.21	82.08

190. **Table 22-23** then presents the calculation of 1% of baseline mortality for EIA (regional) reference populations, against which estimated displacement mortalities are compared to determine the risk of significant impact and whether population modelling may be required.

191. These matters are addressed in further detail in **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios** which also sets out the calculation of the 1% 'threshold' for guillemot at Castlemartin SSSI as presented below in **Table 22-24**.

Table 22-23. Calculation of 1% of EIA (BDMPS) baseline mortalities for displacement species

Species	Adult survival rate[1]	EIA (BDMPS) population[2] (ind.)	BDMPS date range (from Furness, 2015)	Baseline mortality	1% of baseline mortality
Guillemot	0.939	1,145,528	1998 - 2013	69,877	699
Razorbill	0.895	606,914	1990s - 2013	63,726	637
Puffin	0.906	1,482,791	1998 - 2013	139,382	1,394
Manx shearwater	0.87	1,821,544	1990s - 2012	236,801	2,368
Gannet	0.919	661,888	2004 - 2013	53,613	536

[1] From Horswill & Robinson, 2015

[2.] EIA (BDMPS) reference populations as confirmed in the NRW(A) and JNCC advice note dated 15 June 2023.

Table 22-24. Calculation of 1% of Castlemartin SSSI baseline guillemot mortalities

Species	Adult survival rate[1]	SPA breeding population[2] (individuals)	Year of census	Baseline mortality	1% of Baseline mortality
Castlemartin SSSI[5]					
Guillemot	0.939	22,591[2]	2021-2022	1,378	**14**

Guillemot

<u>*Magnitude of impact*</u>

192. Using the maximum rates of displacement (70%) and mortality (10%) advised by NRW (A) and JNCC results in a 'worst case' estimate of 1,052.45 total annual guillemot mortalities (**Table 22-22**) (See full seasonal breakdown in **Appendix 22D**).

193. Considered against the largest BDMPS population of 1,145,528 birds (**Table 22-13**), guillemot are the only species assessed to surpass 1% of the baseline mortalities at the regional EIA-level (699 birds) (**Table 22-23**) as well as in relation to the colony-specific threshold for Castlemartin Range SSSI (14 birds) (**Table 22-24**, with further details in **Appendix 22E**).

Therefore, following NRW (A) and JNCC advice, the population consequences of guillemot displacement impacts have been modelled using Population Viability Analysis (PVA) as presented in **Appendix 22F: Marine Ornithology Population Modelling**. The results from this modelling informs the final judgement on significance of effect.

194. Using the criteria set out in **Table 22-6**; the magnitude of impact of displacement on guillemot has been assessed as **small**.

<u>*Sensitivity of receptor*</u>

195. As set out in the **Species Account**, guillemots are considered to be of **high sensitivity** to displacement.

Significance of the effect

196. Under the EIA matrix (**Table 22-8**) significance of effect to guillemots is considered to be **moderate** and **significant**. As noted, the impact magnitude exceeds the 1% threshold for further consideration of population-level consequences as further investigated under PVA (as reported in **Appendix E** and **Appendix F**).

197. PVA of project-alone (and cumulative) impacts was undertaken against the Castlemartin SSSI guillemot population (as well as against SSSP SPA, as considered in **Appendix 8E: HRA RIAA**). The results of this modelling demonstrated that there would be no long-term population consequences of concern in relation to either of these key Pembrokeshire guillemot colonies.

198. As such, it follows that if there is no significant population consequence from total annual displacement impacts (project-alone and cumulative) against the key colonies assessed, then there will not be significant effects at the wider (EIA) scale, assessing against a larger-sized population. This is supported by the fact that all guillemot mortalities are assumed to be adult and no allowance is made for sabbatical birds (non-breeding adults), both of which are worst case assumptions when being considered against a population which does include immature and juvenile birds (and where there will be a sabbatical component).

199. Furthermore, the colony-specific displacement matrix estimates for guillemot can be compared against the results from the SeabORD modelling undertaken for the auk species (reported in **Annex C** of **Appendix 22D: Marine Ornithology Displacement Assessment**). This should provide comfort that using the 70% displacement / 10% mortality rates from the upper end of the advised matrix impact range results in a substantial overestimation of impact.

200. From which, it can be concluded (using reasoned, expert judgement) that potential guillemot displacement impacts arising from the proposed Project are **not significant** in EIA terms, either regionally or against the protected population at Castlemartin SSSI.

Razorbill

Magnitude of impact

201. A displacement mortality of 1.47 birds was estimated during the breeding season using the worst-case WTG scenario, with 132.16, and 17.99 mortalities estimated during the BDMPS autumn and spring migration seasons and 34.51 mortalities during the wintering season, equating to a total annual displacement mortality of 186.13 birds (**Table 22-22**). Considered against the largest BDMPS population of 606,914 birds (**Table 22-13**), the annual mortalities do not surpass 1% of the EIA baseline mortalities (637 birds) (**Table 22-23**).

202. Using the criteria set out in **Table 22-6**, the magnitude of impact of displacement on razorbill has been assessed as **negligible.**

Sensitivity of receptor

203. As set out in the **Species Account**, razorbills are considered to be of **high sensitivity** to displacement.

Significance of the effect

204. Overall, the significance of effect to razorbill is considered to be **minor** and **not significant** (**Table 22-25**).

Puffin

Magnitude of impact

205. A displacement mortality of 10.64 birds was estimated during the breeding season using the worst-case WTG scenario, and 41.44 mortalities estimated during the BDMPS non-breeding season, equating to a total annual displacement mortality of 52.08 birds (**Table 22-22**). Considered against the largest BDMPS population of 1,482,791 birds (**Table 22-13**), the annual mortalities do not surpass 1% of the EIA baseline mortalities (1,394 birds) (**Table 22-23**).

206. Using the criteria set out in **Table 22-6**, the magnitude of impact of displacement on puffin has been assessed as **negligible**.

Sensitivity of receptor

207. As set out in the **Species Account**, puffins are considered to be of **high sensitivity** to displacement.

Significance of the effect

208. Overall, the significance of effect to puffin is considered to be **minor** and **not significant** (**Table 22-25**).

Gannet

Magnitude of impact

209. A displacement mortality of 19.68 birds was estimated during the breeding season using the worst-case WTG scenario, with 57.20 and 5.20 mortalities estimated during the BDMPS autumn and spring migration seasons, equating to a total annual displacement mortality of 82.08 birds (**Table 22-22**)(See full seasonal breakdown in **Appendix 22D: Marine Ornithology Displacement Assessment**). Considered against the largest BDMPS population of 661,888 birds (**Table 22-13**), the annual mortalities do not surpass 1% of the baseline mortalities (536 birds) (**Table 22-23**).

210. Using the criteria set out in **Table 22-6**, the magnitude of impact of displacement on gannet has been assessed as **negligible**.

Sensitivity of receptor

211. As set out in the **Species Account**, gannets are considered to be of **high sensitivity** to displacement.

Significance of the effect

212. Overall, the significance of effect to gannet is considered to be **minor** and **not significant** (**Table 22-25**)**.** The displacement impacts are considered alongside collision risk in the 'Collision Risk with WTGs' section.

Manx shearwater

Magnitude of impact

213. A displacement mortality of 171.70 birds was estimated during the breeding season using the worst-case WTG scenario, with 1.35 and 63.35 mortalities estimated during the BDMPS autumn and spring migration seasons, equating to a total annual displacement mortality of 236.4 birds (**Table 22-22**) (See full seasonal breakdown in **Appendix 22D: Marine Ornithology Displacement Assessment**). Considered against the largest BDMPS population of 1,821,544 birds (**Table 22-13**), the annual mortalities do not surpass 1% of the baseline mortalities (2,368 birds) (**Table 22-23**).

214. Using the criteria set out in **Table 22-6**, the magnitude of impact of displacement on Manx shearwater has been assessed as **negligible**.

Sensitivity of receptor

215. As set out in the **Species Account**, Manx shearwaters are assessed as being of **high sensitivity** to displacement as requested by NRW (A), JNCC, RSPB and the Wildlife Trusts (**Table 22-5**).

Significance of the effect

216. Overall, the significance of effect to Manx shearwater is considered to be **minor** and **not significant** (**Table 22-25**).

Balearic Shearwater

Magnitude of impact

217. No Balearic shearwaters were recorded during the DAS surveys at the proposed Project, but they are included in assessment for a qualitative consideration of impacts, as requested by NRW (A), JNCC and third-party stakeholders.

218. Due to the low numbers of Balearic shearwaters expected to be present within the Array Area the displacement effects have been assessed as **negligible magnitude.**

Sensitivity of receptor

219. Manx shearwaters are used as a proxy for Balearic shearwaters and therefore they are also assessed as having **high sensitivity** to displacement effects, following stakeholder advice (NRW (A), JNCC, RSPB and the Wildlife Trusts; **Table 22-5**).

Significance of the effect

220. Overall, the significance of effect to Balearic shearwater is considered to be **minor** and **not significant** (**Table 22-25**).

Storm Petrel

Magnitude of impact

221. In the proposed Project Array Area, storm petrels were only recorded in May 2021, with an estimated population of nine individuals (95% CI 0 – 20) (**Section 22.5.1**). However, during pre-application discussions with NRW (A), JNCC and other stakeholders (including RSPB and the Wildlife Trust), storm petrels were identified as an important receptor and have been included in the impact assessment. The number of storm petrels at the Array Area that may be displaced is low and therefore assessed as **negligible magnitude**.

Sensitivity of receptor

222. As set out in the **Species Account**, storm petrels are assessed as being of **high sensitivity** to displacement as requested by NRW (A), JNCC, RSPB and the Wildlife Trusts (**Table 22-5**).

Significance of the effect

223. Overall, the significance of effect to storm petrels is considered to be **negligible** and **not significant** (**Table 22-25**).

224. While not materially affecting the approach to displacement assessment (i.e., birds avoiding WTGs), the proposed PEMP (**Table 22-18**) will help address any potential disturbance impacts arising from operational and maintenance activities (including vessel movements). No additional mitigation is identified.

Table 22-25. Summary of significance conclusion for operational and maintenance displacement

	Magnitude	Sensitivity	Consequence	Impact significance
Disturbance and/or displacement during the operational phase				
Guillemot	Small	High	Moderate	**Not significant***
Razorbill, puffin, gannet, shearwater species, Storm petrel	Negligible	High	Minor	**Not significant**

** This final conclusion for guillemot is based on the PVA modelling undertaken as presented in Appendix 22F: Marine Ornithology Population Modelling. This demonstrates that the estimated guillemot displacement mortality does not result in any long-term population consequence either for colony-specific (Castlemartin Range SSSI) or regional EIA populations.*

Collision Risk with WTGs

225. Once constructed, there is a risk that any birds entering the operational wind farm may collide with the WTG blades (**Table 22-16** worst case). The collision risk of seabirds has been modelled and reported in detail, including a seasonal breakdown, in **Appendix 22C: Marine Ornithology Collision Risk Modelling**. Kittiwake, lesser black backed gull and gannet were identified at higher risk of collision and are therefore assessed on this basis.

226. **Appendix 22C** sets out the details of the modelling method and input parameters used. Two WTG scenarios were modelled (7 or 10 WTGs) with the 10 WTG scenario defined as the 'worst-case' (**Table 22-16**). Stochastic collision risk modelling was undertaken (sCRM; McGregor *et al*., 2018) using Option 2, based on the generic flight height data in Johnston *et al*. (2014a; 2014b).

227. A summary of the seasonal collision mortalities predicted for each key species is provided in **Table 22-26** for each WTG scenario. In this table, collision mortalities are presented based on sCRM using mean monthly densities of birds recorded on-site.

228. Following advice received from NRW and JNCC (note of 15 June 2023), potential collision risk mortalities will be considered as total annual impacts and considered against the largest BDMPS population. For each key species, the reference population against which potential collision mortalities will be assessed are summarised in **Table 22-27.**

Table 22-26. Summary of seasonal collision mortalities (number of birds)

Species	Avoidance rate (SD)	UK breeding season mortality (SD)	Adjusted BDMPS			Annual mortalities
			Autumn migration mortality (SD)	Non-breeding season mortality (SD)	Spring migration mortality (SD)	
10 WTG scenario[1]						
Kittiwake	0.993 (0.0003)	1.1 (0.3)	20.6 (2.8)	NA	2.1 (0.4)	**23.9 (3.8)**
Lesser black-backed gull	0.994 (0.0004)	1.1 (0.2)	0.2 (0.1)	0.2 (0.1)	0.4 (0.2)	**1.9 (0.6)**
Gannet	0.993 (0.0003)	3.0 (0.6)	0.5 (0.3)	NA	0.3 (0.1)	**3.7 (1.5)**

[1] 10 WTG is the worst case scenario, modelled using sCRM Option 2

Table 22-27. Calculation of 1% of EIA (BDMPS) baseline mortalities for collision risk species

Species	Adult survival rate[1]	EIA (BDMPS) population[2] (ind.)	BDMPS date range (from Furness, 2015)	Baseline mortality	1% of baseline mortality
Kittiwake	0.939	1,145,528	1998 - 2013	69,877	699
Razorbill	0.895	606,914	1990s - 2013	63,726	637
Gannet	0.919	661,888	2004 - 2013	53,613	536

[1.] *Horswill & Robinson (2015)*

[2.] *EIA (BDMPS) reference populations as sent in the NRW(A) and JNCC advice note dated 15 June 2023.*

Kittiwake

229. As set out in the **Species Account**, kittiwakes are considered to have **high sensitivity** to collision impacts due to a generally large proportion of birds flying at potential collision risk height (Furness *et al*. (2013); Johnston *et al*. (2014a)). Additionally, kittiwakes are known to spend a large part of their time flying (41- 60% of time at sea spent flying, Garthe and Hüppop, 2004), during both day and night (Furness and Wade, 2012).

230. To estimate kittiwake collision mortality, sCRM Option 2 and an avoidance rate of 0.993 (0.0003 SD) were used. A total annual collision mortality of 23.9 birds was estimated (**Table 22-26**). Considered against the largest BDMPS population of 911,586 birds (**Table 22-13**), the annual mortalities do not surpass 1% of the baseline mortalities (1,331 birds) (**Table 22-27**). Therefore, the magnitude of this impact is assessed as **negligible**.

231. Based on the IAM (**Table 22-8**), it is concluded that the overall effect of collision risk to kittiwake is **minor** and **not significant,** and no additional mitigation is required.

Lesser black-backed gull

232. As set out in the **Species Account**, lesser black-backed gulls are considered to have **high sensitivity** to collision impacts due to a generally large proportion of birds flying at potential collision risk height (Furness *et al*. (2013); Johnston *et al*. (2014a)).

233. To estimate the collision mortalities of lesser black-backed gulls, sCRM Option 2 and avoidance rate of 0.994 (0.0004 SD) were used. A collision total annual collision mortality of 1.9 birds was estimated (**Table 22-26**). Considered against the largest BDMPS population of 240,750 birds (**Table 22-13**), the annual mortalities do not surpass 1% of the baseline mortalities (277 birds) (**Table 22-27**). Therefore, the magnitude of this impact is assessed as **negligible**.

234. Based on the IAM (**Table 22-8**), it is concluded that the overall effect of collision risk to lesser black-backed gull is **minor** and **not significant,** and no additional mitigation is required.

Gannet

235. As set out in the **Species Account**, gannets are considered to have **high sensitivity** to collision impacts due to a generally large proportion of birds flying at potential collision risk height (Furness *et al*. (2013); Johnston *et al*. (2014a)).

236. To estimate the collision mortalities of gannets, sCRM Option 2 and an avoidance rate of 0.993 (0.0003 SD) were used. A total annual collision mortality of 3.7 birds was estimated (**Table 22-26**). Considered against the largest BDMPS population of 661,888 birds (**Table 22-13**), the annual mortalities do not surpass 1% of the baseline mortalities (536 birds) (**Table 22-27**). Therefore, the magnitude of this impact is assessed as **negligible**.

237. Based on the IAM (**Table 22-8**), it is concluded that the overall effect of collision risk to gannet is **minor** and **not significant,** and no additional mitigation is required.

Table 22-28. Summary of significance conclusion for operational and maintenance collision risk

	Magnitude	Sensitivity	Consequence	Impact significance
Collision risk during the operational phase				
Kittiwake, lesser black-backed gull, gannet.	Negligible	High	Minor	**Not significant**

238. For gannet, **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios** sets out the consideration of displacement and collision risk combined, with the mortality estimates for each impact simply summed together. In this regard, none of the project-alone impact scenarios for gannet come close to exceeding the advised 1% EIA thresholds of significance (**Table 22-3** in **Appendix 22E**).

Entanglement with Mooring Lines and Cables

239. Seabirds have the potential to become entangled with debris caught in mooring lines and cables, especially ‘ghost’ or derelict fishing gears and marine litters. Diving birds (as discussed above in the section on underwater noise), include auks (guillemot, razorbill, puffin), Manx shearwater and gannet, and will be at greatest risk of entanglement, as they forage in the water column, so most likely to encounter mooring lines and other gear which may result in entanglement (Kaiser *et al*., 1996; Good *et al*., 2009). There is also potential for sub-sea structures and cables to act as artificial reef which may attract seabirds to forage in the proposed Array Area thus increasing the risk of entanglement.

240. In the unlikely event that entanglement occurs, it has the potential to result in injury or death of the caught individual, meaning that the **sensitivity** of all diving birds to entanglement is considered to be **high**.

241. However, there will be regular ROV inspections to identify any snagged fishing gear or other marine litter on the mooring lines, which can then be removed. This activity will be included in the PEMP, which addresses operation and maintenance activities (**Table 22-18**). This monitoring and remedial action to clear mooring lines will significantly reduce the risk of entanglement for seabirds and therefore the residual **magnitude** of this impact is considered to be **negligible.**

242. Following the IAM (**Table 22-8**), it is concluded that the significance of effect of entanglement risk for diving ornithological species is **minor** and **not significant**.

Table 21-29. Summary of significance conclusion for operational and maintenance entanglement

	Magnitude	Sensitivity	Consequence	Impact significance
Entanglement risk during the operational phase				
Diving ornithological receptors	Negligible	High	Minor	**Not significant**

Attraction of Nocturnal Seabirds to Project Infrastructure Lighting

243. Artificial lighting at sea has the potential to disrupt nocturnal seabird species such as storm petrel, Manx shearwater and Balearic shearwater (Deakin *et al.,*2022). Where affected, birds have been witnessed circling around lit structures at night, increasing their depletion in energy and risk of collision with the structures (Jones, 1980; Longcore *et al*., 2013). During foggy and rainy weather this effect is increased significantly (Ronconi *et al*., 2015). These nocturnal species are therefore considered to have a **high sensitivity** to artificial light attraction.

244. Artificial light effects on seabird mainly depend on two factors, the light colour and the lighting mode (continuous or blinking). It has been commonly observed that red lights have a low rate of attractiveness regardless of the mode, and continuous red lights were found to have similar attractive effects than blinking lights of other colours. Additionally, continuous lights were found to have a significantly greater attractive effect than blinking lights for all other colours (Rich and Longcore, 2006; Raine *et al*., 2007; Deppe *et al*., 2017; Longcore *et al*., 2018; Rebke *et al*., 2019; Commonwealth of Australia, 2020).

245. Lighting of proposed Project infrastructures relates to health and safety requirements, for aviation and navigation, as well as for the wind farm operator. The proposed Project will be required to implement marine lighting and marking in agreement with Trinity House and in compliance with IALA G1162 (IALA, 2021) (see **Chapter 25: Shipping and Navigation** for further information on these requirements) (**Table 22-16** worst case).

246. As the shearwater species and storm petrel usually fly well below the collision risk window, i.e., relatively close to the sea under the lowest sweep of the turbine blade it is not expected that artificial light will measurably increase the likelihood of collision risk. The **magnitude** of the impact is thereby determined to be **negligible.**

247. Therefore, the significance of effect of attraction of nocturnal seabirds to project infrastructure lighting is assessed as **minor** and **not significant**. Adoption of a Lighting and Marking Management Plan (**Table 22-18**) is proposed as embedded mitigation and will further reduce any associated risks to marine ornithological receptors from this impact pathway.

Table 22-30. Summary of significance conclusion for attraction to project infrastructure lighting

	Magnitude	Sensitivity	Consequence	Impact significance
Attraction of nocturnal birds to project lighting during the operational phase				
Shearwater and petrel species.	Negligible	High	Minor	**Not significant**

Creation of Roosting Habitat for Birds due to Presence of Floating Platforms

248. Once constructed, semi-submersible floating platforms can act as perching environment for seabirds, mainly to rest or dry after foraging activities. Offshore wind structures have also been witnessed to act as artificial reefs, attracting potential seabird prey species and increasing potential foraging opportunities, although this was mainly observed around fixed jacket platforms (Vanermen *et al*., 2013). In the Netherlands, gulls and cormorants were found to be the main users of turbine platforms as perching and resting habitat (Leopold *et al*., 2011).

249. Of the key species assessed for this Project, kittiwake and lesser black-backed gull are the two species potentially more likely to use the Project's platforms for perching and roosting. While the creation of new resting and perching opportunities may have a positive effect for seabirds, their attraction to the platforms could potentially increase their risk of collision with the turbines or entanglement with mooring lines.

250. In this regard, both kittiwake and lesser black-backed gull are identified as sensitive to collision risk, however, it is not anticipated that their potential attraction into the wind farm would lead to a material (or measurable) change in outcome. Avoidance rates for collision risk are categorised as meso and micro avoidance (i.e., within wind farm avoidance), and so there would be no increase in collision risk *per se* to the individual birds concerned.

251. As the EIA matrix approach cannot be straightforwardly applied to this complex situation of inter-related effects (as defined in **Section 22.12.4**) expert judgement is instead applied. This particular inter-relationship combines a contrast of potential positive and negative effects. Due to the minor scale of the proposed Project – up to ten WTG with only a small amount of roosting habitat available – the creation of this habitat as well as the consideration of any increased collision risk are both determined to be of **negligible** magnitude.

252. Even if sensitivity is set to **high** (assigned against collision risk rather than the positive aspect of roost creation), there is still only **minor** consequence, determined as **not significant**.

Table 22-31. Summary of significance conclusion for creation of roosting habitat

	Magnitude	Sensitivity	Consequence	Impact significance
Creation of roosting habitat during the operational phase				
Kittiwake, lesser black-backed gull.	Negligible	High	Minor	**Not significant**

Indirect Effects Due to Changes in Habitat and / or Prey Availability and Distribution

253. As presented in **Section 22.8.1** (addressing impact pathways during construction), alteration to the presence, availability or distribution of seabird prey species may result as an indirect impact on seabirds by affecting seabirds foraging within the proposed Project Array Area and surrounding waters. It is expected that disturbance to prey species will be more marked during construction than during operation and maintenance of the proposed Project. The assessment conclusions from **Chapter 19: Benthic Ecology** and **Chapter 20: Fish and Shellfish** have been considered below for assessment of this impact pathway in relation to seabirds.

254. **Chapter 19: Benthic Ecology** concludes that all possible impact pathways to benthic interests during the operational phase of the proposed Project are **not significant**, including thermal and electro-magnetic (EMF) emissions from cables, temporary increase in suspended sediment and/or sediment deposition, alteration and/or indirect loss of habitat, disturbance during maintenance activities and spread of invasive non-native species. Adoption of the proposed PEMP, MPCP and INNS Management Plan (**Table 22-18**) will further reduce any such effects on seabird prey species and no additional mitigation is identified.

255. **Chapter 20: Fish and Shellfish** also concludes that all possible impacts to this receptor group during the operational phase of the proposed Project are **not significant** including species (such as sandeel) important as prey for seabirds. This includes consideration of any impacts (including disturbance) arising to fish and shellfish from either thermal or electro-magnetic (EMF) emissions from cables and/or underwater noise from proposed Project infrastructure or vessel activities. As for benthic interests (with which there is some overlap in receptors) adoption of the proposed PEMP, MPCP and INNS Management Plan (**Table 22-18**) will further reduce any such effects on fish and shellfish and no additional mitigation is identified.

256. Due to the conclusions of **Chapter 19: Benthic Ecology** and **Chapter 20: Fish and Shellfish** resulting in no significant effects being identified, the significance of effect of changes in habitat and / or prey availability for all bird species is subsequently assessed as **negligible** and **not significant**.

257. As noted elsewhere, the OfECC is proposed to pass through SSSP SPA. Any indirect effects due to changes in habitat and/or prey availability and distribution to SPA populations are considered in **Appendix 8E: HRA RIAA.**

Table 22-32. Summary of significance conclusion for changes in habitat and prey availability during operation of the proposed Project

	Magnitude	Sensitivity	Consequence	Impact significance
Indirect Effects Due to Changes in Habitat and / or Prey Availability and Distribution				
All ornithological receptors	Small	Low	Negligible	**Not significant**

22.8.3. *Decommissioning Impacts*

258. At the time of application, there is no detailed decommissioning information to inform a specific impact assessment for this stage of the proposed Project. Decommissioning activities are broadly expected to be a reversal of the installation process, and it is assumed that all infrastructure will be removed. **Table 22-33** provides an assessment of decommissioning activities assuming the same pathways to impact as identified for the construction phase.

Table 22-33. Summary of potential impacts during the decommissioning phase of the proposed Project

Species	Summary	Receptors	Magnitude	Sensitivity	Consequence	Impact significance
Disturbance and / or Displacement Associated with Vessels and Other Offshore Activities	During the decommissioning phase of the proposed Project the impacts to ornithological receptors from disturbance and/or displacement are similar to those during the construction period (**Section 22.8.1**). The sensitivity varies depending on the species with most species having a relatively negligible sensitivity to disturbance from vessel activity, apart from Auks, which were assessed to present a moderate sensitivity to vessel activity. Consequently, sensitivity of all ornithological receptors is precautionary judged as medium. The decommissioning disruption will be small both spatially and temporally and therefore assessed to have a negligible magnitude.	All marine ornithology receptors	Negligible	Medium	Minor	**Not significant**
Effects of Underwater Noise on Diving Seabirds	As for construction (**Section 22.8.1**), the SSSP SPA is the only designated seabird site potentially impacted by the underwater noise along the OfECC. As in **Section 22.8.1**, diving birds are defined as those that dive further than a few meters as part of their foraging behaviour. Although the full effects of underwater noise on seabirds is poorly understood, studies have indicated that auks spend up to 29% of their time at sea underwater, each period lasting less than a couple of minutes. Therefore, exposure is limited to short durations. As a result of the limitations in available research on sensitivities, the sensitivity of all diving birds has been assessed as medium. The localised and short-term nature of the underwater noise impacts the magnitude has been assessed as negligible.	All diving marine ornithology receptors	Negligible	Medium	Negligible	**Not significant**

Species	Summary	Receptors	Magnitude	Sensitivity	Consequence	Impact significance
Indirect Effects Due to Changes in Habitat and / or Prey Availability and Distribution	Alteration to the presence, availability, or distribution of seabird prey species during decommissioning may result in an indirect impact on seabirds by affecting seabirds foraging within the proposed Project site and surrounding waters. Kittiwakes breeding success is considered highly vulnerable to reduced food availability. Their surface feeding behaviour and dependence on sandeels means they have been assessed to have medium sensitivity. The other species are assessed to have small sensitivity as a result of their larger foraging ranges and/or flexible foraging strategies. The magnitude of the impact to all ornithological receptors is assessed as small.	Kittiwake	Small	Medium	Minor	**Not significant**
		All other marine ornithological receptors	Small	Low	Negligible	**Not significant**

22.8.4. *Summary of Residual Environmental Effects*

259. This chapter of the ES has assessed the potential environmental effects on marine ornithological receptors from the construction, operation and maintenance and decommissioning phases of the proposed Project. No significant effects have been identified, and therefore there is no additional mitigation which is proposed (**Section 22.9**).

260. **Table 22-34** summarises the outcomes of this marine ornithological impact assessment undertaken for the proposed Project.

22.9 Additional Mitigation and Enhancement Measures

261. As noted in **Section 22.8.4** there is no additional mitigation necessary or proposed in relation to marine ornithological receptors.

22.9.1. *Monitoring*

262. The Applicant intends to investigate suitable monitoring and/or research to help understand floating offshore wind farm impacts on marine ornithological receptors and welcomes the opportunity to discuss their possible contribution to any monitoring programmes (whether site-specific or more strategic for the Celtic Sea) with NRW (A) and JNCC as the statutory advisers, and other relevant stakeholders as required (including RSPB, the Welsh Wildlife Trusts, the academic community and potentially Natural England).

22.10 Summary of Effects and Conclusions

263. **Table 22-34** summarises the effects of the proposed Project on marine ornithology receptors, including the consideration of additional mitigation and enhancement measures (**Section 22.9**).

Table 22-34. Assessment summary

Potential Impact	Receptor	Receptor Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Significance of Effect
Construction						
Disturbance and/or displacement associated with vessels and other offshore activities	All ornithological receptors	Medium	Negligible	Minor (adverse) Not Significant	None required	Minor (adverse) Not Significant
Effects of underwater sound on diving seabirds	All ornithological receptors	Medium	Negligible	Negligible (adverse) Not Significant	None required	Negligible (adverse) Not Significant
Indirect effects due to changes in habitat and/ or prey availability and distribution	Kittiwake	Moderate	Low	Minor (adverse) Not Significant	None required	Minor (adverse) Not Significant
	All other ornithological receptors	Low	Low	Negligible (adverse) Not Significant	None required	Negligible (adverse) Not Significant
Operation and Maintenance						
Disturbance and/or displacement due to the presence of WTGs and associated maintenance activities	Guillemot	High	Small	Moderate (adverse) so impacts modelled under PVA, with the results showing no significant population consequence	None required	Minor (adverse) Not Significant
	Razorbill, puffin, gannet, Manx shearwater, Balearic shearwater, Storm petrel	High	Negligible	Minor (adverse) Not Significant	None required	Minor (adverse) Not Significant
Collision risk with WTGs	Kittiwake, lesser black-backed gull, gannet.	High	Negligible	Minor (adverse) Not Significant	None required	Minor (adverse) Not Significant

Potential Impact	Receptor	Receptor Sensitivity	Magnitude of impact	Significance of effect	Additional Mitigation	Residual Significance of Effect
Entanglement with mooring lines and cables	Diving ornithological receptors	High	Negligible	Minor (adverse) Not Significant	None required	Minor (adverse) Not Significant
Attraction of nocturnal seabirds to project infrastructure lighting	Shearwater and petrel species.	High	Negligible	Minor (adverse) Not Significant	None required	Minor (adverse) Not Significant
Creation of roosting habitat for birds due to presence of floating platforms and associated infrastructure	Kittiwake, lesser black-backed gull,	High	Negligible	Minor (adverse) Not Significant	None required	Minor (adverse) Not Significant
Indirect effect due to changes in habitat and / or prey availability and distribution	All ornithological receptors	Low	Low	Negligible (adverse) Not Significant	None required	Negligible (adverse) Not Significant
Decommissioning						
Disturbance and/or displacement associated with vessels and other offshore activities	All ornithological receptors	Medium	Negligible	Minor (adverse) Not Significant	None required	Minor (adverse) Not Significant
Effects of underwater sound on diving seabirds	All ornithological receptors	Medium	Negligible	Negligible (adverse) Not Significant	None required	Negligible (adverse) Not Significant
Indirect effects due to changes in habitat and/ or prey availability and distribution	Kittiwake	Moderate	Low	Minor (adverse) Not Significant	None required	Minor (adverse) Not Significant
	All other ornithological receptors	Low	Low	Negligible (adverse) Not Significant	None required	Negligible (adverse) Not Significant

22.11 Cumulative Effects of the Project

22.11.2. Introduction

264. Cumulative effects are those effects upon receptors arising from the proposed Project alongside all existing, and/or reasonably foreseeable projects, plans and activities that result in cumulative effects with any element of the proposed Project.

265. For marine ornithology, existing projects, particularly operational wind farms, may potentially give rise to long term impacts (e.g., collision risk and/or displacement and therefore are included for consideration in this cumulative assessment rather than screened out as part of the baseline. (Such judgements are receptor-specific, so therefore may not reflect the approach taken in other chapters).

266. This section assesses potential cumulative effects on marine ornithology receptors from identified projects, plans and activities that have the potential to act cumulatively with the proposed Project.

267. PINS Advice 17: Cumulative Effects Assessment (2019) suggests that CEA follows a four-stage process. The aim of this approach is to accurately determine relevant projects and associated relationships with scoped in receptors identified in the ES, to be included within the interproject CEA.

268. The approach to the assessment of cumulative effects is detailed in Appendix 5A: Approach to Cumulative Effects Assessment and is also summarised in **Table 22-35**.

Table 22-35. PINS Advice 17 Stages of the CEA process

CEA Stage	Activity
Stage 1	Determine a zone of influence (ZoI) via desk study for each topic receptor scoped into the ES. This will establish a *long list* of projects within each ZoI that will be shortlisted in Stage 2. This list of plans and projects/activities is drawn up through a desk study of planning applications, development plan documents, relevant development frameworks and any other available sources to identify 'other development' within the ZoI. Information on each project (location, development type, status, etc.) is documented, along with the certainty or tier assigned to the 'other development' (i.e. confidence it will take place in the current form and when it will take place in relation to the project). PINS notes that the project should then consult with the relevant planning authority and statutory consultees regarding the long list.
Stage 2	Screening of the long list identified in Stage 1, to establish a short list for the CEA. Screening is based on the criteria presented in the scoping report and subsequent comments by the regulator and statutory consultees. PINS has provided inclusions/ exclusion threshold criteria, against which the potential for 'other development to give rise to significant cumulative effects by virtue of overlaps in temporal scope, the scale and nature of the 'other developments' and /or receiving environment, or any other relevant factors is assessed. From this assessment, a shortlist of 'other developments' to be included in the CEA is produced. It is noted that documented information on each of the 'other developments' is likely to be high level at this stage, outlining the key issues to take forward.

CEA Stage	Activity
Stage 3	Gathering of all information available on short listed projects generated in Stage 2. At this stage all available data and information about the shortlisted projects that will be included in the CEA is collected to inform the assessment. This should utilise the most current information for each project in the public domain, and assess the assumptions and limitations of the information collected on each shortlisted project.
Stage 4	Each of the shortlisted projects are reviewed in turn by the different topics to assess whether cumulative effects may arise and the nature of those effects (i.e. beneficial or adverse). The significance of the effects on environmental receptors is established within each ES technical chapters. Where significant adverse cumulative effects are identified, mitigation measures are also considered within the CEA alongside the mechanism to secure that mitigation, e.g. consent condition requirements.

22.11.1. Scope of Cumulative Effects Assessment offshore ornithology

269. An initial long list of projects which have the potential for a cumulative effect with the proposed Project has been produced and is presented in **Appendix 5A: Approach to Cumulative Effects Assessment**. The assessment has been undertaken cognisant of the advice provided by NRW (A) in their letter of 30 January 2024.

270. The following offshore plans and projects have been considered in the CEA for marine ornithology:

- Marine renewables (wind, wave and tidal);
- Port and harbour developments;
- Marine aggregate extraction and dredging;
- Licensed disposal sites;
- Oil and gas exploration and extraction; and
- Subsea cables and pipelines.

271. The long list has been iterated for marine ornithology following the advice provided by NRW (A) and JNCC. In this regard, the UK Western waters (and Channel, where relevant for certain species) BDMPS (Furness, 2015) is identified as the Zone of Interest and this is the geographic area upon which the EIA seabird reference populations advised by NRW (A) and JNCC are based.

272. All projects within the BDMPS are included in assessment, as presented in **Table 22-36**. In addition, as the BDMPS only applies to UK waters, the CEA also includes projects located in the Celtic and Irish Seas in Irish waters within each seabird species breeding season foraging range (mean max + 1SD) from the focal Pembrokeshire breeding colonies (SSSP SPA, Grassholm SPA and Castlemartin SSSI).

273. **Figure 22-2** presents the geographic location of the projects (UK and Irish) which are included in the CEA for marine ornithology.

Table 22-36. List of projects considered for the marine ornithology cumulative effects assessment

Project Name	Project Type	Tier	Status	Distance to Array Area	Consideration in Marine Ornithological Cumulative Impact Assessment (EIA / HRA)	Assessment Approach
Operational Projects						
Arklow Bank	Offshore Wind	1	Operational	159 km NW	Irish project. No available data for quantified assessment (as for Liverpool Bay projects, see next row).	Qualitative
Barrow	Offshore Wind	1	Operational	321 km NE	There is very limited data for these operational wind farms in Liverpool Bay for EIA and no data available for HRA against the focal Pembrokeshire SPA (and SSSI) breeding seabird colonies. However, if these existing projects were causing a significant impact, or population consequence, against Pembrokeshire SPA (and SSSI) seabird colonies then this would have been picked up in changes to population trends (reductions in population growth, accelerated declines, or switches from an increasing to a decreasing trend). No such impacts have been recorded through the colony monitoring, and therefore it can be concluded that these projects have had no demonstrable effect on the Pembrokeshire SPAs or SSSIs assessed for the proposed Project, and therefore, by implication, for any wider EIA regional populations as defined in NRW (A) and JNCC advice. In line with the above, the projects in Liverpool Bay have been considered qualitatively which aligns with the approach undertaken for the consented projects Awel y Mor (also Liverpool Bay) and Erebus (Pembrokeshire) wind farms; as per the relevant entries below.	Qualitative
Burbo Bank	Offshore Wind	1	Operational	276 km NE		Qualitative
Burbo Bank Extension	Offshore Wind	1	Operational	271 km NE		Qualitative
Gwynt y Mor	Offshore Wind	1	Operational	257 km NE		Qualitative
North Hoyle	Offshore Wind	1	Operational	260 km NE		Qualitative
Ormonde	Offshore Wind	1	Operational	327 km NE		Qualitative
Rhyl Flats	Offshore Wind	1	Operational	251 km NE		Qualitative
Walney Phase 1	Offshore Wind	1	Operational	319 km NE		Qualitative
Walney Phase 2	Offshore Wind	1	Operational	320 km NE		Qualitative
Walney Extension	Offshore Wind	1	Operational	317 km NE		Qualitative
West of Duddon Sands	Offshore Wind	1	Operational	313 km NE		Qualitative
Rampion	Offshore Wind	1	Operational	361 km SE	English project. Only relevant to consider in respect of kittiwake (in terms of BDMPS regions), however, there is no available data for the same reasons as for the Liverpool Bay projects.	Qualitative

Project Name	Project Type	Tier	Status	Distance to Array Area	Consideration in Marine Ornithological Cumulative Impact Assessment (EIA / HRA)	Assessment Approach
Robin Rigg	Offshore Wind	1	Operational	390 km NE	Scottish project. No available data for the same reasons as for the Liverpool Bay projects.	Qualitative
Ramsey Sound (TIGER)	Tidal	1	Operational	55 km N	Ramsey Sound TIGER project has a marine licence for 1.4 MW capacity tidal turbine. Previously, the Tidal Energy Ltd (TEL) Deltastream device was deployed at the site; however, TEL went into administration. The TIGER project has now taken over the lease area and seeks to remove the Deltastream device, to replace it with their own turbine. At present, there is no further information that would allow any quantitative assessment, so this project is considered qualitatively.	Qualitative
Consented Projects and / or Under Construction						
Greenlink Interconnector	Interconnector	1	Construction	29 km N	Subsea electricity connection between Pembrokeshire and Ireland. Construction is due for completion by end of 2024, so there will be no temporal overlap of construction impacts with the proposed Project and no significant long-term seabird population consequences.	Qualitative
Celtic Interconnector	Interconnector	1	Construction	143 km E	Subsea electricity connection between Ireland and France with construction underway and due to finish by 2027. The key marine ornithological impact pathways associated with this project (i.e., construction disturbance and habitat loss) will not result in any significant, long-term population consequences to seabirds that require further consideration here.	Qualitative
Erebus	Offshore Wind	2	Consented	4.8 km NW	Erebus is the closest consented project to the proposed Project. It has good data availability to input into a quantified HRA for the focal species being assessed: guillemot, puffin and gannet. It has also been included in the cumulative scenario for SeabORD displacement modelling, as undertaken for the proposed Project.	**Quantitative and also included in cumulative SeabORD modelling**

Project Name	Project Type	Tier	Status	Distance to Array Area	Consideration in Marine Ornithological Cumulative Impact Assessment (EIA / HRA)	Assessment Approach
Awel y Mor	Offshore Wind	2	Consented	251 km NE	Awel y Mor is the most recently consented project in Welsh waters (decision issued 20 September 2023) located in Liverpool Bay, so at distance from the proposed Project. Four gannet mortalities are assigned against Grassholm SPA on a precautionary basis. There are negligible puffin mortalities to consider and zero guillemot.	**Quantitative**
Twin Hub	Offshore Wind	2	Consented	102 km SW	Twin Hub is located in waters off the Cornish coast. Gannet is the only focal species assessed of relevance to this cumulative assessment for the proposed Project. NE advise minimal impacts against the gannet population at Flatholm SSSI and no advised impacts against Grassholm (NE letter of 14 December 2018).	**Quantitative**
Morlais	Tidal	2	Consented	218 km NE	Morlais is located in waters off Holy Island, Anglesey. A single gannet mortality is assigned against Grassholm SPA on a precautionary basis. There are zero guillemot or puffin mortalities to consider.	**Quantitative**
Projects at Application						
White Cross	Offshore Wind	3	Application	19 km SE	White Cross is located in English waters in the Bristol Channel but in relative proximity to the proposed Project. It has been submitted for determination but is currently on hold pending the submission of supplementary environmental information (SEI). NE have raised queries around the project alone data analysis and impact modelling, and therefore, the available auk and gannet mortality estimates (from displacement matrices and CRM) presented for this project cannot be used with any confidence. In respect of potential cumulative impacts for White Cross, NE provided a 'gap-filling' paper as part of their response to the MMO. While the paper does not specify	Qualitative **but included in cumulative SeabORD modelling**

Project Name	Project Type	Tier	Status	Distance to Array Area	Consideration in Marine Ornithological Cumulative Impact Assessment (EIA / HRA)	Assessment Approach
					the projects for which NE have concerns, they are assumed to be the operational offshore wind farms for the *Western waters* BDMPS as listed and discussed in this table, i.e., Liverpool Bay projects, Rampion and Robin Rigg.	
South Irish Sea Array	Offshore wind	3	Application	132 km NW	Fixed foundation project, between 40-60 turbines, proposed off the southeast Irish coast between Arklow and Wexford. Although believed to be at application stage, no EIA/HRA assessment details available online.	Qualitative
Pre-application Projects, yet to be submitted						
Llŷr 2	Offshore Wind	4	Pre-App	N/A	The Applicant still hopes to progress a Llŷr 2 project depending on the outcome of negotiations with the Crown Estate. Analysis of survey data cannot be further progressed until there is a confirmed project area, although it is still intended for this to be located within the original development area surveyed.	Qualitative
Valorous	Offshore Wind	4	Pre-App	13 km W	Valorous is proposed off the Pembrokeshire coast, however, there is no data for it currently available, so that it can only be acknowledged at the present time.	Qualitative
Gwynt Glas	Offshore Wind	4	Pre-App	23 km SW	Early stage floating offshore wind project under development by EDF Renewables UK and DP Energy, located in the waters off the Pembrokeshire coast. Although it was raised by RSPB for consideration, there is no data yet available and so it can only be acknowledged and considered qualitatively at present.	Qualitative
Llywelyn	Offshore Wind	4	Pre-App	25 km SW	Early stage floating offshore wind project under development by BlueFloat Energy and Renantis. located in waters off the Pembrokeshire coast. Although it was raised by RSPB for consideration, there is no data yet available and so it can only be acknowledged at present.	Qualitative

Project Name	Project Type	Tier	Status	Distance to Array Area	Consideration in Marine Ornithological Cumulative Impact Assessment (EIA / HRA)	Assessment Approach
Petroc	Offshore Wind	4	Pre-App	39 km S	Early stage floating offshore wind project under development by BlueFloat Energy and Renantis. located in Cornish waters. Although it was raised by RSPB for consideration, there is no data currently available and so it can only be acknowledged and considered qualitatively at the present time.	Qualitative
Mona	Offshore Wind	4	Pre-App	289 km NE	Mona is proposed to be located in Liverpool Bay. Preliminary environmental information report (PEIR) submitted early in 2023; however, it has been announced that the project boundary is being revised and therefore no confirmed impact estimates are available. Also, the PEIR only presents EIA information and does not include the colony apportioning calculations necessary for HRA.	Qualitative
Morgan	Offshore Wind	4	Pre-App	314 km NE	Morgan is proposed to be located in Liverpool Bay. Status as above for Mona.	Qualitative
Morecambe	Offshore Wind	4	Pre-App	305 km NE	Morecambe is also proposed to be located in Liverpool Bay with a community consultation launched in April 2023. However, no data is currently available due to its pre-application status.	Qualitative
Mooir Vannan (Isle of Man)	Offshore Wind	4	Pre-App	320 km NE	Mooir Vannan is proposed to be located in waters around the Isle of Man, in proximity to the offshore wind farms in Liverpool Bay. No data currently available.	Qualitative
Rampion 2	Offshore Wind	4	Pre-App	342 km SE	Proposed extension to the Rampion wind farm (listed above); only relevant to consider in respect of kittiwake. No data currently available.	Qualitative

Project Name	Project Type	Tier	Status	Distance to Array Area	Consideration in Marine Ornithological Cumulative Impact Assessment (EIA / HRA)	Assessment Approach
Irish Pre-App Projects	Offshore Wind	4	Pre-App	N/A	There are a number of pre-application projects located in the Celtic Sea, in Irish waters including Arklow Bank 2, NISA, Clogherhead, Codling Wind Park, Dublin Array, Inis Ealga and the North Celtic Sea. These projects are acknowledged and considered qualitatively for cumulative assessment pending agreement on a transboundary approach between UK (Welsh) and Irish governments.	Qualitative

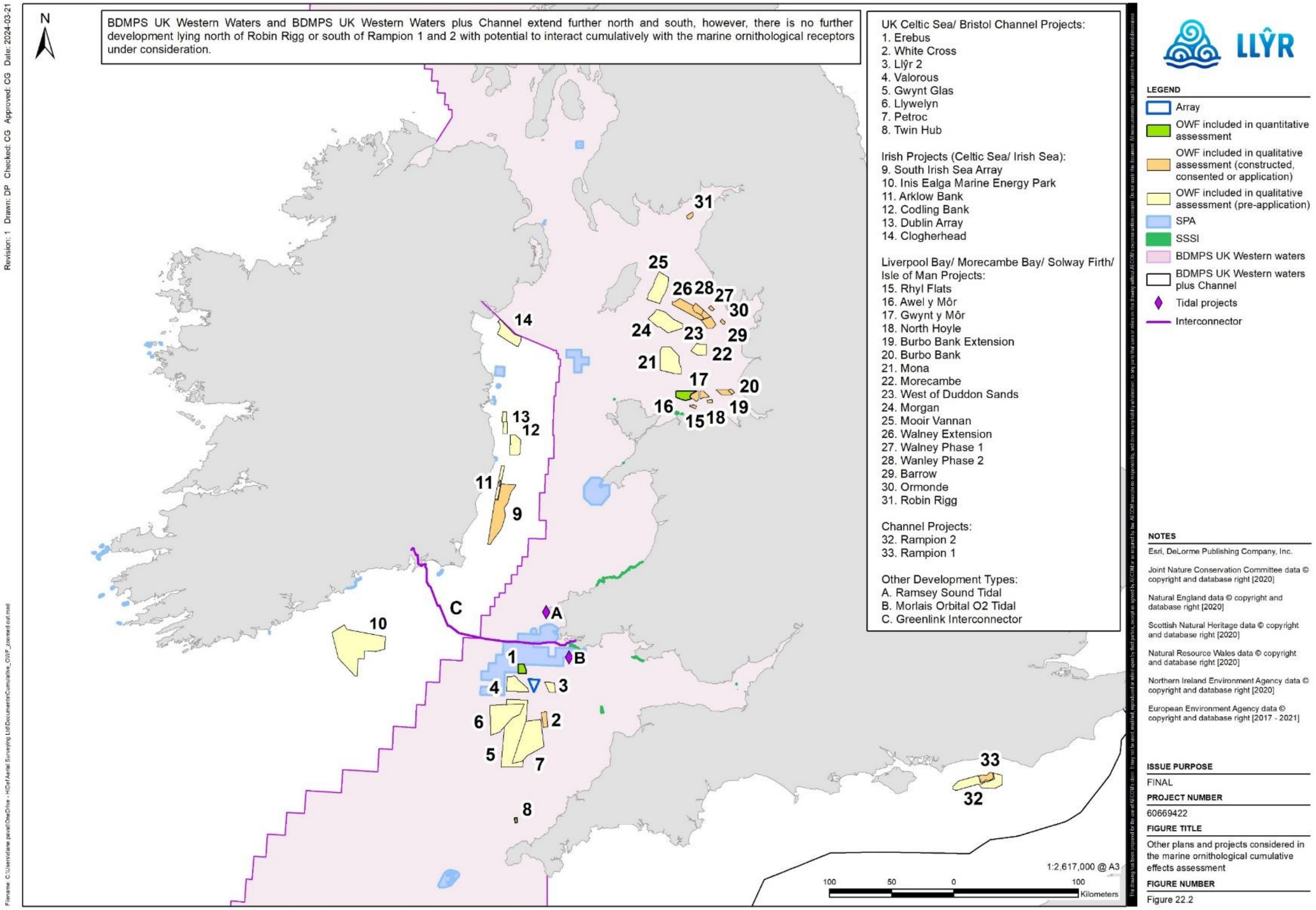

Figure 22-2. Other plans and projects considered in the marine ornithological cumulative effects assessment

22.11.2. *Cumulative Effect Assessment*

Construction and Decomissioning

274. A qualitative consideration of the potential for cumulative construction/decommissioning impacts across projects is provided in **Table 22-37.**

Table 22-37. Qualitative consideration of the potential for cumulative construction/decommissioning impacts arising from the proposed Project in combination with other identified development

Impact Pathway	Rationale
Construction	
Disturbance and/or displacement associated with vessels and other offshore activities	These effects have been assessed as minor for the proposed Project. Erebus and White Cross are the other focal projects in the CEA for which the construction phases might overlap with that for the proposed Project, and which are located in relative proximity. Such disturbance/displacement during construction will not, on its own, give rise to any population consequences on seabirds, and it is unlikely to significantly increase the risk or magnitude of any such consequences in combination with the operational impacts (i.e., long-term operational displacement and/or collision risk) assessed under quantitative PVA. If the same conditions that have been applied to Erebus in the marine licence (i.e., adoption and implementation of a Construction Environmental Management Plan including a Vessel Management Plan) are applied to the proposed Project (and also to White Cross) then there is no outstanding risk of significant cumulative disturbance impacts to seabirds from the construction phases of these offshore wind demonstrator projects.
Effects of underwater noise on diving seabirds	These effects have been assessed as negligible for the proposed Project and it is unlikely that there could be any significant risk of cumulative effects from this impact pathway in combination with other relevant development from the long list where construction phases might overlap with that of the proposed Project. Across projects, any mitigation or good practice construction methods agreed to remove/reduce the level of such impact for more affected receptor groups (i.e., marine mammals and fish) will also help to do the same for diving seabirds. As above, If the same conditions that have been applied to Erebus in the marine licence (i.e., adoption and implementation of a Construction Environmental Management Plan) are applied to the proposed Project (and also to White Cross) then there will be no outstanding risk of significant cumulative effects of underwater noise on diving seabirds.
Indirect effects due to changes in habitat and/ or prey availability and distribution.	These effects have been assessed as negligible for the proposed Project and it is unlikely that there could be any significant risk of cumulative effects from this impact pathway in combination with other relevant development from the long list where construction phases might overlap with that of the proposed Project.

Impact Pathway	Rationale
Decommissioning	
If the same conditions that have been applied to Erebus in relation to decommissioning are applied to the proposed Project (and also to White Cross) then there will be no outstanding risk of significant cumulative effects from the impact pathways associated with this phase of development. As for construction, significant environmental effects from decommissioning activities will be avoided by the implementation of good working practice and management measures on-the-ground.	

Operation and Maintenance

275. This section first addresses those marine ornithological impact pathways which can be considered quantitatively. **Table 22-38** then provides a qualitative consideration of the others.

Disturbance and/or Displacement Due to the Presence of WTGs and Associated Maintenance Activities. Barrier effects due to presence of WTGs

276. **Appendix 22E: Marine Ornithology Project Alone and Cumulative Impact Scenarios** scopes the cumulative assessment for operational disturbance/displacement impacts alongside barrier effects, where quantification of these impacts is possible. In this regard, **Table 22-21** and **Table 22-22** in the project-alone displacement section, set out the 1% baseline mortality thresholds applicable to consider (for regional and colony-specific EIA respectively).

277. The only species in breach of EIA thresholds is guillemot, and only then in relation to the more unlikely rates of displacement and mortality advised (70%/10%). **Appendix 22E** sets out the cumulative displacement impacts modelled for guillemot in relation to the population at Castlemartin SSSI, with the PVA modelling itself, and the PVA outputs, presented in **Appendix 22F: Marine Ornithology: Population Modelling.**

278. As for the project-alone impacts there is no outstanding risk of significant population-level consequences from cumulative offshore wind displacement impacts in relation to the Castlemartin SSSI population (nor in relation to SSSP SPA addressed in **Appendix 8E: HRA RIAA**. The same line of argument applies as previously in relation to regional EIA, such that if impacts are not significant against the closest seabird colonies to the proposed Project, then it could not be expected for there to be any wider concern or risk of population-level consequences against a larger-sized population, at a wider geographic scale.

The only other two species where displacement impacts potentially exceed thresholds are puffin and gannet, however, this is only in relation to their SPA populations, and there is no risk of the proposed Project contributing significantly to any cumulative impact at a wider, regional EIA (BDMPS) scale.

Collision Risk with WTGs

279. As set out in more detail in **Appendix 22E**, it is only gannet where the population consequences of estimated collision risk (summed with displacement mortality) may need further consideration, and only then in relation to Grassholm SPA. As advised above, there is no risk of the proposed Project contributing significantly to any cumulative impacts from collision risk at a wider, regional EIA (BDMPS) scale. This conclusion applies to all three of the species screened in for this assessment: kittiwake, lesser black-backed gull and gannet.

Table 22-38. Qualitative consideration of the potential for cumulative operational impacts arising from the proposed Project in combination with other identified development

Impact Pathway	Rationale
Operation	
Entanglement with mooring lines and cables	This impact pathway has been assessed as minor and non-significant for the proposed Project with regard mooring lines and intra-array cables. It is anticipated that any consented floating wind farms, once built, will have regular ROV inspections to check for any snagged fishing gear or other marine litter on the mooring lines, which will then be removed. If this is undertaken then there will be no significant cumulative impacts arising from this impact pathway.
Attraction of nocturnal seabirds to project infrastructure lighting	This impact pathway has been assessed as minor and non-significant for the proposed Project. If the same relevant condition that has been applied to Erebus in the marine licence (i.e., adoption and implementation of an Aviation and lighting Scheme Plan, as set out in Section 3.26.1 of the Erebus marine licence) is applied to the proposed Project (and also to White Cross) then there is no outstanding risk of significant cumulative impacts to seabirds from this impact pathway during the operational phase of these projects.
Creation of roosting habitat for birds due to presence of floating platforms and associated infrastructure	This impact pathway has been assessed as negligible for the proposed Project, including consideration of the potential for such attraction to increase collision risk. The small number of platforms and total perching space makes it unlikely that there is significant positive effect from this impact pathway, and likewise unlikely to be any measurable increase in risk of seabird collisions due to this attraction. The same is true for Erebus and White Cross, so cumulatively, there is unlikely to be any significant positive or negative effects from this impact pathway in relation to these small-scale offshore wind demonstrator projects in the Celtic Sea / Bristol Channel.
Indirect effects due to changes in habitat and/ or prey availability and distribution.	This impact pathway has been assessed as negligible for the proposed Project and it is unlikely that there could be any significant risk of cumulative effects from this impact pathway over the long-term operation of the proposed Project in combination with the other relevant projects.

22.12 Inter-related Effects of the proposed Project.

280. The term 'inter-related' takes into account the environmental interactions ('inter-relationships') with other receptors within the proposed Project. These are referred to in the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 and further described in **Chapter 31: Inter-related Effect Assessment.**

281. As set out in PINS Advice Note 17 (PINS), 2019, *inter-related project effects*, or ‘inter-relationships between topics’, derive from combinations of different project specific impacts which, when acting together on the same receptor, could result in a new or different effect, or an effect of greater significance than the project effects, when considered in isolation.

282. Inter-related effects comprise the following:

- *Project lifetime effects*: effects that have the potential to occur during more than one phase of the proposed Project (i.e. construction, operation and maintenance and decommissioning) and also to interact in a way that could potentially create a more significant effect than if it was assessed in isolation.
- *Receptor-led effects*: effects that have the potential to interact, spatially and temporally, to create inter-related effects on a receptor.

283. **Chapter 31 - Inter-related Effects Assessment** details the approach to the inter-related effects assessment and includes a description of the likely inter-related effects that may occur as a result of the proposed Project on marine ornithology.

22.12.3. Inter-related Project lifetime effects

284. Inter-related effects that may occur throughout the project lifetime on marine ornithology are detailed in **Table 22-39.**

Table 22-39. Inter-related Project lifetime effects assessment – marine ornithology

Development Phase	Nature of inter-related effect	ES Reference	Inter-related effects assessment
Construction, operation and decommissioning	Impacts combining across the different development phases of the proposed Project	**Sections 22.8.1, 22.8.2** and **22.8.3**	Impacts during construction and decommissioning are short to medium term, lasting between 1-2 years (for each of these two development phases). For marine ornithological receptors all construction / decommissioning impacts are assessed as negligible or minor and will not result in any quantifiable population consequence for any of the species concerned, either from the phases separately or in combination. It is only long-term operation and maintenance impacts where there could be a risk of anything other than temporary effects to individual birds, and in this regard, it is only displacement / barrier effects and / or collision risk which result in any quantifiable measure(s) of (annual) mortality. This mortality is then modelled to consider whether it could lead to any population consequence (**Appendix 22F: Marine Ornithology Population Modelling**). Following current guidance, such quantitative assessment is 'worst case', therefore it effectively already encompasses any unquantified effects arising from the other impact pathways which are assessed qualitatively. For a demonstrator project of this scale, there is no risk that 'adding' qualitative

Development Phase	Nature of inter-related effect	ES Reference	Inter-related effects assessment
			to quantitative impacts would change the outcome of assessment (or population modelling results) for any of the species assessed when considered across development phases; either project-alone (**Section 22.8**) or cumulatively (**Section 22.11**).

22.12.4. *Inter-related receptor-led effects*

285. Possible inter-related receptor-led effects are identified and addressed in the main Project assessment (**Section 22.8**) as follows;

- Combination of displacement / barrier effects and collision risk on gannet during operation of the proposed Project, assessed in **Section 22.8.2**.
- Attraction to floating platforms potentially increasing the risk of collision with WTG blades; identified as primarily relevant to consider in relation to kittiwake and lesser black-backed gull and assessed in **Section 22.8.2**
- Attraction to nocturnal lighting potentially increasing the risk of collision with WTG blades; considered in relation to Manx shearwater and storm petrel as the nocturnal species for which this concern has been raised; assessed in **Section 22.8.2.**

286. As for project lifetime effects, it is not considered feasible that short-term, temporary impacts on individual seabirds (assessed qualitatively) will combine in any meaningful or measurable way with the long-term operational impacts (displacement / barrier effects / collision risk) which are assessed quantitatively. There is no scope that inter-related receptor-led effects would ever lead to a change in the population consequence for any of the seabirds assessed under EIA as reported in this Chapter), either at individual colonies or at the wider regional (BDMPS) scale.

22.13 Transboundary Effects

287. A transboundary effect refers to the impacts or effects of a project that extend beyond the boundaries of the United Kingdom and have the potential to affect the environment of other countries within the European Economic Area (EEA). These effects can occur either from the proposed Project on its own or when combined with the effects of other projects or activities in the wider geographical area.

288. The marine ornithological receptors under consideration in this Chapter are mobile species (as discussed in **Section 22.4.3** and set out in the baseline **Species Accounts**). During the breeding season, seabird species are central-placed foragers and the foraging ranges of many of the species assessed (**Table 22-10**) extend from the focal (Welsh/UK) breeding colonies into the waters of other EEA states, particularly the area of the Celtic Sea encompassed within Irish waters.

289. In the non-breeding season, seabirds will migrate and forage across even larger distances than in the breeding season as they are not restricted to chick-rearing activities or colony location. While the seabird BDMPS used for non-breeding season assessment are defined spatially in

relation to UK waters (Furness, 2015), their associated populations have a non-UK component i.e., birds that breed elsewhere but which migrate through and / or overwinter in UK waters.

290. As well as this, the proposed Project lies within the identified foraging ranges of qualifying interests from SPA seabird breeding colonies located in other EEA states, including Ireland, as considered under the HRA process (**Appendix 8D: HRA Screening** and **Appendix 8E HRA RIAA**).

291. Accounting for these transboundary effects is therefore already integral to assessment of the proposed Project, both in relation to its project-alone impacts and cumulatively with the other development identified in **Section 22.11** of this Chapter (and presented on **Figure 22-2**). Transboundary effects in relation to EIA are therefore not reported separately in this Chapter, with assessment of SPAs in other EEA states addressed (as noted) in **Appendix 8D: HRA Screening** and **Appendix 8E: HRA RIAA**.

22.14 References

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