MORGAN OFFSHORE WIND PROJECT GENERATION ASSETS

Environmental Statement

Volume 2, Chapter 5: Offshore ornithology

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Image of an offshore wind farm

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Errata

Errata reference number	Deadline included	Document number	Volume and chapter	Paragraph/ Table/Figure	Description of errata	Correction
18	D1	APP-023	Volume 2, Chapter 5 Offshore ornithology	Table 5.173: Summary of potential cumulative environmental effects, mitigation and monitoring	Scenario 1, Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure: 'Residual effect' for Guillemot during operation is incorrectly presented as 'Minor adverse'.	Scenario 1, Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure: 'Residual effect' for Guillemot during operation should be 'Negligible'.

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5.5	Offshore ornithology apportioning technical report
5.6	Offshore ornithology population viability analysis technical report

Glossary

Term	Meaning
Avoidance	Probability that a bird takes successful evasive action to avoid collision with a turbine.
Biologically Defined Minimum Population Scales	Seasonal subdivision of bird population size. The rationale behind these subdivisions is that the likely origin of a bird in a particular location depends on the time of year.
Collision risk	Risk of a bird lethally colliding with a wind turbine within a wind farm.
Collision risk model	A model that calculates collision risk for a species within a wind farm based on a set of wind farm and bird species specific parameters. Collision risk models can be run deterministically or stochastically.
Confidence Interval	A confidence interval displays the probability that a parameter will fall between a pair of values around the mean.
Design-based Abundance Estimates	An estimated total abundance of birds within a given area. The design-based method is based on the premise that the portion of the study area that is surveyed is representative of the remainder of the study area.
Deterministic model	Model where a single value for each input parameter that goes into the model is used, leading to a single output without variation.
Disturbance sensitivity	Disturbance by wind farm structures, ship and helicopter traffic factor used scores from 1 (limited escape behaviour and a very short flight distance when approached), to 5 (strong escape behaviour, at a large response distance).
Habitat specialisation	The habitat specialisation factor represents the range of habitats species are able to use and whether they use these as specialists or generalists. This score classifies species into categories from 1 (tend to forage over large marine areas with little known association with particular marine features) to 5 (tend to feed on very specific habitat features, such as shallow banks with bivalve communities, or kelp beds).
Lowest Astronomical Tide	The lowest level of the sea surface with respect to the land.
MRSea	The ‘Marine Renewables Strategic Environmental Assessment’ statistical package for R to model spatial count data and predict spatial abundances. This package has been developed by the Centre for Research into Ecological and Environmental Modelling (CREEM) specifically for dealing with data collected for offshore wind farm projects.
Ornithology	Ornithology is a branch of zoology that concerns the study of birds.
Parameter	Parameters are the input elements of a model that together affect the output of a model. In collision risk models, examples of parameters are the number of wind turbines and the length of the bird.
Season	Bird behaviour and abundance is recognised to differ across a calendar year, with particular months recognised as being part of different seasons. The biologically defined minimum population scales (BDMPS) seasons used in this report are based on those in Furness (2015), hereafter referred to as seasons. Separate seasons are recognised in this technical report in order to establish the level of importance any seabird species has within the study area during any particular period of time.
Stochastic model	Model where the input parameters that go into the model are allowed to vary, leading to a range of output.

Acronyms

Acronym	Description
BDMPS	Biologically Defined Minimum Population Scales
BNG	Biodiversity Net Gain
BTO	British Trust for Ornithology
CEA	Cumulative Effects Assessment
CFP	Common Fisheries Policy
CRM	Collision Risk Modelling
DCO	Development Consent Order
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EU	European Union
EWG	Expert Working Group
HRA	Habitats Regulation Assessment
ISAA	Information to Support Appropriate Assessment
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LSE	Likely Significant Effect
MDS	Maximum Design Scenario
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MNR	Marine Nature Reserves
MPCP	Marine Pollution Contingency Plan
MRSea	Marine Renewables Strategic Environmental Assessment
NERC	Natural Environment and Research Council
NPS	National Policy Statements
NRW	Natural Resources Wales
NSIPs	Nationally Significant Infrastructure Projects
OSP	Offshore Substation Platform
PEIR	Preliminary Environmental Information Report
PVA	Population Viability Analysis
RSPB	Royal Society for the Protection of Birds
sCRM	Stochastic Collision Risk Model
SD	Standard Deviation
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body

Acronym	Description
SOSSMAT	Strategic Ornithological Support Services Migration Assessment Tool
SPAs	Special Protection Areas Zone
SSCs	Suspended Sediment Concentrations
SSSIs	Sites of Specific Scientific Interest
UK	United Kingdom
VOR	Valued Ornithological Receptor
UXO	Unexploded Ordnance
ZoI	Zone of Influence

Units

Unit	Description
%	Percentage
kJ	kiloJoule
km^2	Square kilometres
km	Kilometres
m	Metre
MW	Megawatt

5 Offshore ornithology

5.1 Introduction

5.1.1 Overview

5.1.1.1 This Chapter of the Environmental Statement presents the assessment of the potential impact of the Morgan Offshore Wind Project Generation Assets (hereafter referred to as the Morgan Generation Assets) on offshore ornithology. Specifically, this chapter considers the potential impact of the Morgan Generation Assets during the construction, operations and maintenance, and decommissioning phases.

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

- Volume 4, Annex 5.1: Offshore ornithology baseline characterisation report of the Environmental Statement
- Volume 4, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement
- Volume 4, Annex 5.3: Offshore ornithology collision risk modelling (CRM) technical report of the Environmental Statement
- Volume 4, Annex 5.4: Offshore ornithology migratory bird CRM technical report of the Environmental Statement
- Volume 4, Annex 5.5: Offshore ornithology apportioning technical report of the Environmental Statement
- Volume 4, Annex 5.6: Offshore ornithology PVA technical report of the Environmental Statement.

5.1.1.3 The offshore ornithology chapter considers any seabirds that are present at some point in their life cycle in the study areas and non-seabird species using the study areas during migratory flights. The overarching term 'seabird' is used to refer to species that depend on the marine environment for survival at some point in their life cycle. Therefore, in addition to the true seabirds, seaducks and divers and grebes are also included because of their additional reliance on marine areas, especially in the non-breeding season. The study areas are defined in section 5.4.4.

5.1.2 Purpose of Chapter

5.1.2.1 The primary purpose of the Environmental Statement is outlined in Volume 1, Chapter 1: Introduction of the Environmental Statement. In summary, the primary purpose of an Environmental Statement is to support the Development Consent Order (DCO) application for the Morgan Generation Assets under the Planning Act 2008 (the 2008 Act). The Environmental Impact Assessment (EIA) has been finalised following completion of pre-application consultation and the Environmental Statement will accompany the application to the Secretary of State for Development Consent.

5.1.2.2 In particular, this Environmental Statement chapter:

1. Presents the existing environmental baseline established from desk studies, site-specific surveys and consultation
2. Identifies any assumptions and limitations encountered in compiling the environmental information

3. Presents the potential environmental effects on offshore ornithology arising from the Morgan Generation Assets, based on the information gathered and the analysis and assessments undertaken
4. Highlights any necessary monitoring and/or measures adopted as part of the project which could prevent, minimise, reduce or offset the possible environmental effects of the Morgan Generation Assets on offshore ornithology.

5.2 Legislative and policy context

5.2.1 Legislation

5.2.1.1 The full relevant legislative context for the Morgan Generation Assets has been detailed in Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement, with the legislation outlined below being the most relevant to offshore ornithology.

Marine and Coastal Access Act 2009

5.2.1.2 Parts three and four of the Marine and Coastal Access Act 2009 introduced a new marine planning and licensing system for overseeing the marine environment and a requirement to obtain a marine licence for certain activities and works at sea. Section 149A of the Planning Act 2008 allows applicants for development consent to apply for ‘deemed marine licences’ as part of the consenting process.

Habitats Regulations

5.2.1.3 The Conservation of Habitats and Species Regulations 2017 (as amended) and the Conservation of Offshore Marine Habitats and Species Regulations 2017 (as amended) (collectively known as the ‘Habitats Regulations’) require the assessment of significant effects on internationally important nature conservation sites, including:

- Special Areas of Conservation (SACs) or candidate SACs
- Special Protection Areas (SPAs) or potential SPAs
- Sites of Community Importance
- Ramsar sites (note that these sites are not covered by the Habitats Regulations but are treated as such by governing bodies).

5.2.1.4 These designated sites have been given full consideration in Volume 4, Annex 5.1: offshore ornithology baseline characterisation technical report of the Environmental Statement and are given further consideration within section 5.5.3 of this chapter and in ISAA Part 3 – SPA and Ramsar Sites Assessments (Document Reference E1.3).

Environment Act 2021

5.2.1.5 The Environment Act 2021 sets out targets, plans and policies for environmental protection in England. Schedule 15 of the Environment Act 2021 sets out provisions for Biodiversity Net Gain (BNG) in respect of nationally significant infrastructure projects (NSIPs) and amends the Planning Act 2008. These provisions are not yet in force. The provisions include the requirement for the production of BNG statements for applications for development consent under the Planning Act. In response to the recent consultation on the requirements of the Environment Act 2021, the Government has stated that it intends to produce a draft BNG statement and intends to consult with the industry on this (Department for Environment, Food and Rural Affairs (Defra, 2022). The stated intention is for the requirements of the Environment Act 2021 in relation to biodiversity to be implemented no later than 2025, which will temporally overlap with the ongoing development of the Morgan Generation Assets and will require further consideration.

5.2.2 Planning policy context

5.2.2.1 The Morgan Generation Assets will be located in English offshore waters (beyond 12 nm from the English coast). As set out in Volume 1, Chapter 1: Introduction of the Environmental Statement. As the Morgan Generation Assets is an offshore generating station with a capacity of greater than 100 MW located in English waters, it is a NSIP as defined by Section 15(3) of the Planning Act 2008 (as amended). As such, there is a requirement to submit an application for a DCO to the Planning Inspectorate to be decided by the Secretary of State for the Department for Energy Security and Net Zero.

5.2.3 National Policy Statements

5.2.3.1 There are currently six energy National Policy Statements (NPSs), two of which contain policy relevant to offshore wind development and the Morgan Generation Assets, specifically:

- NPS for Energy (NPS EN-1) which sets out the UK Government's policy for the delivery of major energy infrastructure (Department for Energy Security & Net Zero, 2023a)
- NPS for Renewable Energy Infrastructure (NPS EN-3) (Department for Energy Security & Net Zero, 2023b).

5.2.3.2 NPS EN-1 and NPS EN-3 include guidance on what matters are to be considered in the assessment. These are summarised in Table 5.1. NPS EN-1 and NPS EN-3 also highlight a number of factors relating to the determination of an application and in relation to mitigation. These are summarised in Table 5.2.

Table 5.1: Summary of the NPS EN-1 and NPS EN-3 provisions relevant to offshore ornithology.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
NPS-EN1	
All proposals for projects that are subject to the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations) must be accompanied by an Environmental Statement (ES) describing the aspects of the environment likely to be significantly affected by the project. (NPS EN1, paragraph 4.3.1). The Regulations require an assessment of the likely significant effects of the proposed project on the environment, covering the direct effects and any indirect, secondary, cumulative, transboundary, short, medium, and long-term, permanent and temporary, positive and negative effects at all stages of the project, and also of the measures envisaged for avoiding or mitigating significant adverse effects. (NPS EN1, paragraph 4.3.3).	Assessment of the potential effects of the Morgan Generation Assets relevant to offshore ornithology is considered in section 5.9. The approach to mitigation is discussed in section 5.7.1.2, section 5.9 and section 5.11.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
For the purposes of this NPS and the technology specific NPSs the ES should cover the environmental, social and economic effects arising from preconstruction, construction, operation and decommissioning of the project. (NPS EN-1 paragraph 4.3.5)	Construction, operations and maintenance and decommissioning effects of the Morgan Generation Assets relevant to offshore ornithology are assessed in section 5.9. There are not anticipated to be any impacts on offshore ornithological receptors during the pre-construction stage of the Morgan Generation Assets.
The applicant must provide information proportionate to the scale of the project, ensuring the information is sufficient to meet the requirements of the EIA Regulations. (NPS EN-1 paragraph 4.3.10)	Volume 1, Chapter 2, Policy and Legislative Context of the Environmental Statement sets the legislative context, and Volume 1, Chapter 5, Environmental Impact Assessment Methodology of the Environmental Statement sets out the proportionate approach taken to the assessment.
The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests. (NPS EN-1 paragraph 5.4.19)	The Morgan Generation Assets will aim to conserve habitats through a number of measures adopted to reduce the impact of the Morgan Generation Assets including measures to preserve ecologically important features as well as broader measures such as the development of an environmental management plan. These measures have been put in place to take advantage of opportunities to conserve ecological features of conservation interest. The Applicant's approach to biodiversity enhancement is presented in the Biodiversity Benefit and Green Infrastructure Statement (Document Reference J18). The Applicant has identified a number of opportunities within the Irish Sea which could deliver additional intertidal and offshore biodiversity benefits, including increases to the productivity of breeding seabirds, biodiversity enhancing cable protection, artificial reef blocks and restoration of fish and shellfish habitats outside of protected sites. The Applicant will continue to explore these opportunities as the Project's design develops, in collaboration with stakeholders post-consent.
In some instances, it may not be possible at the time of the application for development consent for all aspects of the proposal to have been settled in precise detail. Where this is the case, the applicant should explain in its application which elements of the proposal have yet to be finalised, and the reasons why this is the case. Where some details are still to be finalised, the ES should, to the best of the applicant's knowledge, assess the likely worst-case environmental, social and economic effects of the proposed development to ensure that the impacts of the project as it may be constructed have been properly assessed. (NPS EN-1 paragraphs 4.3.11 and 4.3.12)	The maximum design scenario (MDS) is shown in Table 5.25. The MDS has been selected as those scenarios having the potential to result in the greatest effect on an identified receptor or receptor group. The assessment of effects is contained in section 5.9.
The highest level of biodiversity protection is afforded to sites identified through international conventions. The Habitats Regulations set out sites for which an HRA will assess the implications of a plan or project, including Special Areas of Conservation and Special Protection Areas. (NPS EN-1 paragraphs 5.4.4)	Internationally designated sites are identified in section 5.5.3, and are described in Volume 4, Annex 5.1: Offshore Ornithology Baseline Characterisation of the Environmental Statement and, where relevant assessments provided in ISAA Part 3 – Special Protection Area (SPA) and Ramsar Site Assessments (Document Reference E1.3).

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
As a matter of policy, the following should be given the same protection as sites covered by the Habitats Regulations and an HRA will also be required: (a) potential Special Protection Areas and possible Special Areas of Conservation; (b) listed or proposed Ramsar sites; and (c) sites identified, or required, as compensatory measures for adverse effects on any of the other sites covered by this paragraph. (NPS EN-1, paragraph 5.4.5).	Internationally designated sites, including potential SPAs, are identified in Table 5.15 and described in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement. The findings of the HRA process are reported in an Information to Support Appropriate Assessment (ISAA) part 3 – SPA and Ramsar Site Assessments (Document Reference E1.3), which assesses the impact specifically on all European sites and is submitted alongside the Environmental Statement.
Many 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. (NPS EN-1 paragraph, 5.4.7).	All relevant SSSIs are identified in section 5.5.3 and described in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement. The assessment of impacts takes account all impacts on all designated sites (including SSSIs) within the Morgan offshore ornithology study areas as defined in section 5.5.3, where necessary.
Many individual 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. (NPS EN-1 paragraph, 5.4.16).	The assessments presented in this chapter of the Environmental Statement have followed relevant legislation and guidance as identified in Volume 1, Chapter 2: Policy and legislative context of the Environmental Statement and Volume 2, Chapter 15: Inter-related Effects (Offshore) of the Environmental Statement with regard to inter-dependencies and ecosystem impacts.
Where the development is subject to EIA, the applicant should ensure that the Environmental Statement clearly sets out any effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance (including those outside England), on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity, including irreplaceable habitats. (NPS EN-1 paragraph, 5.4.17).	The baseline ornithological environment is described in section 5.4. As part of this chapter, the process of identifying designated sites has been undertaken and results are presented in section 5.5.3. The specific bird species that may be impacted by the potential effects of the Morgan Generation Assets are identified in Table 5.15 and an assessment of the potential effects for these specific species are identified and considered in section 5.9.
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	The approach taken to mitigation is described in section 5.7.1.2 and follows the mitigation hierarchy defined.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
• 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. • mitigations required as a result of legal protection of habitats or species will be complied with. (NPS EN-1 paragraph 5.4.35)	
NPS-EN3	
As part of the Offshore Wind Environmental Improvement Package set out in the British Energy Security Strategy, government committed to establishing Offshore Wind Environmental Standards (OWES; previously referred to as Nature Based Design Standards) to accelerate deployment whilst offering greater protection of the marine environment. OWES aim to support developers to take a more consistent approach to avoiding, reducing, and mitigating the impacts of an offshore wind farm and/or offshore transmission infrastructure. The measures could apply to the design, construction, operation and decommissioning of offshore wind farms and offshore transmission (as defined in EN-5 at section 2.12). Defra will consult on a series of OWES before drafting clear OWES Guidance, which sets out where and how Defra expects each measure to be applied to a development. Once the OWES Guidance is issued, the Secretary of State will expect applicants to have applied the relevant measures to their applications. Applicants should explain how their proposals comply with the guidance or, alternatively, the grounds on which a departure from them is justified. Any reasons for departure from the OWES should be fully detailed within the application documents, with details of any agreements made with statutory consultees. (NPS EN-3 paragraph 2.8.90 to 2.8.92)	The project is aware of the requirements in NPS EN3 to apply the guidance on Environmental Standards, once the final guidance is issued. The project will review the guidance once available and determine how the project complies with the guidance, and where, if relevant, the project departs from them.
Applicants should consult at an early stage of pre-application with relevant statutory consultees and energy not-for profit organisations/non governmental organisations as appropriate, on the assessment methodologies, baseline data collection, and potential avoidance, mitigation and compensation options which should be undertaken (NPS EN-3 paragraph 2.8.104)	Throughout the Morgan Generation Assets consultations with relevant statutory and non-statutory stakeholders have been carried out (e.g. via the Evidence Plan process Expert Working Groups (EWG)) and are presented in section 5.2. A Scoping Report was submitted to the Planning Inspectorate and a Scoping Opinion was received, discussed in section 5.2. Furthermore, section S42 responses from the relevant statutory and non-statutory stakeholders were received following submission of the Preliminary Environmental Information Report (PEIR) technical Annexes and chapter. All the responses provided, and changes suggested by the stakeholders are presented in the Consultation report (Document Reference E3).

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
Applicant assessment of the effects on the subtidal environment should include: • loss of habitat due to foundation type including associated seabed preparation, predicted scour, scour protection and altered sedimentary processes, e.g. sandwave/boulder/UXO clearance; • environmental appraisal of inter-array and other offshore transmission and installation/maintenance methods, including predicted loss of habitat due to predicted scour and scour/cable protection and sandwave/boulder/UXO clearance; • habitat disturbance from construction and maintenance/repair vessels' extendable legs and anchors; • increased suspended sediment loads during construction and from maintenance/repairs; • predicted rates at which the subtidal zone might recover from temporary effects; • potential impacts from EMF on benthic fauna; • potential impacts upon natural ecosystem functioning; • protected sites; and • potential for invasive/non-native species introduction. (NPS EN-3 paragraph 2.8.126)	Assessment of indirect effects on prey species is provided in section 5.9.
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. (NPS EN-3 paragraph 2.8.136)	Assessment of the potential effects of the Morgan Generation Assets relevant to offshore ornithology are discussed in section 5.9.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
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 windfarms. (NPS EN-3 paragraph 2.8.143)	Baseline survey methods have been discussed with Natural Resources Wales (NRW), Natural England, the Joint Nature Conservation Committee (JNCC) and the Royal Society for the Protection of Birds (RSPB) through the Evidence Plan process EWG. Relevant data from other operational offshore wind farms has been considered to inform the assessment of potential significant effects of the Morgan Generation Assets and the cumulative effects assessment in section 5.11.
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. (NPS EN-3 paragraph 2.8.144)	Collision risk modelling, displacement assessment, and population viability assessment has been undertaken for birds using parameters that have been agreed with Statutory Nature Conservation Bodies (SNCBs) through the Evidence Plan process EWG. Potential effects from collision risk and displacement are presented and assessed in section 5.9.
The assessment should be undertaken for all stages of the lifespan of the proposed wind farm in accordance with the appropriate policy and guidance for offshore wind farm EIAs. (NPS EN-3 paragraph 2.8.198)	The construction, operations and maintenance and decommissioning phases of Morgan Generation Assets have been assessed in section 5.9.
Mitigation measures which applicants are expected to have considered include: • surveying and micrositing of the turbines, designing array layout, or re-routing of the interconnector and inter-array cables to avoid adverse effects on sensitive/protected habitats, biogenic reefs or protected species; • Reducing as much as possible the amount of infrastructure that will cause habitat loss in sensitive/protected habitats; • burying cables at a sufficient depth, taking into account other constraints, to allow the seabed to recover to its natural state; and • the use of anti-fouling paint could be minimised on subtidal surfaces in certain environments, to encourage species' colonisation on the structures, unless this is within a soft sediment MPA and thus would allow colonisation by species that would not normally be present. (NPS EN-3 paragraph 2.8.234)	The measures adopted as part of the project are discussed in section 5.7.1.2. Where necessary mitigation measures are discussed in section 5.9 and 5.11.
The Secretary of State should consider the effects of a proposed development on marine ecology and biodiversity, considering all relevant information made available by the applicant (NPS EN-3 paragraph 2.8.302)	Section 5.9 presents the assessment of effects of the Morgan Generation Assets on offshore ornithology receptors.

Table 5.2: Summary of NPS EN-1 and NPS EN-3 policy on decision making relevant to offshore ornithology.

Summary of NPS EN-1 and EN-3 provision	How and where considered in the Environmental Statement
NPS EN-1	
In the 25 Year Environment Plan, the government set out its vision for a quarter of-a-century action to help the natural world regain and retain good health. A commitment to review the plan every 5 years was set into law in the Environment Act 2021. The Environmental Improvement Plan was published in 2023, which reinforces the intent of the 25 Year Environment Plan and sets out a plan to deliver on its framework and vision. The government's policy for biodiversity in England is set out in the Environmental Improvement Plan 2023, the National Pollinator Strategy and the UK Marine Strategy. The aim is to halt overall biodiversity loss in England by 2030 and then reverse loss by 2042, support healthy well-functioning ecosystems and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people. This aim needs to be viewed in the context of the challenge presented by climate change. Healthy, naturally functioning ecosystems and coherent ecological networks will be more resilient and adaptable to climate change effects. Failure to address this challenge will result in significant adverse impact on biodiversity and the ecosystem services it provides. (NPS EN-1, paragraph 5.4.2).	Assessment of the potential effects of the Morgan Generation Assets and associated mitigation for specific species are identified and discussed in section 5.9 and 5.7.1.2 respectively.
NPS EN-3	
Where adverse effects on site integrity/conservation objectives are predicted, the Secretary of State should consider the extent to which the effects are temporary or reversible, and the timescales for recovery. The Secretary of State should also consider the extent to which the effects may impede achievement of the MPA target (including any interim target) set under the Environment Act 2021. (NPS EN-3, paragraph 2.8.305).	Assessment of the potential effects of the Morgan Generation Assets is provided in sections 5.9 and 5.11.

5.2.4 National Planning Policy Framework

5.2.4.1 The Morgan Generation Assets study area includes areas of the English Mainland. The National Planning Policy Framework (December 2023) (NPPF) provides overarching advice regarding development. The aim of achieving sustainable development is the main theme of the NPPF. Those sections of particular relevance to offshore ornithology are set out in Table 5.3, below.

Table 5.3: English National Planning Policy Framework.

Summary of NPPF provision	How and where considered in the Environmental Statement
Planning policies and decisions should contribute to and enhance the natural and local environment by: a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);… d) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. (NPPF, paragraph 180)	Internationally and nationally designated sites relevant to the Morgan Generation Assets are identified in section 5.5.3. Assessments for internationally designated sites are included E1.3 ISAA Part 3 – SPA assessment with assessments of nationally designated sites provided in 5.9 and 5.11 where required. The measures adopted as part of the project are discussed in section 5.7.1.2. Where necessary mitigation measures are discussed in section 5.9 and 5.11.
Plans should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework; take a strategic approach to maintaining and enhancing networks of habitats and green infrastructure; and plan for the enhancement of natural capital at a catchment or landscape scale across local authority boundaries. (NPPF, paragraph 181)	Internationally and nationally designated sites relevant to the Morgan Generation Assets are identified in section 5.5.3.
To protect and enhance biodiversity and geodiversity, plans should: a) Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation; and b) promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity. (NPPF, paragraph 185)	Internationally and nationally designated sites relevant to the Morgan Generation Assets are identified in section 5.5.3. Assessments for internationally designated sites are included E1.3 ISAA Part 3 – SPA assessment with assessments of nationally designated sites provided in 5.9 and 5.11 where required. Please also see the Biodiversity benefit statement (Document Reference J8)

Summary of NPPF provision	How and where considered in the Environmental Statement
When determining planning applications, local planning authorities should apply the following principles: a) if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused; b) development on land within or outside a Site of Special Scientific Interest, 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 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 Sites of Special Scientific Interest. (NPPF, paragraph 186)	Internationally and nationally designated sites relevant to the Morgan Generation Assets are identified in section 5.5.3. Assessments for internationally designated sites are included E1.3 ISAA Part 3 – SPA assessment with assessments of nationally designated sites provided in 5.9 and 5.11 where required. The measures adopted as part of the project are discussed in section 5.7.1.2. Where necessary mitigation measures are discussed in section 5.9 and 5.11.
The following should be given the same protection as habitats sites: a) potential Special Protection Areas and possible Special Areas of Conservation; b) listed or proposed Ramsar sites; and b) sites identified, or required, as compensatory measures for adverse effects on habitats sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites. (NPPF, paragraph 187)	Internationally and nationally designated sites relevant to the Morgan Generation Assets are identified in section 5.5.3. Assessments for internationally designated sites are included E1.3 ISAA Part 3 – SPA assessment with assessments of nationally designated sites provided in 5.9 and 5.11 where required.

5.2.5 North West Inshore and North West Offshore Coast Marine Plans

5.2.5.1 The assessment of potential changes to offshore ornithology has also been made with consideration to the specific policies set out in the North West Inshore and North West Offshore Coast Marine Plans (MMO, 2021). Key provisions are set out in Table 5.3 along with details as to how these have been addressed within the assessment.

Table 5.4: North West Inshore and North West Offshore Marine Plan policies of relevance to offshore ornithology.

Policy	Key provisions	How and where considered in the Environmental Statement
NW-SCP-1	Proposals within or relatively close to nationally designated areas should have regard to the specific statutory purposes of the designated area. Great weight should be given to conserving and enhancing landscape and scenic beauty in National Parks and Areas of Outstanding Natural Beauty.	As part of this chapter (as well as Volume 4, Annex 5.1: Offshore ornithology baseline characterisation report of the Environmental Statement), designated sites with mobile features connected to the Morgan Generation Assets have been identified. This is to ensure that all features and species of conservation importance were considered, where relevant, in this assessment. The HRA Stage 1 Screening Report (Document Reference E1.4) considers the direct or indirect effects on features of relevant Special Protection Area (SPA) sites, and where relevant will be included in the HRA Stage 2 ISAA – Part 3 - SPA assessments (Document Reference E1.3).
NW-MPA-1	Proposals that support the objectives of marine protected areas and the ecological coherence of the marine protected area network will be supported.	As part of this chapter (as well as Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement), designated sites with mobile features connected to the Morgan Generation Assets have been identified (section 5.5.3). This is to ensure that all features and species of conservation importance were considered, where relevant, in this assessment. The E1.4 HRA Phase 1 Screening Report considers the direct or indirect effects on features of relevant SPA sites, and where relevant will be included E1.3 ISAA Part 3 – SPA assessments. Please also see the Biodiversity benefit statement (Document Reference J18).
NW-BIO-1	NW-BIO-1 encourages and supports proposals that enhance the distribution of priority habitats and priority species.	The Morgan Generation Assets will aim to conserve habitats and species as far as reasonably practicable through a number of measures adopted to reduce the impact of the Morgan Generation Assets (section 5.7.1.2). Please also see the Biodiversity benefit statement (Document Reference J18).
NW-BIO-2	NW-BIO-2 requires proposals to manage negative effects which may significantly adversely impact the functioning of healthy, resilient and adaptable marine ecosystems.	In addition to measures adopted as part of the Morgan Generation Assets and sensitive project design, secondary mitigation has considered where an impact is considered to be significant in EIA terms. This assessment is undertaken for each impact in section 5.9 where necessary. Please also see the Biodiversity benefit statement (Document Reference J18).
NW-CE-1	Proposals which may have adverse cumulative effects with other existing, authorised, or reasonably foreseeable proposals must demonstrate that they will avoid, minimise and mitigate.	Cumulative effects have been quantified and their significance assessed in section 5.11. The assessment has adhered to the mitigation hierarchy (to avoid, minimise and mitigate) as set out in Volume 1, Chapter 5: EIA Methodology Chapter of the Environmental Statement and the site selection process described in Volume 1, Chapter 4: Site Selection and Consideration of Alternatives of the Environmental Statement.

5.3 Consultation

5.3.1 Summary

5.3.1.1 A summary of the key issues raised during consultation activities undertaken to date specific to offshore ornithology is presented in Table 5.5 below, together with how these issues have been considered in the production of this Environmental Statement chapter. Further detail is presented in the following Annexes:

- Volume 4, Annex 5.1: Offshore ornithology baseline characterisation report of the Environmental Statement
- Volume 4; Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement
- Volume 4, Annex 5.3: Offshore ornithology CRM technical report of the Environmental Statement
- Volume 4, Annex 5.4: Offshore ornithology migratory bird CRM technical report of the Environmental Statement
- Volume 4, Annex 5.5: Offshore ornithology apportioning technical report of the Environmental Statement
- Volume 4, Annex 5.6: Offshore Ornithology PVA Technical Report of the Environmental Statement.

5.3.2 Evidence plan

5.3.2.1 The purpose of the Evidence Plan process is to agree the information the Morgan Generation Assets needs to supply to the Secretary of State, as part of a DCO application for the Morgan Generation Assets. The Evidence Plan seeks to ensure compliance with the HRA and EIA Regulations. The development and monitoring of the Evidence Plan and its subsequent progress is being undertaken by the Steering Group. The Steering Group comprises the Planning Inspectorate, the Applicant, NRW, Natural England, JNCC and the Marine Management Organisation (MMO) as the key regulatory SNCBs. To inform the EIA and HRA process during the pre-application stage of the Morgan Generation Assets, EWGs were also set up to discuss and agree topic specific issues with the relevant stakeholders. Consultation was undertaken via the Offshore Ornithology EWG, with meetings held in February 2022, July 2022, November 2022, February 2023, June 2023, October 2023 and December 2023 (Table 5.5).

5.3.2.2 The responses provided and changes suggested by the stakeholders through the EWG are summarized in Table 5.5 together with changes implemented in the chapter of the Environmental Statement.

5.3.3 Section 42 consultation

5.3.3.1 A number of comments were received during the S42 consultation following submission of the PEIR chapter. All the responses provided, and changes suggested by the stakeholders are presented in the consultation report (Document Reference E.3) together with changes implemented in the technical reports underpinning the Environmental Statement.

5.3.3.2 A summary of the key responses with changes implemented in this technical report of the Environmental Statement are presented in Table 5.5.

Table 5.5: Summary of key topic and issues raised during consultation activities undertaken for the Morgan Generation Assets relevant to offshore ornithology.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
February 2022	Offshore Ornithology Expert Working Group 1 – Natural England, JNCC, The Wildlife Trust (TWT), MMO, and RSPB.	The EWG agreed the broad approach to digital aerial survey, as understood, with regards to the use of digital aerial surveys, a grid-based sampling design, monthly surveys, and the use of a 10 km buffer in every direction for the Morgan Generation Assets.	The buffer for the Morgan aerial survey reaches 10 km all the way round the Morgan Array Area.
June 2022	Scoping Opinion The Planning Inspectorate	The Environmental Statement should provide a full description of the nature of the operations and maintenance activities, including type, frequency, and potential for overlapping activities with those associated with existing and planned wind farms in the area, or set out the assumptions made where exact information is not known.	In the Environmental Statement, impacts across each phase have been detailed and justified ensuring all relevant information is included (see sections 5.9 and 5.11).
		In light of the number of ongoing developments within the vicinity of the Proposed Development application site, the Environmental Statement should clearly state which developments will be assumed to be part of the baseline and those which are to be considered as other development for the purposes of the cumulative effects assessment. It is noted from the Scoping Report that the proposed onshore operations and maintenance base will be progressed under a separate consent application (it is not stated as intended to be part of the transmission assets application). The Environmental Statement should take this into account in the cumulative effects assessment. Respondents to the Scoping Report have identified proposed developments or provided advice on the types of projects, plans, or activities that should be included (see Appendix 2 of this Opinion); these should be taken into account in the cumulative effects assessment. The Applicant should seek to agree the scope of the projects assessed with these consultation bodies.	The Cumulative Effects Assessment (CEA) takes into Account the impact associated with the Morgan Generation Assets together with other projects and plans including the proposed onshore operations and maintenance base, where relevant. The projects and plans selected as relevant to the CEA presented within the Environmental Statement are based upon the results of a screening exercise. Each project has been considered on a case by case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved (see sections 5.10 and 5.11). The Applicant has sought to agree the scope of the CEA with the consultation bodies as part of the Evidence plan process.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		Effects of underwater noise on marine life due to jacket or monopile cutting and removal. The Scoping Report proposes to assess the effects of underwater noise on marine life due to jacket or monopile cutting and removal during decommissioning. However, the Scoping Report does not specifically identify this potential impact within the Fish and shellfish ecology, Marine mammals or Offshore ornithology sections. The outcomes of this assessment should be presented within the relevant Environmental Statement Chapters.	The indirect impact of underwater sound on prey species relevant to ornithological receptors has been assessed for the construction, operations and maintenance and decommissioning phases (section 5.9).
		Collision risk from presence of wind turbines during construction and decommissioning. The Inspectorate acknowledges that this potential impact is associated with the presence of operational wind turbines and agrees to scope this matter out of the construction and decommissioning phases.	Collision effects during construction and decommissioning phases has been scoped out of the assessment in the Environmental Statement.
		Barrier effects from presence of wind turbines during construction and decommissioning. The Inspectorate acknowledges that this potential impact is associated with the presence of operational wind turbines and agrees to scope this matter out of the construction and decommissioning phases.	Barrier effects during construction and decommissioning phases has been scoped out of the assessment in the Environmental Statement.
		The Inspectorate concurs with the view that operational turbine noise is unlikely to result in disturbance/displacement, and that displacement is to be accounted for in the above-water assessment. The Inspectorate agrees that disturbance and displacement from underwater noise from the operation of turbines can be scoped out. However, the Inspectorate notes that assessment of noise from vessel traffic and other operational activities is proposed to be scoped in and the Inspectorate agrees with this approach. The Inspectorate acknowledges that no piling is proposed for decommissioning, however, potential effects from underwater noise associated with cutting and removal of foundations,	Disturbance and displacement from airborne noise, underwater sound, presence of vessels and infrastructure has been assessed for all project phases (section 5.9)

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		towers, platforms and turbines may occur. In the absence of sufficient justification with regards to the sources and levels of underwater noise from decommissioning activities, the Inspectorate advises the Environmental Statement should include an assessment of this matter where significant effects are likely to occur.	
		The risk of pollution is proposed to be managed through the implementation of measures set out in post-consent plans including an Environmental Management Plan (EMP) and a Marine Pollution Contingency Plan (MPCP). The Inspectorate agrees that such efforts are capable of mitigation through management practices and is content to scope this matter out. The Environmental Statement should provide details of the proposed measures to be included in the Environmental Management Plan and MPCP, and explain how these measures will be secured.	The implementation of an offshore Environmental Management Plan (offshore EMP) is considered in the Environmental Statement and includes measures to reduce the risk of pollution events including an MPCP (see section 5.7.1.2).
		It is noted that the approach to obtaining density and spatial abundance estimates will be discussed within the Evidence Plan process. The Inspectorate advises that given the fundamental importance of this discussion to the outcomes of the EIA process, the Applicant should seek to agree the modelling parameters used and the methodology applied with the relevant consultees, giving careful consideration to the sharing of information through the Evidence Plan process.	Noted; all parameters used within modelling used to obtain density and spatial abundance estimates have been agreed with SNCBs and following latest guidance document from SNCBs. Approach is detailed in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation Technical Report of the Environmental Statement.
		The scoping Report Identifies potential barrier effects from the presence of wind turbines, however consideration should be given in the Environmental Statement to the collective impact of the turbines and the proposed offshore platforms in this regard, in particular with respect to the number and location of the platforms in proximity to the turbine array.	The barrier effect resulting from all infrastructure has been assessed in the Environmental Statement for the operations phase (see section 5.9).

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		Vessel Management Plan, Environmental Management Plan and Marine Pollution Contingency Plan. The Scoping Report does not provide any detail on the specific measures to be included within these plans, noting they may evolve as the EIA progresses. Where these measures are being relied upon for the assessments in the Environmental Statement they must be set out in the Environmental Statement in detail, including how they are to be secured (e.g. by DCO requirement).	Within the Environmental Statement, a number of measures (primary and tertiary) have been adopted as part of the Morgan Generation Assets to reduce the potential for impacts on offshore ornithology. These primary and tertiary measures have been detailed in Table 5.26 and include the Vessel traffic management plan (Document Reference J13) and post-consent plans (EMP and MPCP).
		The Inspectorate advises that the breeding, non-breeding, and migratory seasons (where applicable) are defined for each relevant bird species assessed. Effort should be made to agree the definitions of each season with the relevant consultees including where the use of seasonal peaks is part of the modelling methodology.	Seasonal extents, breeding, non-breeding and migratory seasons as applicable, are defined based primarily on information from Furness (2015). The definitions and approach has been agreed with SNCBs through the Evidence Plan process.
		Other Residues and Emissions – dust, pollutants, light, noise and vibration. These aspects are proposed to be assessed in other relevant chapters and therefore are not proposed to be assessed in standalone chapters. They will be assessed in: • Physical processes • Benthic subtidal ecology • Fish and shellfish • Marine mammals • Offshore ornithology • Underwater noise • Seascape, landscape and visual resources. It is noted that currently, the Scoping Report does not report on all of these impacts within the referenced aspect Chapters, for example, lighting is not addressed in the offshore ornithology or other biological assessment Chapters and the lighting proposed is not described in the front end of the Scoping Report. Provided other residues and emissions are referenced within the relevant Chapters listed above and	The effects mentioned are considered where relevant in the chapters referenced (including but not limited to underwater noise, prey impacts and pollution). Assessment of the collision effect in the Environmental Statement is based on the maximum number of structures in the wind farm, the influence of lighting of structures at night is considered as part of the collision risk assessment (section 5.9.4).

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		cross-references are made where appropriate, the Inspectorate is content with this approach.	
July 2022	Offshore Ornithology Expert Working Group 2 – Natural England, JNCC, and RSPB.	Agreement on the approach to baseline characterisation as set out in the baseline characterisation technical paper.	Approach is presented in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement and summarised in section 5.4 of the Environmental Statement.
		Agreement to the approach to stochastic Collision Risk Model (sCRM) as discussed in the EWG02 meeting, which supersede the Morgan CRM technical paper following the Natural England advice.	Approach to the sCRM is presented in Volume 4, Annex 5.3: Offshore ornithology CRM technical report of the Environmental Statement and includes the approach recommended by SNCBs.
	Scoping Opinion Natural England	The advice within this letter is provided with respect to the generation assets scoping report provided, but we consider that the transmission assets are an integral part of the project and therefore the Environmental Statement should, at the point of submission, be in a position to consider the project as a whole. Therefore the final Environmental Statement, when considering the project as a whole, will include additional impacts and designated sites than those mentioned within the Morgan Offshore Wind Project: Generation Assets Scoping Report.	Noted with cumulative assessment based on the appropriate projects scoped in, with all scoped in projects detailed with justification provided in the Environmental Statement (see sections 5.10 and 5.11).
		We advise that secondary scour protection impacts on seabed habitats are scoped in until further detailed methods and impacts can be assessed, and justification provided to scope out of the Environmental Statement.	Indirect impacts on seabird prey species due to temporary habitat loss/disturbance are considered across all phases of the project (see section 5.9).
		Tracking studies should also be used where available to evidence connectivity, or lack thereof, they should also be used to aid screening where possible.	Tracking data available from the Seabird Tracking Database (Birdlife International, 2022) have been reviewed and summarised for each species in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		An impact assessment should identify, describe, and evaluate the effects that are likely to result from the project in combination with other projects and activities that are being, have been or will be carried out. The following types of projects should be included in such an assessment (subject to available information): • existing completed projects • approved but uncompleted projects • ongoing activities • plans or projects for which an application has been made and which are under consideration by the consenting authorities • plans and projects which are reasonably foreseeable, (i.e. projects for which an application has not yet been submitted, but which are likely to progress before completion of the development) and for which sufficient information is available to assess the likelihood of cumulative and in-combination effects.	The CEA screening Annex (Volume 3, Annex 5.1: Cumulative effects screening matrix of the Environmental Statement (Document Reference F3.5.1) has been produced with details regarding which projects have been scoped in and why (see sections 5.10 and 5.11). It is considered that all relevant projects have been included in the CEA.
		Natural England does not hold local information on local sites, local landscape character, priority habitats and species or protected species. Local environmental data should be obtained from the appropriate local bodies. This may include the local environmental records centre, the local wildlife trust, local geo-conservation group or other recording society.	A desk study for the baseline characterisation has been provided within Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement.
		The Environmental Statement should thoroughly assess the impact of the proposals on habitats and/or species listed as 'Habitats and Species of Principal Importance' within the England Biodiversity List, published under the requirements of S41 of the Natural Environment and Rural Communities (NERC) Act 2006. Section 40 of the NERC Act 2006 places a general duty on all public authorities, including local planning authorities, to conserve and enhance biodiversity. Further information on this duty is available here	The conservation values of species has been considered within Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement including those metrics mentioned. The conservation value of a species is incorporated into the assessments provided in sections 5.9 and 5.11.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		https://www.gov.uk/guidance/biodiversity-duty-public-authority-duty-to-have-regard-to- conserving-biodiversity.	
		Although Natural England questions the utility of flight height data derived by the 'size-based' and similar methods, if this data has been produced, we would welcome its inclusion for comparison with the generic flight height distributions (Johnston *et al.*, 2014), noting that we would not expect it to be used in CRM. Confirmation on whether information on flight height has been processed.	Generic flight height data from Johnston *et al.* (2014) were used in Volume 4, Annex 5.3: Offshore Ornithology CRM Technical Report of the Environmental Statement. Site-specific data have not been utilised as they were not deemed suitable for use in collision risk modelling.
July to August 2022	JNCC and Natural England – baseline characterisation paper provided and agreed as part of the Offshore Ornithology Expert Working Group 2.	Recommend that a power analysis is undertaken to demonstrate that survey coverage is appropriate. Although analysis of 12% of the sea surface is likely to be sufficient, best practice would be to conduct a power analysis to determine the level and distribution of survey coverage to analyse.	Power analysis has been completed. The results shared and agreement reached with the EWG.
30th May 2023	S42 – Consultation Log North West Wildlife Trust	Transboundary. Given the proximity to Welsh waters and Isle of Man, we expect there to be full consideration of transboundary effects and cumulative impacts across borders. The Irish Sea is a busy regional sea, under significant pressure and the cumulative and in-combination effects on the marine environment from building offshore infrastructure on such a large scale could have significant impacts on the marine environment if not managed correctly.	Transboundary impacts on UK waters have been assessed in section 5.12. The assessments provided in sections 5.9 and 5.11 are of relevance to Welsh and Isle of Man interests.
June 2023	S42 – Consultation Log Isle of Man Department of Infrastructure	The PEIR set out the preliminary findings of EIA undertaken to date. The TSC was satisfied from the information in these documents that all international environmental standards and best practice will be adhered to when undertaking the collection and analysis of the data obtained from within the proposed development area and will ensure appropriate mitigation measures are in place to address any concerns	Measures adopted as part of the project are discussed in section 5.7.1.2.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		identified throughout the remaining Environmental Assessments process. The TSC had however expected there to be more emphasis and greater detail provided on proposed mitigation measures for the impacts identified to date as part of the PEIR, particularly as set out in the Statement of Community Consultation whereby *'It (the PEIR) also sets out measures that could prevent, reduce or offset any environmental effects, identified as part of early assessments and consultation*'.	
		Whilst the Isle of Man is not a member of the EU and is therefore not directly covered by most European directives, the Isle of Man still follows relevant European environmental safeguards and expects best practice to be followed. The Isle of Man also meets its obligations under both the Bonn and the Bern Conventions, via statutory instruments, specifically the Wildlife Act 1990. As part of this, the TSC would request that appropriate consideration is given to the species which are protected under this Act and ensure that there are no detrimental impacts on these species as part of this proposed project given its close proximity to Isle of Man waters. In addition, the same would be requested in respect of the marine protected sites and the manner in which these are designated and managed, and key seabird breeding sites, including any transboundary impacts arising from the project.	Relevant ornithological receptors associated with the Isle of Man will be given due consideration throughout the EIA (e.g. the great black-backed gull population on the Isle of Man).
		It is noted that the cumulative effects will be thoroughly investigated. However, of particular importance and concern would be the habitats and species found within Isle of Man waters, particularly those protected under Manx law or identified as threatened or declining by the OSPAR Convention, and which may be affected by the proposed developments. Comments included below request the inclusion of relevant, island-based conservation organisations which may also have relevant information and data of interest to the project. Any maritime developments within or adjacent to the Isle of Man territorial waters could potentially impact commercial fisheries n Manx waters so it would be appreciated if the relevant fishing organisations on the island	Relevant ornithological receptors associated with the Isle of Man will be given due consideration throughout the EIA. This includes consideration of specific datasets and populations that may inform assessments or be impacted by the project. Relevant organisations have also been consulted through the Evidence Plan process.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		were included as consultees via the appointed Fisheries Liaison Officer.	
		The above proposal also has the possibility for potential trans-boundary impacts on Manx land/seascapes and the TSC would particularly like to ensure that the impacts on wildlife/habitat conservation and fisheries in Manx waters are fully considered within the scope of this assessment developments.	Transboundary impacts are considered in section 5.12.
		Chapter 10 – Offshore Ornithology DEFA has had the opportunity, in addition to the PEIR, of contributing to discussions at the offshore ornithology working group. It is noted that some matters raised cannot be taken into account within the PEIR due to the timing and that this may be picked up later, within the Environmental Statement. **Transboundary effects**–- The developer has stated verbally that they have considered the Isle of Man bird populations and their conservation status and no significant impacts are predicted. The PEIR (section 10.11) lists the potential transboundary effects. The Manx Birds of Conservation Concern has also been quoted (section 10.4 and Table 10.9) in the PEIR. The Environmental Statement should include a statement on the consideration of/effects on Manx bird populations within the transboundary assessment. See also note below on Transboundary effects assessment.	Relevant ornithological receptors associated with the Isle of Man will be given due consideration throughout the EIA. Transboundary impacts are considered in section 5.12. The assessments provided in sections 5.9 and 5.11 are of relevance to Welsh and Isle of Man interests.
		Non-seabird migrants – we note that no effects have been found for any species in this assessment and we are content with the assurance that Manx data has been included within the assessment, noting our interest in species such as hen harrier and whooper swan.	Noted. Consideration of collision risk on migratory seabirds and waterbirds is provided in Volume 4, Annex 5.4: Offshore Ornithology Migratory Bird Collision Risk Modelling Technical Report of the Environmental Statement and assessed in sections 5.9 and 5.11.
		Collison risk, great black–backed gull – although the risk in the PEIR had been assessed as low for this species, it is nevertheless a comparatively high potential effect on the regional population, when compared with the expected effects on other species (breeding period increase in baseline mortality 0.0631% to 0.5581%). We request that the Isle of	Relevant ornithological receptors associated with the Isle of Man have been given due consideration throughout the EIA.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		Man population is looked at specifically in this respect, as the Island has long held a significant population of this species, though reduced recently, which is itself a concern. The JNCC Seabirds Monitoring Partnership data (or local Seabirds Count report) can be used.	
		Species Value and Recoverability in assessments – It is noted that razorbill is on the Isle of Man Birds of Conservation Concern red list, and though showing long term population stability it shows a severe recent reduction in population ipp://manxbirdlife.im/wp–-content/uploads/2021/08/BoCCIoM-2021-TABLES-vWEB04-2021-07-30.pdf, and herring gull, great black-backed gull and lesser black-backed gull all show severe breeding declines on the Isle of Man. We suggest that in relation to Value and Recoverability, it would be better to reflect the trends and status found in the regional population assessed rather than the overall UK trends which have been quoted, where data allows. These may or may not differ for a particular species but we note some pronounced declines in the Manx data, in comparison to national trends, in the recent JNCC 'Seabirds Count' survey, which may have significance in relation to any Irish Sea assessments.	Relevant ornithological receptors associated with the Isle of Man will be given due consideration throughout the EIA including in within Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement and section 5.9 of this chapter. The conservation values of species have been considered within Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement including metrics relevant to those bird species on the Isle of Man. The conservation value of a species is incorporated into the assessments provided in sections 5.9 and 5.11.
		Cumulative Assessment – It is noted that the Isle of Man wind farm proposal has not been included in the cumulative assessment, as no data has been published yet, but it is possible that details may be in the public domain before an Environmental Assessment is produced, and this should be kept in mind, to update the assessment if data becomes available. Two years of ornithological surveys will be completed in June 2023.	Appropriate information regarding the Isle of Man wind farm, available at the time of the publication of the Environmental Impact Assessment, has been included in the assessment (see sections 5.9 and 5.11).
	S42 – Consultation Log Natural England	**Matrix to Determine Effect Significance** We acknowledge that a matrix approach to determining the significance of effects on ecological features, is commonly used. However, this method often relies on value- rather than evidence-based judgements. The subjective evaluation of magnitude of impact and sensitivity/importance of receptors through expert judgement has led to many impact	The assessments presented utilise the most recent relevant science and evidence. This accompanied with expert judgement, which is applied in all cases to ensure the level of significance identified by the matrix approach is correct, is considered to provide a robust consideration of the likely significance of impact on ornithological receptors.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		magnitudes and receptor importance/sensitivities being downgraded across topics in the PEIR. We also note that any effect that is concluded to be of moderate or major significance in the PEIR, is deemed to be ‘significant’ in EIA terms, whereas effects concluded to be of negligible or minor significance, are deemed ‘not significant’ in EIA terms. This cut-off could exclude any effect concluded to be less than moderate, in turn, this could lead to errors in assessing cumulative effects adequately.	
		Impacts on the Natural Environment – Natural England’s Key Concerns **Generic Comments** The advice provided is with respect to the generation assets PEIR submission provided, but we consider that the transmission assets are an integral part of the project and therefore the Environmental Statement should, at the point of submission, be in a position to consider the project as a whole. Therefore, the final Environmental Statement , when considering the project as a whole, will include additional impacts and designated sites than those mentioned within the Morgan Offshore Wind Farm Generation Assets PEIR submission. Natural England advises that the potential impacts of the project cannot be considered in isolation from its transmission assets and the associated Morgan Offshore Wind Farm project, and accordingly we will only consider a full, cumulative assessment of these projects as adequate to support the DCO application.	The cumulative assessment includes consideration of impacts associated with the Morgan and Morecambe Transmission Assets (see sections 5.10 and 5.11).
		Vol.2, Ch.10, The cumulative and in-combination assessments do not factor in impacts from a number of other projects due to a lack of data. Impacts specified as ‘unknown’ have been treated as zero which will inevitably underestimate impacts, potentially significantly. Natural England consider this approach to be unacceptable, and hence consider it inappropriate to comment on the potential significance of	Cumulative assessments incorporate information from all projects that may act cumulatively with the Morgan Generation Assets. For some projects, due to a lack of suitable data consideration is qualitative providing detailed consideration of the likely impact of these projects in the absence of a project-specific quantitative appraisal. This approach is consistent with the approach taken for previous offshore wind farm projects in UK waters and the Round 4 Plan-level HRA. Since PEIR the Applicant has

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		cumulative or in-combination presented in the PEIR submission. Natural England also notes that; *'data used within the assessing cumulative collision risk is based on published information produced by the respective project developers. As such, the input parameters (e.g., avoidance rates) and the collision risk model used (e.g., deterministic) may vary from those put forward in this Chapter'*. Natural England propose working collaboratively with stakeholders through the EWG to generate suitable impact estimates for historic projects and facilitate comprehensive, quantitative cumulative and in-combination assessments. Generally, Natural England consider that data used for historic projects should be updated to reflect contemporary input parameters and methods wherever practicable.	undertaken an exercise to obtain as much data as possible for cumulative projects which has been incorporated into the assessments presented (see section 5.11).
		Vol 2, Ch 10. Natural England agree that displacement and collision impacts should be summed for species susceptible to both. Therefore, we consider gannet should be assessed for the combined impact of displacement and collision for the project alone.	Displacement and collision impacts will be summed for relevant species in the assessments conducted (see sections 5.9 and 5.11).
		Vol 2, Ch 10. 10.10 Cumulative displacement impacts are assessed for guillemot, razorbill, puffin, gannet. Natural England consider Manx shearwater should also be assessed. Carry out cumulative (and in-combination) assessments for Manx shearwater displacement impacts.	Inclusion of cumulative/in-combination assessments for Manx shearwater have been considered and added where required (see section 5.11).
		Environmental Impact Assessment - Document Used: Chapter 5 EIA Methodology **Vol.1, Ch.5** There is no information on anticipated vessel movements presented in offshore ornithology documentation. Natural England advises that some indication should be given as to where construction and maintenance vessels are likely	The number of vessel movements predicted to be associated with different phases of the Morgan Generation Assets are provided in section 5.7. At this stage the port facilities to be used during different phases of the project are not known, which is not unexpected given the stage of the project and is consistent with many other offshore wind farm projects.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		to sail from as well as the likely increase in vessels activity. As a minimum, routes through the Liverpool Bay SPA should follow best practice protocols (including adhering to existing routes wherever possible) to minimise disturbance to common scoter and red-throated diver. Subject to more information being provided, the need for seasonal restrictions may require consideration (01 November to 31 March inclusive).	
	S42 – Consultation Log Natural Resource Wales	184. Offshore Ornithology. Key issues. Lack of assessment of SSSIs and features. There is a lack of assessment of Sites of Special Scientific Interest (SSSIs) and features where there is potential for connectivity – for example, the Pen y Gogarth / Great Orme's Head SSSI is designated for breeding kittiwake, guillemot and razorbill and the Morgan generation assets project is located within foraging range of all of these features from this site. Therefore, quantitative assessments of collision risk for kittiwake and displacement for guillemot and razorbill should be undertaken for this site.	Assessments take account of all relevant populations. The methodology used to identify designated sites that may be impacted by impacts associated with the Morgan Generation Assets is provided in section 5.4.6. The designated sites identified when applying this methodology are identified in in section 5.5.3 and include international and national sites which are then considered in relevant assessments in both sections 5.9 and 5.11 and HRA Stage 2 ISAA – Part 3 – SPA assessments (Document Reference E1.3).
		215. Offshore Ornithology. Detailed comments. Assessment of Significant Effects/Impacts at EIA scale. Cumulative EIA Scale Impacts (section 10.10 of Chapter 10). NRW (A) do not consider it appropriate to base the cumulative (and hence also in combination) assessments on so many unknowns for impacts from many of the relevant other projects. Whilst these historic projects may not have undertaken quantitative assessments, or assessments using current approaches, estimates will need to be generated for these unknown projects in order to undertake meaningful assessments. NRW (A) suggest this should be explored collaboratively through the offshore ornithology EWG. These discussions could also cover potential issues over different avoidance rates, collision model options etc. used by other projects where there are data available.	Cumulative assessments incorporate information from all projects that may act cumulatively with the Morgan Generation Assets. For some projects, due to a lack of suitable data consideration is qualitative providing detailed consideration of the likely impact of these projects in the absence of a project-specific quantitative appraisal. This approach is consistent with the approach taken for previous offshore wind farm projects in UK waters and the Round 4 Plan-level HRA.
		219. Offshore Ornithology. Detailed comments. Assessment of Significant Effects/Impacts at EIA scale. Cumulative EIA Scale Impacts (section 10.10 of Chapter 10). NRW (A) also	Cumulative assessments include all relevant species.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
		suggest that cumulative collision assessments of migrant species are also undertaken, at least with Morgan Generation Assets, Mona, Morecambe Generation Assets and Awel y Môr as a minimum, as there is the potential that such birds could encounter these sites.	
		220. Offshore Ornithology. Detailed comments. Assessment of Significant Effects/Impacts at EIA scale. Combined Displacement and Collision (section 10.10.4 of Chapter 10). NRW (A) welcome that combined cumulative displacement and cumulative collision have been assessed for gannet (and kittiwake) in section 10.10.4 of Chapter 10. However, the combined impact of displacement plus collision risk for the Morgan project alone should also be undertaken for these species.	The combined impact of displacement plus collision risk is included in the assessment (see sections 5.9 and 5.11).
	S42 consultation RSPB	Confirmed that RSPB would provide their input via the EWG and that the main breeding seabird species of interest to the RSPB includes Manx Shearwater (*Puffinus puffinus*), Northern Gannet (*Morus bassanus*), Black-legged Kittiwake (*Rissa tridactyla*), Common Guillemot (*Uria algae*) and Razorbill (*Alca torda*) along with non-breeding Red-throated Diver (*Gavia stellata*) and Common Scoter (*Melanitta nigra*). Commented on breeding Lesser Black-backed Gull (*Larus fuscus*), despite the low frequency of occurrence during the reported survey work. This is because, with the exception of the Ribble and Alt Estuary SPA colony, the main Irish Sea breeding colonies (at Bowland Fells SPA and Morecambe Bay and Duddon Estuary SPA) require restoration to a favourable conservation status and the implications of this needs careful consideration via the Expert Working Groups.	Noted. Discussions with RSPB have been ongoing throughout the pre-application process through the EWGs.

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
	S42 consultation North West Wildlife Trust	Confirmed that the North West Wildlife Trust (NWWT) echo RSPBs comments on the PEIR. Given the number of OWF being developed in the Irish Sea, NWWT expect a full cumulative impact assessment to be undertaken, including consideration of transboundary impacts. Concerns are raised over the possible disturbance, displacement and barrier effects on sensitive receptors, particular black-legged kittiwake and northern gannet.	Cumulative effects and transboundary impacts in relation to offshore ornithology are considered within Volume 2, Chapter 5: Offshore ornithology of the Environmental Statement.
	S42 – Consultation Log Barrow Offshore Windfarm Burbo Bank Extension Wind Farm Burbo Bank Wind Farm West of Duddon Sands Windfarm Walney Extension Windfarm (Walney 3 and 4) Walney Offshore Windfarms (Walney 1 and 2)	Cumulative and in-combination effects of projects It is important to ensure that all environmental impacts of your project are properly and fully assessed including any potential cumulative or in combination effects with Barrow/Burbo Bank Extension/Burbo Bank/West of Duddon Sands/Walney 3 and 4/Walney 1 and 2. As an example, the impact upon Whooper Swan has been the subject of studies in relation to Barrow/Burbo Bank Extension/Burbo Bank/West of Duddon Sands/Walney 3 and 4/Walney 1 and 2 and these studies have shown Whooper Swan transits through or close to your proposed development. Whooper Swan have so far been omitted in your offshore ornithology chapter.	The impacts on migratory waterbirds are considered in the assessment (see sections 5.9 and 5.11).
October 2023	Offshore Ornithology Expert Working Group 6 – Natural England, Joint Nature Conservation Committee (JNCC), and the Royal Society for the Protection of Birds (RSPB).	Discussions associated with regional populations in the breeding season. Consultees disagreed with the approach presented.	The Applicant has applied an approach to calculating regional populations in the breeding season consistent with that used for many previous offshore wind farms. The Applicant has reservations associated with the approach proposed by the Natural England and NRW due to the potential for this to over-estimate the regional population which has implications for associated assessments and would therefore lower the result of the assessment and is therefore potentially less precautionary. Discussions will continue with the EWG to resolve this issue.
December 2023	Offshore Ornithology Expert Working Group 7 - Natural England, JNCC, NRW, RSPB, TWT, Isle of	Methodology updates that affect the assessment were presented to the EWG (e.g. project alone and CEA breeding regional population approach and avoidance rates for gull species).	Following discussion with SNCBs, the applicant has presented for the project alone the impacts in the context of the smallest regional breeding population. The NRW approach (as agreed with JNCC and Natural England) shows a smaller regional population for northern gannet

Date	Consultee and type of response	Topics and issues raised	Response to issue raised and/or where considered in this Chapter
	Man Government, MMO, Niras	Following presentation of the Applicant's approach to calculating regional breeding population against NRW approach (as agreed with JNCC and NE), NRW/JNCC/NE requested that the impacts in the context of the smallest regional breeding population for project alone should also be presented for relevant species. Following discussion on data sources on avoidance rates, NRW/JNCC/NE requested that the Natural England avoidance rates should be used when assessing collision risk to gull species.	and Manx shearwater and the Applicant has presented these values alongside the foraging range populations. The impacts are presented in section 5.9.

5.4 Baseline methodology

5.4.1 Relevant guidance

5.4.1.1 Baseline characterisation of the Morgan Generation Assets has had due regard to the methodologies and approaches set out in the following guidance documents:

- Guidelines for ecological impact assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. September 2018 Version 1.1 - updated September 2019 (CIEEM, 2019)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase I: Expectations for pre-application baseline data for designated nature conservation and landscape receptors to support offshore wind applications (Natural England, 2022a)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase II: Expectations for pre-application engagement and best practice guidance for the Evidence Plan process (Natural England, 2022b)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and presentation at examination for offshore wind applications (Natural England, 2022c).
- Environmental Impact Assessment for Offshore Renewable Energy projects (British Standards Institute (BSI) (2015); and
- UK Planning Inspectorate Advice Note Twelve: Transboundary Impacts (PINS, 2015); and Advice Note Seventeen: Cumulative Effects Assessment (PINS, 2019).

5.4.2 Scope of the assessment

5.4.2.1 The scope of this Environmental Statement has been developed in consultation with relevant statutory and non-statutory consultees as detailed in Table 5.6. Taking into account the scoping and consultation process, Table 5.6 summarises the issues considered as part of this assessment.

Table 5.6: Impacts considered within this assessment.

Activity	Potential impacts scoped into the assessment
Construction phase	
	• Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure • Indirect impacts from underwater sound affecting prey species • Temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs).
Operations and maintenance	
	• Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure • Temporary habitat loss/disturbance and increased SSCs • Presence of operational wind turbines may lead to collision risk. Additional mortality may cause a decrease in seabird populations

Activity	Potential impacts scoped into the assessment
	• Presence of operational wind turbines may result in additional energy expenditure as migrating or commuting birds fly longer distances around the wind farm.
Decommissioning	
	• Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure • Indirect impacts from underwater sound affecting prey species • Temporary habitat loss/disturbance and increased SSCs.

5.4.2.2 On the basis of the baseline environment and the description of development outlined in Volume 1, Chapter 3: Project description of the Environmental Statement, a number of impacts have been scoped out of the assessment at the scoping stage for offshore ornithology. These impacts are outlined, together with a justification for scoping them out, in Table 5.7.

Table 5.7: Impacts scoped out of the assessment for offshore ornithology.

Potential impact	Justification
Direct disturbance and displacement impacts from underwater sound during the operations and maintenance phase.	Underwater sound as a result of operation of the wind turbines is extremely unlikely to result in sound levels that would harm birds (Betke *et al.* 2004). In the unlikely event that such low levels of sound emission result in displacement of birds away from wind turbines, this impact would already be accounted for by the above-water operational displacement assessment.
Accidental pollution during all phases of the Morgan Generation Assets.	Pollution impacts (accidental oil/fuel spills) during all phases of the Morgan Generation Assets relating to the generation assets are scoped out on the basis that the implementation of a MPCP will avoid the risk of significant pollution events. Consequently, seabirds are extremely unlikely to be significantly affected by any such pollution impacts.
Indirect impact from underwater sound from wind turbine operation on prey fish species during the operations and maintenance phase.	Sound generated by operational wind turbines is of a very low frequency and low sound pressure level (Andersson, 2011). Studies have found that sound levels are only high enough to possibly cause a behavioural reaction within metres from a wind turbine (Sigray and Andersson, 2011) and therefore such levels are not considered to have potentially significant effects on fish. The Marine Management Organisation (MMO, 2014) review of post-consent monitoring at offshore wind farms found that available data on the operational wind turbine sound, from the UK and abroad, in general showed that sound levels from operational wind turbines are low and the spatial extent of the potential impact of the operational sound is low. This is supported by project specific modelling which indicated that effects on fish (e.g. injury or behavioural effects) are unlikely to occur for the modelled operations wind turbines. See Outline underwater sound management strategy (Document Reference J14) for further details. Impacts to prey species during the operations and maintenance phase, other than those associated with underwater sound, are considered in section 5.9.3.

5.4.3 Methodology to inform baseline

5.4.3.1 In order to inform the Environmental Statement, 24 months of digital aerial surveys were undertaken between April 2021 and March 2023. The digital aerial surveys aim to characterise the distribution and abundance of seabirds within the Morgan Generation Assets offshore ornithology study area (Figure 5.1).

5.4.3.2 Furthermore, information on offshore ornithology within the Morgan Generation Assets offshore ornithology study area was collected through a detailed desktop review of existing studies and datasets.

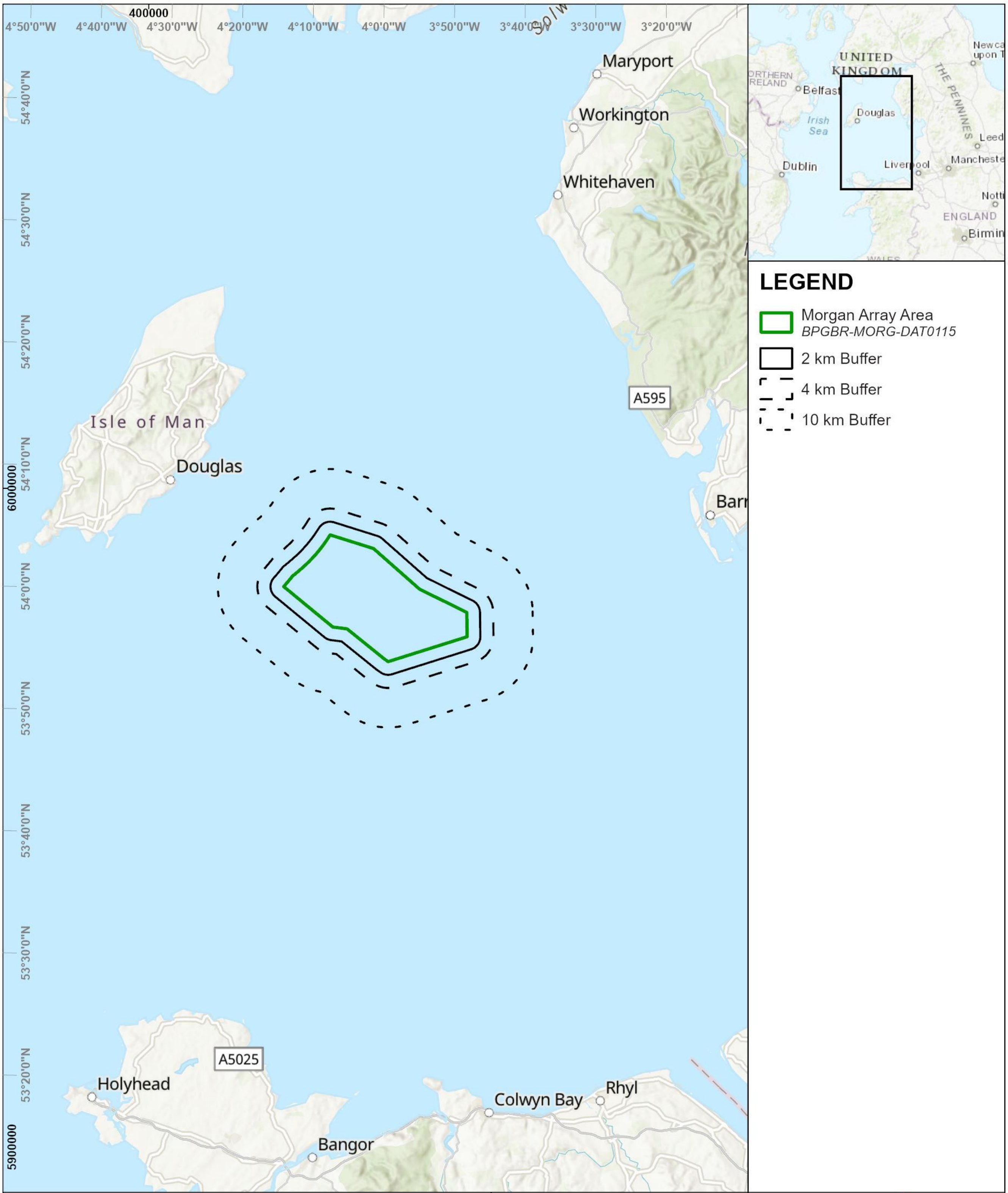
5.4.3.3 The full details of both the site-specific surveys and desktop review methodology are presented in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement.

5.4.4 Study area

5.4.4.1 There are multiple study areas defined for the offshore ornithology assessment. These are identified in Figure 5.1 and Table 5.8 alongside their relevance to the assessments presented. Study areas that have a species-specific element are not presented in Figure 5.1.

Table 5.8: Study areas used in the assessments for the Morgan Generation Assets

Study area	Spatial extent	Relevance to the assessments
Morgan Generation Assets Offshore Ornithology Study Area	Morgan Offshore Ornithology Array Area only and with associated buffers	Represents the footprint of the Morgan Array Area both alone (collision risk modelling) and with buffers extending to 2 km (for displacement analyses), 4 km (for baseline characterisation) and 10 km (the area covered by baseline surveys).
Morgan Generation Assets Offshore Ornithology Regional Study Area	Species, season, impact and assessment stage specific	The regional study areas for a species are dependent on the ecology of that species, and is defined, where appropriate, in relevant sections of the Environmental Statement.
Morgan Generation Assets Offshore Ornithology Cumulative Study Area	Species and season specific	Identified by consideration of the foraging ranges and Biologically Defined Minimum Population Scales (BDMPS) areas of seabird species for which cumulative assessments are required. As the extent of foraging ranges varies greatly between species (Woodward *et al.*, 2019), the Zone of Influence (ZoI) of the Morgan Generation Assets therefore varies between the species considered in the assessment. The ZoI of the Morgan Generation Assets was defined according to the species-specific foraging ranges (as compiled by Woodward *et al.,* 2019).



Service Layer Credits: World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS World Topographic Map: Esri UK, Esri, HERE, Garmin, Foursquare, FAO, METI/NASA, USGS World Hillshade: Esri, CGIAR, USGS	**Data Sources:** RPS, NIRAS
Project Name: MORGAN OFFSHORE WIND PROJECT	0 5 10 15 nm 0 5 10 20 30 km
Drawing Title: Morgan Offshore Ornithology Array Area Study Areas	**Geodetic Information:** Datum: ETRS 1989 Projection: ETRS 1989 UTM Zone 30N Scale@160mmx220mm: 1:975,000

Drawing Number: NIRA-MG-ORN-037-01

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01	13/11/23	1st Issue	JOSW	HAZ

Figure 5.1: Morgan Generation Assets offshore ornithology study area.

5.4.5 Desktop study

5.4.5.1 Information on offshore ornithology within the Morgan Generation Assets Offshore Ornithology Regional Study Area was collected through a detailed desktop review of existing studies and datasets. These are summarised in Table 5.9 below with full details presented in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement.

Table 5.9: Summary of key desktop reports.

Source/reference	Description	Data source	Date	Site coverage
HiDef Aerial Surveying Limited (2023)	Digital video aerial surveys conducted between 2015 and 2020 to provide updated density and abundance estimates for red-throated diver (*Gavia stellata)*, common scoter (*Melanitta nigra)* and the waterbird assemblage within the Liverpool Bay/Bae Lerpwl SPA.	Digital aerial data	January to March in 2015, 2018, 2019 and 2020.	Original Liverpool Bay/Bae Lerpwl SPA designated in 2010.
Cleasby *et al.* (2020)	Identifying important at-sea areas for seabirds using species distribution models and hotspot mapping for four seabird species: kittiwake (*Rissa tridactyla*), guillemot (*Uria aalge*), razorbill (*Alca torda*) and shag (*Gulosus aristotelis*).	Tracking data	May to July, (2010 to 2014)	Some overlap with the Morgan Generation Assets offshore ornithology study area and provides information on birds in the wider context of the site.
Waggitt *et al.* (2020)	Distribution maps of cetacean and seabird populations in the northeast Atlantic	Aerial and vessel survey data	1980 to 2018	Northeast Atlantic wide coverage and complete overlap with the Morgan Generation Assets offshore ornithology study area.
Wakefield *et al.* (2017)	Breeding density, fine-scale tracking, and large-scale modelling reveal the regional distribution of four seabird species.	Tagging data	2010 to 2014	Some degree of overlap of predicted density in the Morgan Generation Assets offshore ornithology study area.
Bradbury *et al.* (2014)	SeaMaST provides evidence on the use of sea areas by seabirds and inshore waterbirds in English territorial waters, mapping their relative sensitivity to offshore wind farm developments.	Boat and aerial surveys	1979 to 2012	Overlap with the Morgan Generation Assets offshore ornithology study area.

Source/reference	Description	Data source	Date	Site coverage
Joint Nature Conservation Committee (JNCC) *et al.* (2023)	Population and productivity data for breeding seabirds around the UK	Bird counts and productivity data at breeding colonies	1986 to 2023	Count data at breeding colonies that may have connectivity with the Morgan Generation Assets offshore ornithology study area.
Lawson *et al.* (2016)	Results from eight seasons of aerial observer surveys of the Liverpool Bay region, used to inform the extension to the Liverpool Bay/Bae Lerpwl SPA.	Aerial surveys	2001 to 2011	Coverage limited to inshore areas.
BirdLife International (2022)	Interface to view seabird tracking database	Seabird tracking data	Various dates	Some overlap of seabird tracks with the Morgan Generation Assets offshore ornithology study area.
Clewley *et al.* (2021)	Assessing movements of Lesser Black-backed Gulls *(Larus fuscus)* using GPS tracking devices in relation to the Walney Extension and Burbo Bank Extension Offshore Wind Farms	Tagging data	Tagging data collected across four breeding seasons between 2016 and 2019	Birds made limited use of the marine environment.
Dean *et al.* (2010)	Behavioural mapping of a pelagic seabird: combining multiple sensors and a hidden Markov model reveals the distribution of at-sea behaviour	Tagging data	2009, 2010, 2011 breeding seasons	No usage of Morgan Generation Assets offshore ornithology study area.
Furness (2015)	Non-breeding season populations of seabirds in UK waters.	Population data. Literature review	Uses data up to 2013	Provides non-breeding season populations for all of UK waters. Also provides seasonal extents for multiple species.
Guilford *et al.* (2008)	GPS tracking of the foraging movements of Manx Shearwaters (*Puffinus puffinus)* breeding on Skomer Island, Wales	Tagging data	Breeding seasons between 2004 and 2006	Limited usage of Morgan Generation Assets offshore ornithology study area.
Kober *et al.* (2010)	An analysis of the numbers and distribution of seabirds within the British Fishery Limit aimed at identifying areas that qualify as possible marine SPAs	Population data. Literature review	1980 to 2004	Provides seasonal extents and distribution for multiple species covering UK waters.
JNCC (2021)	Seabird Population Trends and Causes of Change: 1986 to 2019 Report	Population demographic data	1986 to 2019	Provides information on seabird population trends for all of the UK.

Source/reference	Description	Data source	Date	Site coverage
Wade *et al.* (2016)	Provides vulnerabilities of seabird species to impacts associated with offshore wind farms incorporating data uncertainty	Literature review	N/A	Vulnerability ratings applicable to seabird species that may occur at the Morgan Generation Assets.
Woodward *et al.* (2019)	Desk-based revision of seabird foraging ranges used for HRA screening	Data on foraging range. Literature review	Incorporates information up to 2019	Provides foraging range data for seabird species in UK waters.
Woodward *et al.* (2020)	Population estimates of birds in Great Britain and the United Kingdom	Population data	Typically 2013 to 2017 for breeding estimates and 2012/13 to 2016/17 for wintering estimates	Covers all bird species in the UK.

5.4.6 Identification of designated sites

5.4.6.1 All designated sites with qualifying interest features that could be affected by the construction, operations and maintenance and decommissioning phases of Morgan Generation Assets have been identified.

5.4.6.2 All designated sites of international (e.g. SPAs or Ramsar sites) and national (e.g. SSSIs or Marine Nature Reserves (MNR) within the Isle of Man) importance which directly overlap one of the study areas or have features which connect to the study areas have been identified.

5.4.6.3 On a precautionary basis, connectivity was established during the breeding season if a site (for which a species is a qualifying feature) is within foraging range of the Morgan Generation Assets offshore ornithology study area (using mean maximum + 1 Standard Deviation (SD) (Woodward *et al.*, 2019).

5.4.6.4 Additional designated sites are included within the E1.3 ISAA Part 3 – SPA assessments for the non-breeding period (migration and winter), these are identified in Table 5.13 following the methodology applied in the HRA Stage 1 Screening Report (Document Reference E1.4) to identify LSE. Impacts are likely to be greatest during those periods during which birds are constrained to specific areas (e.g. foraging ranges during the breeding season) and not during periods when birds are not spatially constrained and can therefore exploit much larger areas (e.g. during non-breeding seasons).

5.4.7 Site-specific surveys

5.4.7.1 In order to inform the Environmental Statement, site-specific surveys were undertaken, as agreed with the statutory bodies. A summary of the surveys undertaken to inform the offshore ornithology impact assessment is outlined in Table 5.10 below.

Table 5.10: Summary of site-specific survey data.

Title	Extent of survey	Overview of survey	Survey contractor	Date	Reference to further information
Digital Aerial Surveys	Morgan Array Area with buffer zone (up to 10 km)	Digital aerial surveys to characterise the distribution and abundance of seabirds within the Morgan Generation Assets offshore ornithology study area.	APEM	April 2021 to March 2023	Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement.

5.5 Baseline environment

5.5.1 Desktop studies findings

5.5.1.1 The Morgan Generation Assets offshore ornithology study area is situated in the Irish Sea. The Irish Sea separates the islands of Ireland and Great Britain. To the south, it is linked to the Celtic Sea by the St George's Channel, and in the north to the Inner Seas off the West Coast of Scotland by the North Channel, also known as the Straits of Moyle.

5.5.1.2 Twenty one species of seabird have been reported as regularly nesting on beaches or cliffs around the Irish Sea (Mitchell *et al.,* 2004) and a large proportion of the Manx shearwater *Puffinus puffinus* biogeographic population utilises the waters of the Irish Sea. Most of the worlds Manx shearwater population is found in the UK with over 90% of the UK population found on the Islands of Rum, Eigg (Scotland), Skomer and Skokholm (Wales) (Mitchell *et al.*, 2004; JNCC, 2020) located in waters adjacent to the Irish Sea.

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

5.5.1.4 For the most widespread and abundant seabirds of the central Irish Sea, namely gannet *Morus bassanus*, guillemot *Uria aalge*, herring gull *Larus argentatus*, kittiwake *Rissa tridactyla*, lesser black-backed gull *Larus fuscus*, Manx shearwater and razorbill *Alca torda* (Mitchell *et al.* 2004), there are a number of breeding colonies within the species-specific foraging ranges (mean-maximum + 1SD foraging ranges compiled by Woodward *et al.* (2019)) from the Morgan Generation Assets offshore ornithology study area (see Table 5.13).

5.5.1.5 Desktop review of boat-based and aerial survey data analysed by Waggitt *et al.* (2020) and Bradbury *et al.* (2014) revealed key patterns of temporal and spatial use in the Morgan Generation Assets offshore ornithology study area. These are summarised below within Table 5.11 with full details presented in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement.

Table 5.11: Summary of regional abundance and distribution of seabirds of relevance to the Morgan Generation Assets.

Species	Data source	Abundance and distribution
Common scoter *Melanitta nigra*	Lawson *et al.* (2016) HiDef Aerial Surveying Limited (2023)	The Morgan Generation Assets are located in the east Irish Sea, which contains areas of importance for common scoter (Lawson *et al.* 2016). The closest of these areas to the Morgan Generation Assets are incorporated into the designation of the Liverpool Bay SPA. The areas of highest density occur off the English coast at Blackpool, Lancashire and off the Welsh coast between Colwyn Bay and the Dee Estuary. However, these areas do not overlap with the Morgan Generation Assets. Areas closest to the Morgan Generation Assets support negligible densities (mean densities between 0.00 to 4.51 birds per km^2) of common scoter. Peak densities typically occurred during February to March (Lawson *et al.* 2016). More recent surveys have shown a similar pattern of distribution (HiDef Aerial Surveying Limited, 2023).
Kittiwake *Rissa tridactyla*	Waggitt *et al.* (2020)	From March to July, kittiwakes are dispersed widely around the British coast (Waggitt *et al.,* 2020). Highest densities are located in inshore areas along the North Sea coast (Waggitt *et al.,* 2020). Waggitt *et al.* (2020) data shows that in the east Irish Sea, densities are highest in March. From April until August, densities of kittiwake in the east Irish Sea, and especially the area in which the Morgan Generation Assets are located, remain relatively low. From September the importance of the east Irish Sea begins to increase, however overall densities during this period are lower than seen during breeding months (Waggitt *et al.,* 2020, especially between November and January when the majority of kittiwake have left UK waters (Furness, 2015).
Black-headed gull *Chroicocephalus ridibundus*	Bradbury *et al.* (2014)	Regional survey data indicates that black-headed gulls have a coastal distribution within the east Irish Sea during the summer, with relatively low densities along the English, Welsh, and Scottish coasts (Bradbury *et al.* 2014). In the winter, their distribution extends further offshore, but the Morgan Generation Assets remain of relatively low importance. The area where the Morgan Generation Assets are located is considered of limited importance for the species in both the summer and winter (Bradbury *et al.* 2014).
Little gull *Hydrocoloeus minutus*	Lawson *et al.* (2016) HiDef Aerial Surveying Limited (2023)	The Morgan Generation Assets are located in the east Irish Sea, which contains areas of importance for little gull (Lawson *et al.* 2016). The closest of these areas to the Morgan Generation Assets are incorporated into the designation of the Liverpool Bay SPA. The areas of highest density occur offshore and were incorporated into the updated boundary of the SPA, which was designated in 2017. These areas do not overlap with the Morgan Generation Assets. The wider Liverpool Bay Area of Search used to define the boundary of the Liverpool Bay SPA in Lawson *et al.* (2016) does not overlap with the Morgan Generation Assets. Those areas closest to the Morgan Generation Assets support negligible densities (mean densities between 0.00 to 0.01 birds per km^2) of little gull. Peak densities typically occurred during February to March (Lawson *et al.* 2016).

Species	Data source	Abundance and distribution
		Recent surveys suggest that little gulls are more abundant further south than the distributions observed in Lawson et al.(2016) (HiDef Aerial Surveying Limited, 2023).
Common gull *Larus canus*	Bradbury *et al.* (2014)	Common gull has a coastal distribution within the east Irish Sea during summer, with relatively low densities occurring along the English, Welsh and Scottish coasts (Bradbury *et al.* 2014). This reflects the limited abundance of the species in the east Irish Sea during this period as birds have moved to breeding areas further north. In the winter the distribution extends further offshore, but the Morgan Generation Assets remain of relatively low importance. The area in which the Morgan Generation Assets is located is of limited importance for the species, in both the summer and winter.
Great black-backed gull *Larus marinus*	Bradbury *et al.* (2014)	The east Irish Sea is of limited importance for great black-backed gull based on data from Bradbury *et al.* (2014). In the breeding season, a small area of relatively moderate densities occurs offshore of Morecambe Bay (Bradbury *et al.*, 2014). In the non-breeding season relatively low densities occur throughout the east Irish Sea. In both seasons, the area in which the Morgan Generation Assets are located is of low importance.
Herring gull *Larus argentatus*	Waggitt *et al.* (2020)	In the full UK breeding season (March to August) (Furness, 2015), the Morgan Generation Assets area does not support high densities of herring gull (Waggitt *et al.,* 2020). Areas to the east associated with inshore areas around Morecambe Bay and to the north around the Isle of Man coast support relatively high densities of the species. In the non-breeding season, densities are much lower with the Morgan Generation Assets offshore ornithology study area being of similar relative importance, as in the breeding season.
Lesser black-backed gull *Larus fucus*	Waggitt *et al.* (2020)	Regional survey data indicates that during the full UK breeding season (April to August) (Furness, 2015), the area where the Morgan Generation Assets is located, supports moderate densities of lesser black-backed gulls. Higher densities are observed just to the east, associated with breeding colonies in Morecambe Bay and the Ribble and Alt Estuaries. After the breeding season, the importance of the Morgan Generation Assets area reduces, with densities continuing to decrease throughout the non-breeding season. Densities begin to increase again during the pre-breeding period and unto the next breeding season.
Sandwich tern *Thalasseus sandvicensis*	Bradbury *et al.* (2014)	Sandwich tern has a coastal distribution within the east Irish Sea during the summer with relatively low densities occurring along the English and Welsh coasts that extend approximately 15 km offshore (Bradbury *et al.* 2014). The area in which the Morgan Generation Assets are located is of negligible importance for the species.

Species	Data source	Abundance and distribution
Little tern *Sternula albifrons*	Bradbury *et al.* (2014)	Densities of little tern are low throughout the east Irish Sea in the breeding season, with localised areas of relatively moderate densities in the nearshore close to the Dee Estuary, Formby and Walney (Bradbury *et al.* 2014). These reflect the locations of breeding colonies and the species limited foraging range.
Common tern *Sterna hirundo*	Bradbury *et al.* (2014)	Densities of common tern are low throughout the east Irish Sea in both the breeding and non-breeding seasons (Bradbury *et al.* 2014). Common terns are present at a number of breeding colonies in the east Irish Sea but with a limited foraging range (Woodward *et al.*, 2019).
Arctic tern *Sterna paradisaea*	Bradbury *et al.* (2014)	Regional survey data indicates negligible densities of Arctic terns throughout the east Irish Sea, in both the breeding and non-breeding seasons.
Great skua *Stercorarius skua*	Waggitt *et al.* (2020)	The density layers for great skua associated with Waggitt *et al.* (2020) show that the Morgan Generation Assets offshore ornithology study area supports relatively low to negligible densities through the year. However, the surveys used to inform the density layers in Waggitt *et al.* (2020) may not have adequately captured the movements of this species during passage periods.
Arctic skua *Stercorarius parasiticus*	Bradbury *et al.* (2014)	Regional survey data indicates that the east Irish Sea is of limited importance for Arctic skuas throughout the year, reflecting the absence of breeding colonies in the vicinity of the east Irish Sea. However, the surveys used to inform the density layers in Waggitt *et al.* (2020) may not have adequately captured the movements of this species during passage periods.
Guillemot *Uria aalge*	Waggitt *et al.* (2020)	Regional survey data showed that in the full UK breeding season (March to July) (Furness, 2015), the Morgan Generation Assets do not support high densities of guillemot (Waggitt *et al.,* 2020). The nearest areas supporting high densities of species are located on the east coast of Ireland – associated with the breeding colonies around Dublin. In the non-breeding season, the relative importance of the Morgan Generation Assets offshore ornithology study area increases as the season progresses.
Razorbill *Alca torda*	Waggitt *et al.* (2020)	Regional survey data showed that in the full UK breeding season (April to July) (Furness, 2015), the Morgan Generation Assets area does not support high densities of the species (Waggitt *et al.,* 2020). The nearest areas of high species densities are located on the east coast of Northern Ireland. In the non-breeding season, the relative importance of the Morgan Generation Assets offshore ornithology study area increases as the season progresses until March. Densities during this period are however much lower than in the breeding season.

Species	Data source	Abundance and distribution
Puffin *Fratercula arctica*	Waggitt *et al.* (2020)	Regional survey data showed that in the full UK breeding season (April to August) (Furness, 2015), the area in which the Morgan Generation Assets is located does not support high densities of puffin (Waggitt *et al.*, 2020) and there are no areas of high density within the east Irish Sea. In the non-breeding season, the relative importance of the Morgan Generation Assets remains low.
Red-throated diver *Gavia stellata*	Lawson *et al.* (2016) HiDef Aerial Surveying Limited (2023)	The Morgan Generation Assets are located in the east Irish Sea, areas within which are of importance for red-throated diver. The closest of these areas to the Morgan Generation Assets are incorporated into the designation of the Liverpool Bay SPA. The areas of highest density occur off the North Wales coast, especially offshore of Colwyn Bay and Llandulas, in the mouth of the Menai Strait, the Dee Estuary and off the coast at Formby (Lawson *et al.,* 2016). These areas do not overlap with the Morgan Generation Assets. The wider Liverpool Bay Area of Search used to define the boundary of the Liverpool Bay SPA in Lawson *et al.* (2016) does not overlap with the Morgan Generation Assets however, those areas closest to the Morgan Generation Assets support negligible densities. Peak densities typically occurred during February to March (Lawson *et al.* 2016). More recent surveys have shown a similar pattern of distribution (HiDef Aerial Surveying Limited, 2023).
European storm petrel *Hydrobates pelagicus*	Waggitt *et al.* (2020)	Consistent with the site-specific surveys, the density layers associated with Waggitt *et al.* (2020) show that densities of European storm petrel in the area occupied by the Morgan Generation Assets offshore ornithology study area are negligible throughout the year. However, the surveys used to inform the density layers in Waggitt *et al.* (2020) may not have adequately captured the movements of this species during passage periods.
Leach's petrel *Oceanodroma leucorhoa*	Kober *et al.* (2015) Stone *et al.* (1995)	The Morgan Generation Assets and the east Irish Sea in general, are of limited importance for Leach's petrel during the breeding season. Breeding season distributions of the species provided by both Kober *et al.* (2015) and Stone *et al.* (1995) suggest no Leach's petrels are found in the east Irish Sea during the breeding season. Outside of this period Leach's petrel migrate through UK waters occasionally occurring off the coast of the Wirral, England.
Fulmar *Fulmarus galcialis*	Waggitt *et al.* (2020)	Fulmar has a protracted breeding season, with Furness (2015) defining the full UK breeding season as January to August. During this period the Morgan Generation Assets offshore ornithology study area is of low importance to the species. This continues through the non-breeding season when densities are also lower.
Manx shearwater *Puffinus puffinus*	Waggitt *et al.* (2020)	The density layers for Manx shearwater associated with Waggitt *et al.* (2020) show that the Morgan Generation Assets offshore ornithology study area supports relatively low to negligible densities through the year. Higher

Species	Data source	Abundance and distribution
		densities occur further west, closer to Ireland, and are associated with the east Irish Sea Front, an area known for its importance for the species.
Gannet *Morus bassanus*	Waggitt *et al.* (2020)	The work by Waggitt *et al.* (2020), based on aerial and boat-based survey data collected between 1980 to 2018, indicated that gannet were found in the highest densities to the west of the Morgan Array Area during the breeding (March to September) and the non-breeding seasons (October to February).
Cormorant *Phalacrocorax carbo*	Waggitt *et al.* (2020)	Cormorant have a coastal distribution within the east Irish Sea during both the breeding and non-breeding seasons with relatively low densities occurring along the English and Welsh coasts. The area in which the Morgan Generation Assets are located is of limited importance for the species in both the summer and winter.
Shag *Gulosus aristotelis*	Waggitt *et al.* (2020)	Consistent with the site-specific surveys, the density layers associated with Waggitt *et al.* (2020) show that densities of shag in the area occupied by the Morgan Generation Assets offshore ornithology study area are negligible throughout the year.

5.5.2 Site-specific survey findings

5.5.2.1 Table 5.12 presents the results of the site-specific digital aerial surveys undertaken across the Morgan Generation Assets offshore ornithology study area between April 2021 and March 2023. A full description of the results of the site-specific baseline digital aerial surveys are provided in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement. This includes design-based abundance estimates for all species and model-based abundance (using the Marine Renewables Strategic Environmental Assessment (MRSea) package) for the most abundant seabird species.

Table 5.12: Summary of the abundance and distribution of seabird species recorded during site-specific digital aerial surveys.

Species	Present/absent during surveys	Abundance and distribution
Common scoter *Melanitta nigra*	Absent	Common scoters were not recorded in the Morgan Generation Assets offshore ornithology study area (including the 10 km buffer) during the 24-month baseline aerial survey programme of the Morgan Generation Assets.
Kittiwake *Rissa tridactyla*	Present	Kittiwakes were recorded in all 24 months of the digital aerial surveys. Peak numbers occurred in the December 2021 survey. The species was most abundant in the post- and pre-breeding seasons of both survey years, especially December and at the start of the breeding season (March and April). The predicted abundance varied greatly for the rest of the breeding season (April to August) but was generally low between May to August and consistently much lower than post- and pre-breeding season months. There was an easterly bias in the distribution of kittiwake across the Morgan Generation Assets offshore ornithology study area.
Black-headed gull *Chroicocephalus ridibundus*	Absent	Black-headed gulls were not recorded in the Morgan Generation Assets offshore ornithology study area during the 24-month baseline aerial survey programme of the Morgan Generation Assets.
Little gull *Hydrocoloeus minutus*	Present	Little gulls were recorded within the Morgan Generation Assets offshore ornithology study area in three of the 24 months of the baseline aerial survey programme. The highest population occurred in January 2023 (159 birds) with birds also occurring in April 2021 (8 birds) and January 2022 (15 birds). Throughout the three surveys, birds were primarily located in the south half of the Morgan Generation Assets survey area.
Mediterranean gull *Ichthyaetus melanocephalus*	Present	Mediterranean gulls were recorded within the Morgan Generation Assets offshore ornithology study area in only one of the 24 months of the baseline aerial survey programme with this being in the January 2023 survey. One bird was observed in the south part of the Morgan Generation Assets survey area during the January 2023 survey translating into a population estimate of eight birds.
Common gull *Larus canus*	Present	Common gulls were recorded within the Morgan Generation Assets offshore ornithology study area in eight of the 24 months of the baseline aerial survey programme. The highest population occurred in December 2022. Of the eight surveys in which the species was recorded, seven were during the non-breeding season, predominantly between November and January. The only records of birds in the breeding season came during the April 2022 survey. Due to the small number of birds recorded there were no obvious trends in the distribution of birds across the Morgan Generation Assets survey area.
Great black-backed gull *Larus marinus*	Present	Great black-backed gulls were recorded within the Morgan Generation Assets offshore ornithology study area in 10 of the 24 months of the baseline aerial survey programme. Peak numbers occurred in January 2022. The majority of birds were recorded in the non-breeding season defined for the species (September to March). In the breeding season birds were recorded in both August and March surveys. The populations of birds recorded during the non-breeding season were generally higher than those recorded in the breeding season. Birds were generally recorded in the south and east parts of the Morgan Generation Assets survey area.

Species	Present/absent during surveys	Abundance and distribution
Herring gull *Larus argentatus*	Present	Herring gulls were recorded within the Morgan Generation Assets offshore ornithology study area in 14 of the 24 months of the baseline aerial survey programme. The highest populations were estimated in the non-breeding season defined for the species with the peak population occurring in January 2022. Small populations were recorded in breeding season months (less than 20 birds) with the exception of March 2023, when a population of 207 birds was estimated although this may reflect pre-breeding movements of birds. There was no obvious trend in the distribution of herring gull across the Morgan Generation Assets survey area.
Lesser black-backed gull *Larus fuscus*	Present	Lesser black-backed gulls were recorded within the Morgan Generation Assets offshore ornithology study area in 11 of the 24 months of the baseline aerial survey programme. The highest populations were estimated in August or September likely reflecting dispersal/migratory movements of birds from breeding colonies. Smaller populations (less than 20 birds) were estimated in all other months.
Sandwich tern *Thalasseus sandvicensis*	Absent	Sandwich terns were not recorded in the Morgan Generation Assets offshore ornithology study area (including the 10 km buffer) during the 24-month baseline aerial survey programme of the Morgan Generation Assets.
Little tern *Sternula albifrons*	Absent	Little terns were not recorded in the Morgan Generation Assets offshore ornithology study area (including the 10 km buffer) during the 24-month baseline aerial survey programme of the Morgan Generation Assets.
Roseate tern *Sterna dougallii*	Absent	Roseate terns were not recorded in the Morgan Generation Assets offshore ornithology study area (including the 10 km buffer) during the 24-month baseline aerial survey programme of the Morgan Generation Assets.
Common tern *Sterna hirundo*	Present	Common terns were recorded within the Morgan Generation Assets offshore ornithology study area in only one of the 24 months of the baseline aerial survey programme. Six birds were observed in the south part of the Morgan Generation Assets survey area during the May 2021 survey translating into a population estimate of 59 birds.
Arctic tern *Sterna paradisaea*	Present	Arctic terns were recorded within the Morgan Generation Assets offshore ornithology study area in only one of the 24 months of the baseline aerial survey programme. Three birds were observed in the south part of the Morgan Generation Assets survey area during the August 2022 survey translating into a population estimate of 63 birds.
Great skua *Stercorarius skua*	Present	Great skuas were recorded within the Morgan Generation Assets offshore ornithology study area in only one of the 24 months of the baseline aerial survey programme. One bird was observed on the southwest boundary of the Morgan Array Area during the October 2022 survey translating into a population estimate of eight birds.
Arctic skua *Stercorarius parasiticus*	Present	Arctic skuas were recorded within the Morgan Generation Assets offshore ornithology study area in only one of the 24 months of the baseline aerial survey programme. One bird was observed in the southwest part of the Morgan Generation Assets offshore ornithology study area during the September 2022 survey translating into a population estimate of seven birds.

Species	Present/absent during surveys	Abundance and distribution
Guillemot *Uria aalge*	Present	Guillemots were recorded within the Morgan Generation Assets offshore ornithology study area in all of the baseline aerial surveys. Populations were generally highest outside of the breeding season. The species was generally most abundant in the non-breeding season of both survey years, although the lowest populations estimated occurred in the November 2021 survey. The peak population occurred in August or September 2022 (depending on the calculation method used). In the breeding season of both survey years guillemot are distributed through the Morgan Generation Assets survey area. In the early part of the non-breeding season (August to December in 2021 and August and September in 2022) there appears to be an easterly bias in the modelled distribution of guillemot.
Razorbill *Alca torda*	Present	Razorbills were recorded within the Morgan Generation Assets offshore ornithology study area in 19 of the 24 months of the baseline aerial survey programme. The highest populations were recorded outside of the breeding season, with very few birds observed between April and August in both years. The peak populations in both years occurred in the December surveys. There was an easterly bias in the distribution of razorbills across the Morgan Generation Assets offshore ornithology study area.
Puffin *Fratercula arctica*	Present	Puffins were recorded within the Morgan Generation Assets offshore ornithology study area in 4 of the 24 months of the baseline aerial survey programme. Birds were recorded in April (19 birds) and May 2021 (18 birds), September 2022 (eight birds) and January 2023 (10 birds). Due to the limited numbers of birds recorded there is no obvious trend in the distribution of the species across the Morgan Generation Assets survey area.
Red-throated diver *Gavia stellata*	Absent	Red-throated divers were not recorded in the Morgan Generation Assets offshore ornithology study area (including the 10 km buffer) during the 24-month baseline aerial survey programme of the Morgan Generation Assets.
European storm petrel *Hydrobates pelagicus*	Absent	European storm petrels were not recorded in the Morgan Generation Assets offshore ornithology study area during the 24-month baseline aerial survey programme of the Morgan Generation Assets.
Leach’s petrel *Oceanodroma leucorhoa*	Absent	Leach’s petrels were not recorded in the Morgan Generation Assets offshore ornithology study area (including the 10 km buffer) during the 24-month baseline aerial survey programme of the Morgan Generation Assets.
Fulmar *Fulmarus glacialis*	Present	Fulmars were recorded within the Morgan Generation Assets offshore ornithology study area in 14 of the 24 months of the baseline aerial survey programme. The highest populations were estimated outside of the migration-free breeding season including in January 2022, when the peak population occurred, and between November 2022 and March 2023. The distribution of the species within the Morgan Generation Assets survey area was generally focussed in north and west areas.

Species	Present/absent during surveys	Abundance and distribution
Manx shearwater *Puffinus puffinus*	Present	Manx shearwaters were recorded within the Morgan Generation Assets offshore ornithology study area in 11 of the 24 months of the baseline aerial survey programme. Birds were observed between April and September 2021 and May and September 2022, reflecting the occurrence of the species in UK waters. The peak population in 2021 occurred in July and in September in 2022. No birds were recorded between October and March in both survey years reflecting the seasonal presence of Manx shearwater in UK waters.
Gannet *Morus bassanus*	Present	Gannets were recorded within the Morgan Generation Assets offshore ornithology study area in 22 of the 24 months of the baseline aerial survey programme. The highest populations occurred in both years towards the end of the breeding season into the post-breeding season with peak number in either August or September of both years. Outside of this period populations were generally lower and the species was absent in the Morgan Generation Assets offshore ornithology study area in the January and February 2023 surveys. The distribution of the species within the Morgan Generation Assets survey area was generally focussed in north and east areas.
Cormorant *Phalacrocorax carbo*	Absent	Cormorants were not recorded in the Morgan Generation Assets offshore ornithology study area during the 24-month baseline aerial survey programme of the Morgan Generation Assets.
Shag *Gulosus aristotelis*	Absent	Shags were not recorded in the Morgan Generation Assets offshore ornithology study area during the 24-month baseline aerial survey programme of the Morgan Generation Assets.

5.5.3 Designated sites

International Sites (European sites and Ramsar sites)

5.5.3.1 Internationally designated sites identified for the offshore ornithology assessment are described in Table 5.13. Sites are ordered according to straight line distance from the Morgan Generation Assets offshore ornithology study area. It is important to note that the measured distances represent the direct line distance, which may include crossing over a substantial amount of land, possibly covering the entire UK. Consequently, these distances do not necessarily reflect the typical flight patterns of seabirds, which usually avoid flying over large bodies of land. These sites may therefore be further away if measured using marine pathways. The list provided in Table 5.13 is consistent with the list of sites for which Likely Significant Effect (LSE) was identified in the E1.4 HRA Phase 1 Screening Report.

Table 5.13: Designated sites and relevant qualifying interests for the offshore ornithology assessment. Sites are ordered according to distance from the Morgan Array Area

[1] Measured as the closest, straight line, distance from the SPA (irrespective of the presence of land masses).

Designated site	Closest Distance to the Morgan Array Area (km)[1]	Relevant Qualifying interest	Season of relevance to the Morgan Generation Assets assessments
Morecambe Bay and Duddon Estuary SPA/Morecambe Bay Ramsar	31.1	Lesser black-backed gull Herring gull Breeding seabird assemblage	Annual cycle for all features
Ribble and Alt Estuaries SPA (and Ramsar site)	51.0	Lesser black-backed gull Breeding seabird assemblage	Annual cycle for all features
Irish Sea Front	56.7	Manx shearwater	Annual cycle for all features
Bowland Fells SPA	70.0	Lesser black-backed gull	Annual cycle for all features
North-west Irish Sea SPA	88.2	Kittiwake Herring gull Guillemot Razorbill	Annual cycle for kittiwake Non-breeding season for herring gull, guillemot and razorbill
Copeland Islands SPA	112.3	Manx shearwater	Annual cycle for all features
Glannau Aberdaron ac Ynys Enlli/ Aberdaron Coast and Bardsey Island SPA	128.7	Manx shearwater	Annual cycle for all features
Lambay Island SPA	130.4	Kittiwake Herring gull Guillemot Razorbill Breeding seabird assemblage	Annual cycle for kittiwake and breeding seabird assemblage Non-breeding season for herring gull, guillemot and razorbill
Ireland's Eye SPA	138.6	Kittiwake	Annual cycle for all features
Howth Head Coast SPA	139.3	Kittiwake	Annual cycle for all features
Ailsa Craig SPA	142.3	Gannet	Annual cycle for all features

Designated site	Closest Distance to the Morgan Array Area (km)[1]	Relevant Qualifying interest	Season of relevance to the Morgan Generation Assets assessments
		Kittiwake Breeding seabird assemblage	
Wicklow Head SPA	165.4	Kittiwake	Annual cycle for all features
Rathlin Island SPA	186.1	Kittiwake Guillemot Razorbill Breeding seabird assemblage	Annual cycle for kittiwake and breeding seabird assemblage Non-breeding season(s) for guillemot and razorbill
Forth Islands SPA	219.9	Gannet Breeding seabird assemblage	Non-breeding seasons only for all features
Flamborough and Filey Coast SPA	233.5	Kittiwake Breeding seabird assemblage	Non-breeding seasons only for all features
Skomer, Skokholm and the Seas off Pembrokeshire SPA	252.0	Manx shearwater Kittiwake Lesser black-backed gull Guillemot Razorbill Breeding seabird assemblage	Annual cycle for kittiwake, Manx shearwater and breeding seabird assemblage Non-breeding seasons only for lesser black-backed gull, guillemot and razorbill
North Colonsay and Western Cliffs SPA	257.6	Kittiwake Guillemot Breeding seabird assemblage	Annual cycle for kittiwake and breeding seabird assemblage Non-breeding season for guillemot
Grassholm SPA	260.3	Gannet	Annual cycle for all features
Saltee Islands SPA	265.9	Gannet Kittiwake Guillemot Razorbill Breeding seabird assemblage	Annual cycle for gannet and kittiwake Non-breeding season(s) for guillemot and razorbill
Rum SPA	340.7	Manx shearwater Breeding seabird assemblage	Annual cycle for all features
Mingulay and Berneray SPA	370.3	Guillemot Razorbill Breeding seabird assemblage	Non-breeding seasons only for all features
Buchan Ness to Collieston Coast SPA	385.7	Kittiwake Breeding seabird assemblage	Non-breeding seasons only for all features
Troup, Pennan and Lion's Heads	414.7	Kittiwake Breeding seabird assemblage	Non-breeding seasons only for all features
The Shiant Isles SPA	442.5	Razorbill Breeding seabird assemblage	Non-breeding seasons only for all features

Designated site	Closest Distance to the Morgan Array Area (km)[1]	Relevant Qualifying interest	Season of relevance to the Morgan Generation Assets assessments
East Caithness Cliffs SPA	449.8	Kittiwake Breeding seabird assemblage	Non-breeding seasons only for all features
Isles of Scilly SPA/Isles of Scilly Ramsar	464.8	Lesser black-backed gull Great black-backed gull Manx shearwater Breeding seabird assemblage	Annual cycle for Manx shearwater and breeding seabird assemblage Non-breeding seasons only for lesser black-backed gull and great black-backed gull
Seas off St Kilda SPA	474.3	Guillemot Fulmar Gannet	Annual cycle for fulmar and breeding seabird assemblage Non-breeding seasons only for gannet and guillemot
Handa SPA	480.2	Guillemot Razorbill Breeding seabird assemblage	Non-breeding seasons only for all features
St Kilda SPA	490.4	Guillemot Gannet Fulmar Manx shearwater Breeding seabird assemblage	Annual cycle for fulmar, Manx shearwater and breeding seabird assemblage Non-breeding seasons only for gannet and guillemot
Cape Wrath SPA	502.3	Kittiwake Guillemot Breeding seabird assemblage	Non-breeding seasons only for all features
Flannan Isles SPA	510.8	Guillemot Breeding seabird assemblage	Non-breeding seasons only for all features
Sule Skerry and Sule Stack SPA	548.9	Guillemot Gannet Breeding seabird assemblage	Non-breeding seasons only for all features
North Rona and Sula Sgeir SPA	567.8	Gannet Breeding seabird assemblage	Non-breeding seasons only for all features
West Westray SPA	580.3	Kittiwake Breeding seabird assemblage	Non-breeding seasons only for all features
Hermaness, Saxa Vord and Valla Field SPA	763.5	Gannet Breeding seabird assemblage	Non-breeding seasons only for all features

National Sites (SSSI, ASSI and MNRs)

5.5.3.2 Nationally designated sites (seabird colonies within SSSI and MNR sites) identified for the offshore ornithology assessment are described in Table 5.14. The identification of relevant sites has considered those SSSIs adjacent to the Irish Sea only. Sites are ordered according to distance from the Morgan Array Area within each category of site.

Table 5.14: Nationally designated sites and relevant qualifying interests for the offshore ornithology assessment.

Designated Site	Closest Distance to the Morgan Array Area (km)	Relevant Qualifying Interest
SSSI (seabird colonies)		
Duddon Estuary SSSI	36.6	Lesser black-backed gull
St Bee's Head SSSI	53.5	Kittiwake Herring gull Guillemot Razorbill Puffin
Pen y Gogarth / Great Ormes Head SSSI	63.2	Kittiwake Guillemot Razorbill
Creigiau Rhiwledyn / Little Ormes Head SSSI	65.6	Kittiwake Guillemot Razorbill
Arfordir Gogleddol Penmon SSSI	66.2	Fulmar
Abbey Burn Foot to Balcary Point SSSI	78.3	Kittiwake Guillemot Razorbill Fulmar
Ynys Enlli SSSI	137.5	Kittiwake Storm petrel Manx shearwater
Marine Nature Reserves (MNR)		
Laxey Bay MNR	22.4	Shag Gannet
Little Ness MNR	22.7	Fulmar
Douglas Bay MNR	23.0	Cormorant Shag
Baie ny Carrickey MNR	30.4	Kittiwake Guillemot Razorbill Puffin
Calf and Wart Bank MNR	36.3	Puffin Manx shearwater
Niarbyl Bay MNR	36.9	Fulmar Lesser black-backed gull

Designated Site	Closest Distance to the Morgan Array Area (km)	Relevant Qualifying Interest
Port Erin Bay MNR	37.0	Herring gull Fulmar
West Coast MNR	38.8	Gannet

5.5.4 Valued Ornithological Receptors

5.5.4.1 Offshore ornithology Valued Ornithological Receptors (VOR) have been selected (Table 5.15) based on the conservation status of the ornithological receptor, their vulnerability to impact (for each impact which has been scoped in for the assessment) and known abundance from site specific surveys and desktop studies (Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement; Volume 4, Annex 5.3: Offshore ornithology CRM technical report of the Environmental Statement; Volume 4, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement).

5.5.4.2 Valued Ornithological Receptors were initially identified based on their abundance in site specific surveys and/or desktop studies. Where the abundance of a species present at the Morgan Generation Assets plus a 4 km buffer breached the 1% threshold of the regional population in any season the species was identified as a VOR. It is considered that any impacts on species occurring in numbers of less than 1% of the relevant regional population will not be significant (Table 5.17). This process is not however, applied as a definitive threshold with expert judgement also used to identify species for which this threshold may not be applicable. This therefore ensures that species are not erroneously omitted from further assessment (e.g. migratory species or where a species is of particular importance in relation to the Morgan Generation Assets through, for example, SPA connectivity). Migratory seabird and waterbird species are considered for collision risk impacts only with a species inclusion based on overlap between the Morgan Generation Assets and species-specific migratory corridors (see Volume 4, Annex 5.4: Offshore Ornithology Migratory Bird Collision Risk Modelling Technical Report of the Environmental Statement).

5.5.4.3 The conservation status for each species takes account of relevant conservation metrics in England, Wales and the Isle of Man and are defined in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement. The inclusion of VORs in collision and displacement assessments is based on the vulnerability to each respective impact. This process is detailed in Volume 4, Annex 5.3: Offshore ornithology CRM technical report of the Environmental Statement and Volume 4, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement.

5.5.4.4 The VORs included in the assessment exhibit seasonality in their distribution and abundance during site-specific surveys, which reflects the timing of the breeding and non-breeding seasons and migratory periods (i.e. pre- and post-breeding).

5.5.4.5 Species-specific impacts have been assessed in relation to their seasonality as defined in Furness (2015). Regional population estimates for the breeding, non-breeding, pre-breeding and post-breeding periods have been defined in Table 5.16 and calculated using the BDMPS relevant for each species (Furness, 2015). Population estimates for the breeding population were based on SPA and non-SPA sites located within the species' foraging range of the Morgan Generation Assets.

Breeding colony counts were extracted from the Seabird Monitoring Programme (SMP) online database (JNCC *et al.,* 2023). In addition, in the breeding season, the immature proportions presented in Furness (2015) were applied to the breeding adult proportion calculated from SMP to account for this population component.

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

Table 5.15: Evaluation of VORs showing species assessed for significance of effect from the Morgan Generation Assets.

Species	Conservation status	SPA connectivity	Population importance in the breeding season as determined from site-specific surveys	Population importance in the post-breeding/pre-breeding season as determined from site-specific surveys	Population importance in the non-breeding season as determined from site-specific surveys	Conservation value	Taken forward to impact assessment
Common scoter	Schedule 1	No	Negligible	N/A	Negligible	National	No – species not recorded during baseline aerial surveys
Kittiwake	Red-listed	Yes	Regional	Local	N/A	International	Yes - SPA connectivity. Breeding season population estimates of regional importance.
Black-headed gull	Amber-listed	No	Negligible	N/A	Negligible	Local	No – species not recorded during baseline aerial surveys
Little gull	Annex I and Schedule 1	No	N/A	N/A	Regional	National	Yes – non-breeding season populations of regional importance
Common gull	Amber-listed	No	Local	N/A	Local	Local	No - peak estimates did not surpass population importance thresholds
Mediterranean gull	Annex I and Schedule 1	No	Local	N/A	Local	National	No - peak estimates did not surpass population importance thresholds
Great black-backed gull	Amber-listed	No	Regional	N/A	Regional	Regional	Yes – breeding and non-breeding season populations of regional importance

Species	Conservation status	SPA connectivity	Population importance in the breeding season as determined from site-specific surveys	Population importance in the post-breeding/pre-breeding season as determined from site-specific surveys	Population importance in the non-breeding season as determined from site-specific surveys	Conservation value	Taken forward to impact assessment
Herring gull	Red-listed	Yes	Regional	N/A	Local	International	Yes - SPA connectivity. Breeding season population estimates of regional importance
Lesser black-backed gull	Amber-listed	Yes	Local	Local	Local	International	Yes – SPA connectivity
Sandwich tern	Annex I	No	Negligible	Negligible	N/A	National	Yes – migratory species
Little tern	Annex I and Schedule 1	No	Negligible	Negligible	N/A	National	Yes – migratory species
Roseate tern	Annex I and Schedule 1	No	Negligible	Negligible	N/A	National	Yes – migratory species
Common tern	Annex I	No	Local	Negligible	N/A	National	Yes – migratory species
Arctic tern	Annex I	No	Negligible	Local	N/A	National	Yes – migratory species
Great skua	Amber-listed	Yes	Negligible	Local	N/A	International	Yes – migratory species
Arctic skua	Red-listed	No	Negligible	Local	N/A	Regional	Yes – migratory species
Guillemot	Amber-listed	No	Regional	N/A	Local	Regional	Yes - Breeding season population estimates of regional importance
Razorbill	Amber-listed	No	Regional	N/A	Local	Regional	Yes - Breeding season population estimates of regional importance
Puffin	Red-listed	Yes	Local	N/A	Local	International	Yes – SPA connectivity

Species	Conservation status	SPA connectivity	Population importance in the breeding season as determined from site-specific surveys	Population importance in the post-breeding/pre-breeding season as determined from site-specific surveys	Population importance in the non-breeding season as determined from site-specific surveys	Conservation value	Taken forward to impact assessment
Red-throated diver	Annex I and Schedule 1	No	Negligible	Negligible	Negligible	National	No – species not recorded during baseline aerial surveys
European storm petrel	Annex I	Yes	Negligible	Negligible	Negligible	National	Yes – migratory species
Leach’s petrel	Annex I and Schedule 1	Yes	Negligible	Negligible	Negligible	National	Yes – migratory species
Fulmar	Amber-listed	Yes	Local	Local	Local	International	Yes – SPA connectivity
Manx shearwater	Amber-listed	Yes	Local	Local	N/A	International	Yes – SPA connectivity
Gannet	Amber-listed	Yes	Local	Local	N/A	International	Yes – SPA connectivity
Cormorant	Green-listed	No	Negligible	Negligible	Negligible	Negligible	No – species not recorded during baseline aerial surveys
Shag	Annex I	No	Negligible	Negligible	Negligible	National	No – species not recorded during baseline aerial surveys

Seasonality

5.5.4.7 The behaviour and abundance of bird populations vary across an annual cycle, contingent on the biological seasons relevant to different seabird species. The VORs included in the assessment showed seasonality in their distribution and abundance during the site-specific surveys, which reflected the timing of the breeding and non-breeding seasons and migratory periods (i.e. pre- and post-breeding). These distinct biological seasons are acknowledged in order to assess the significance of each bird species within the Morgan Generation Assets during each specific time period.

5.5.4.8 Seasons used within the assessment were defined according to the breeding, non-breeding and migratory periods (autumn and spring migration) from Furness (2015) with the breeding season taking precedence where overlaps between seasonal extents exist. Seasons relevant to each species are shown in Table 5.16.

5.5.4.9 Further information on the derivation of seasons is presented in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation technical report of the Environmental Statement.

Table 5.16: Seasonal definitions as the basis for assessment based on Furness (2015).

1. Not available within Furness (2015), based on Kober *et al.* (2010)

Species	Pre-breeding season/spring migration	Breeding season	Post-breeding season/autumn migration	Non-breeding/winter season
Kittiwake	January to March	April to August	September to December	n/a
Little gull[1]	n/a	n/a	n/a	August to April
Great black-backed gull	n/a	March to August	n/a	September to February
Herring gull	n/a	March to August	n/a	September to February
Lesser black-backed gull	March	April to August	September to October	November to February
Sandwich tern	March	April to August	September	n/a
Little tern	April	May to August	September	n/a
Roseate tern[1]	April	May to August	September	n/a
Common tern	April	May to August	September	n/a
Arctic tern	April	May to August	September	n/a
Great skua	March to April	May to August	September to October	November to February
Arctic skua	April to May	May to July	August to October	n/a
Guillemot	n/a	March to July	n/a	August to February
Razorbill	January to March	April to July	August to October	November to December
Puffin	n/a	April to August	n/a	September to March
European storm petrel[1]	January to May	June to October	November to December	n/a
Leach's petrel[1]	January to May	June to October	November to December	n/a

Species	Pre-breeding season/spring migration	Breeding season	Post-breeding season/autumn migration	Non-breeding/winter season
Fulmar	December to March	April to August	September to October	November
Manx shearwater	March	April to August	September to October	n/a
Gannet	December to February	March to September	October to November	n/a

Reference populations

5.5.4.10 Regional population estimates for the non-breeding, wintering and autumn and spring migration periods have been defined in Table 5.17.

5.5.4.11 These populations are calculated using the BDMPS relevant for each species (Furness, 2015). Population estimates for the breeding population were based on SPA and non-SPA sites located withing the species' foraging range (using Woodward *et al.,* 2019) of the Morgan Generation Assets. Breeding Colony counts were extracted from the SMP online database (JNCC *et al.,* 2023).

5.5.4.12 During the breeding season, in addition to seabirds associated with breeding colonies, there will be immature birds and 'sabbatical' birds (mature seabirds not breeding in a given year) present within the region. Population counts therefore must be adjusted to account for these components of the population.

5.5.4.13 As outlined in Volume 4, Annex 5.1 Offshore ornithology baseline characterisation of the Environmental Statement, calculation of the total regional breeding population was explored collaboratively with the Offshore Ornithology EWG due to their being little quantitative evidence to support the calculation of the number of immature and non-breeding birds present in relevant sea areas during the breeding season. The EWG proposed that the sum of the adult and immature population estimates for all colonies that sit within the relevant species BDMPS from Furness (2015) should be used in order to estimate the total regional breeding population. The EWG noted that there are potential inaccuracies associated with this approach. Additionally, this approach makes broad assumptions about immature populations and therefore increases the total regional breeding population figure. As a more precautionary approach therefore, the number of immature birds present in the regional BDMPS has been estimated using the ratio of immatures per breeding adult provided in the relevant species accounts in Furness (2015). This approach assumes that all immatures associated with each breeding colony will be present within the foraging range defined for each species.

5.5.4.14 The Applicant acknowledges there are also potential inaccuracies with this approach as it may under-or over-estimate the true count of immature birds. This is because the approach does not account for immature birds from other breeding colonies outside of foraging range that may interact with the relevant sea area which could under-estimate the number of immature birds present. However, it also assumes that all immature birds associated with breeding colonies within foraging range will be present in the relevant sea area whereas in reality many of these immature birds will be located outside of UK waters or in other areas of UK waters. However as stated, taking this approach will result in a more precautionary assessment due to making use of a much smaller total regional breeding population against which the impacts have been assessed.

5.5.4.15 The regional breeding populations presented in Table 5.17 are used in the Morgan Generation Assets alone assessments only. The EWG did not make a distinction between the project alone and cumulative assessments however, due to the larger spatial scale associated with cumulative assessments, with other projects considered cumulatively potentially affecting additional colonies that may be unaffected by the focal project, a different approach, consistent with that recommended by the EWG has been applied. The approach to the calculation of regional breeding populations used in the cumulative assessment is discussed in paragraphs 5.11.1.6 to 5.11.1.8 with the resulting populations presented in Table 5.66.

5.5.4.16 In the non-breeding season, seabirds are not constrained by the necessity to provision young and can, depending on individual species, range widely within UK seas and beyond. The ZoI for seabird species where an assessment in the non-breeding season and migratory periods is deemed to be required is based on the BDMPS area defined by Furness (2015) which usually equates to the 'UK Western Waters', 'UK Western Waters and Channel' or 'UK south-west and Channel waters' depending on the species (Furness, 2015). The total regional breeding population (adult plus juveniles and immatures) are presented in Table 5.17 alongside the non-breeding and migration periods BDMPS.

5.5.4.17 As shown in Table 5.16, only certain seasons have been taken forward to the assessment. Furness (2015) provides under each species account the appropriate seasons to be used within assessments and hence why not all seasons in Table 5.17 have been utilised. These seasons were agreed with the EWG during meeting 2 (July 2022).

Table 5.17: Seasonal regional population used within the assessment.

Species	Pre-Breeding Season/Spring Migration	Breeding Season	Post Breeding Season/Autumn Migration	Non-breeding/Winter Season
Kittiwake	691,526	130,017	911,586	n/a
Little gull	n/a	n/a	n/a	333
Great black-backed gull	n/a	999	n/a	17,742
Herring gull	n/a	24,286	n/a	173,299
Lesser black-backed gull	163,305	87,807	163,304	41,159
Sandwich tern	10,761	1,920	10,761	n/a
Little tern	1,602	0	1,602	n/a
Roseate tern	3,230	0	3,230[7]	n/a
Common tern	64,659	0	64,659	n/a
Arctic tern	17,696	0	17,696	n/a
Great skua	25,090	1,239	16,336	1,398
Arctic skua	5,111	0	5,287	n/a
Guillemot	n/a	76,129	n/a	1,139,220

Species	Pre-Breeding Season/Spring Migration	Breeding Season	Post Breeding Season/Autumn Migration	Non-breeding/Winter Season
Razorbill	606,914	7,891	606,914	341,422
Puffin	n/a	183,387	n/a	304,557
European storm petrel	90,000	10,538	180,000	n/a
Leach's petrel	180,000	6,815	450,000	n/a
Fulmar	828,194	231,423	828,194	556,367
Manx shearwater	1,580,895	2,230,698	1,580,895	n/a
Gannet	661,888	651,586	545,954	n/a

Baseline mortality rates

5.5.4.18 The impact of additional mortality due to wind farm effects is assessed in terms of the change in the baseline mortality rate which could result. It has been assumed that all age classes are equally at risk of effects, with each age class affected in proportion to its presence in the population. Therefore, a weighted average baseline mortality rate has been calculated for those species screened in for assessment. This is therefore appropriate for use in assessments for all age classes, .

5.5.4.19 Age specific survival rates for each species from Horswill and Robinson (2015) were entered into a matrix population model. Updated productivity values were provided by JNCC/British Trust for Ornithology (BTO) (JNCC *et al.*, 2023), with the UK average over the course of 2010 to 2019 calculated and used. Not all species and colonies had updated counts after 2014, and so the national average from Horswill and Robinson (2015) was used if no updated rates from JNCC/BTO were made available. Productivity values were used to calculate the expected proportions in each age class. Each age class survival rate was multiplied by its proportion and the total for all ages summed to give the average survival rate for all ages. The average mortality rate was subsequently calculated by subtracting the survival rate from 1. The demographic rates, age class proportions and average mortality rates calculated are presented in Table 5.18.

5.5.4.20 Baseline mortality rates for migratory seabird and waterbird species represent adult baseline mortality rates from relevant literature sources (Robinson, 2005) and are quoted where relevant in section 5.9.

Table 5.18: Demographic rates from JNCC/BTO (JNCC *et al.*, 2023) and Horswill and Robinson (2015) and population age ratios calculated from population models used to estimate average mortality for use in impact assessment.

Species	Parameter	Age Class						Adult	Productivity	Average mortality
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6			
Kittiwake	Survival	0.790	0.854	0.854	0.854	N/A	N/A	0.854	0.619	0.156
	Proportion in population	0.160	0.126	0.107	0.090	N/A	N/A	0.517	N/A	N/A
Great black-backed gull	Survival	0.798	0.930	0.930	0.930	0.930	N/A	0.930	1.061	0.095
	Proportion in population	0.188	0.134	0.112	0.094	0.078	N/A	0.394	N/A	N/A
Herring gull	Survival	0.798	0.834	0.834	0.834	0.834	N/A	0.834	0.498	0.171
	Proportion in population	0.132	0.110	0.096	0.084	0.073	N/A	0.505	N/A	N/A
Lesser black-backed gull	Survival	0.820	0.885	0.885	0.885	0.885	N/A	0.885	0.438	0.121
	Proportion in population	0.120	0.099	0.088	0.079	0.069	N/A	0.547	N/A	N/A
Guillemot	Survival	0.560	0.792	0.917	0.939	0.939	N/A	0.939	0.583	0.133
	Proportion in population	0.153	0.084	0.065	0.058	0.053	N/A	0.587	N/A	N/A
Razorbill	Survival	0.630	0.630	0.895	0.895	N/A	N/A	0.895	0.532	0.172
	Proportion in population	0.155	0.099	0.064	0.059	N/A	N/A	0.623	N/A	N/A
Puffin	Survival	0.709	0.709	0.709	0.760	0.805	N/A	0.906	0.555	0.176
	Proportion in population	0.155	0.113	0.082	0.060	0.046	N/A	0.544	N/A	N/A
Fulmar	Survival	0.260	N/A	N/A	N/A	N/A	N/A	0.936	0.410	0.221
	Proportion in population	0.233	N/A	N/A	N/A	N/A	N/A	0.767	N/A	N/A

Species	Parameter	Age Class						Adult	Productivity	Average mortality
		0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6			
Manx shearwater	Survival	0.870	0.870	0.870	0.870	0.870	N/A	0.870	0.600	0.130
	Proportion in population	0.140	0.120	0.103	0.089	0.077	N/A	0.471	N/A	N/A
Gannet	Survival	0.424	0.829	0.891	0.895	0.895	N/A	0.919	0.766	0.193
	Proportion in population	0.201	0.084	0.069	0.061	0.054	N/A	0.531	N/A	N/A

5.5.5 Future baseline scenario

5.5.5.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that 'an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge' is included within the Environmental Statement. In the event that the Morgan Generation Assets Project does not come forward, an assessment of the future baseline conditions has been carried out and is described within this section.

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

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

5.5.5.4 Most seabird species in the UK are at the southern limit of their range in the northeast Atlantic and therefore an increase in global temperatures could result in a shift in species' range with the potential for overall declines in population size (Frederiksen *et al.*, 2007, 2013 and Mitchell *et al.*, 2020). In the UK and Ireland, climate change is considered to be the likely primary cause of decline in seabird populations in the future, with anticipated depletion of breeding conditions for most species either indirectly, through changes in prey abundance, or directly during extreme weather events (Mitchell *et al.*, 2020). On current predictions it is anticipated that sea surface temperatures will continue to rise (see Volume 4, Chapter 2: Climate Change of the Environmental Statement).

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

5.5.6 Data limitations

5.5.6.1 Baseline characterisation of the Morgan Generation Assets offshore ornithology study area and resulting assessments of significance use site-specific data (digital aerial surveys) conducted over a period of 24 months (April 2021 to March 2023). As sampling is undertaken once a month for a period of 24 months, it may be considered to represent a snapshot of each month. Indeed, seabird numbers may fluctuate both spatially and temporally in response to environmental conditions. However, the sampling regime adopted at the Morgan Generation Assets is identical to other baseline characterisation surveys at offshore wind farms projects which have been previously agreed by SNCBs as suitable for baseline characterisation. The approach to baseline characterisation of the Morgan Generation Assets was also agreed through the EWG.

5.5.6.2 The level of precision of the abundance estimates is crucial as reliable abundance underpins the robustness of the predictions and the assessment of the effects on the VORs. To characterise the baseline conditions, model-based estimates using the MRSea package were produced to predict numbers across the survey area alongside 95% confidence intervals to provide a level of uncertainty. Design based estimates for bird numbers and densities in each month were also generated. These were compared to the MRSea estimates to provide additional validation of the MRSea outputs and estimates for months where low raw abundances prevented the use of the MRSea model. Flight heights for the sCRM were derived from the published literature rather than site-specific data. Generic flight height distributions published by Johnston *et al.* (2014) were therefore used in sCRM for this assessment. The application of site-specific flight height data collected by LiDAR survey was considered during the survey programme but was not undertaken following consultation with the EWG in 2021. At the time of consultation, the EWG did not endorse the use of LiDAR as a method for collecting flight height data to parameterise CRMs due to the lack of an established body of scientific evidence. Other methods to collect site-specific flight height data (e.g. derived from aerial imagery) were not currently considered to be sufficiently robust or precise in their estimates and have associated issues with the application of appropriate avoidance rates. The use of generic flight heights has been agreed through the Evidence Plan process EWG as presented in section 5.3.2.

5.5.6.3 The impact of the short, medium and long-term effects of the 2022 HPAI outbreak on seabird colony abundance and vital rates (productivity and survival) on UK breeding colonies is unclear. It is also unclear yet how the distribution and abundance of seabirds at sea was affected during the 2022 summer outbreak. The disease has affected 61 bird species, including species such as gannet, razorbill, guillemot, puffin, Manx shearwater, fulmar and small and large gull species (Pearce-Higgins *et al.*, 2023). The impact has affected gannet and great skua especially (Pearce-Higgins *et al.*, 2023) with the United Kingdom supporting over 50% of the global gannet population and 60% of the global great skua population (JNCC, 2021).

5.6 Impact assessment methodology

5.6.1 Overview

5.6.1.1 The offshore ornithology impact assessment has followed the methodology set out in Volume 1, Chapter 5: EIA methodology of the Environmental Statement. Specific to the offshore ornithology impact assessment, the following guidance documents have been considered:

- Guidelines for ecological impact assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. September 2018 Version 1.1 - updated September 2019 (CIEEM, 2019)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase I: Expectations for pre-application baseline data for designated nature conservation and landscape receptors to support offshore wind applications (Natural England, 2022a)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase II: Expectations for pre-application engagement and best practice guidance for the Evidence Plan process (Natural England, 2022b)
- Offshore Wind Marine Environmental Assessments: Best Practice Advice for Evidence and Data Standards. Phase III: Expectations for data analysis and

presentation at examination for offshore wind applications (Natural England, 2022c).

- Environmental Impact Assessment for Offshore Renewable Energy projects (British Standards Institute (BSI) (2015); and
- UK Planning Inspectorate Advice Note Twelve: Transboundary Impacts (PINS, 2015); and Advice Note Seventeen: Cumulative Effects Assessment (PINS, 2019).

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

- The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 and the 2017 Habitats Regulations
- European Commission ('EC') Directive 2009/147/EC (codified version of 79/409/EC) on the Conservation of Wild Birds (the 'Birds Directive')
- Ramsar Convention on Wetlands of International Importance 1971.
- Wildlife and Countryside Act 1981 (as amended).

5.6.2 Impact assessment criteria

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

5.6.2.2 The criteria for defining magnitude in this chapter are outlined in Table 5.19 below. This set of definitions has been determined on the basis of changes to bird populations.

Table 5.19: Definition of terms relating to the magnitude of an impact.

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

5.6.2.3 In addition, where an impact can be quantified (e.g. through the use of collision risk modelling or displacement analysis), the magnitude of an effect is compared to the baseline mortality of the relevant population for a species. Where the impact magnitude represents more than a 1% increase in the baseline mortality of the relevant population, further analyses, such as population modelling, may then be used to help determine the significance of the effect.

5.6.2.4 The criteria for defining recoverability and sensitivity in this chapter are outlined in Table 5.20 and Table 5.23 below. The definitions used to determine the recoverability of each VOR are presented in Table 5.20 with the parameters supporting these definitions presented in Table 5.21. The definition of sensitivity considers the vulnerability of a receptor as well as taking into account the receptor's conservation importance. Identification of vulnerability has used information from Wade *et al.* (2016) and Bradbury *et al.* (2014) with values presented in Table 5.22. The recent effects of Highly Pathogenic Avian Influenza (HPAI) has caused changes to many seabird populations. However, the overall recoverability defined for the purposes of assessment is based on the longer-term population trends and not the impacts caused by HPAI which are as yet unknown.

Table 5.20: Definition of recoverability.

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

Table 5.21: Information used to determine recoverability of VORs used to define sensitivity of VORs.

Notes:

[1] BTO (2023)

[2] JNCC (2021)

[3] Trend for Irish Sea colonies from JNCC (2021)

Species	Clutch size (no. of eggs) [1]	Age at first breeding	Regional trend (%) [3]	National trend (%)		Overall recoverability
				1985 to 88 to 1998 to 2002 [2]	2000 to 2019 [2]	
Kittiwake	2	4	- 82 to - 19	- 25	- 29	Low
Little gull	2 to 3	2 to 3	Not available	Not available	Not available	Medium
Great black-backed gull	2 to 3	4	Not available	- 4	- 23	Medium
Herring gull	3	4	Not available	- 13	Not available	Medium
Lesser black-backed gull	3	4	Not available	+ 40	Not available	Medium
Sandwich tern	1 to 2	3	Not available	- 15	+ 5	Medium
Little tern	2 to 3	3	Not available	- 23	- 28	Medium
Roseate tern	1 to 2	2	Not available	- 83	+ 125	High
Common tern	2 to 3	3	Not available	- 9	- 3	Medium
Arctic tern	1 to 2	4	Not available	- 31	- 5	Medium
Great skua	2	7	Not available	+ 26	n/a	Medium
Arctic skua	2	4	Not available	- 37	- 70	Low
Guillemot	1	5	- 34 to + 120	+ 31	+ 60	High
Razorbill	1	4	+ 10 to + 91	+ 21	+37	High
Puffin	1	5	Not available	+ 19	Not available	Medium
European storm petrel	1	4	Not available	Not available	Not available	Medium

Species	Clutch size (no. of eggs) [1]	Age at first breeding	Regional trend (%) [3]	National trend (%)		Overall recoverability
				1985 to 88 to 1998 to 2002 [2]	2000 to 2019 [2]	
Leach's petrel	1	5	Not available	Not available	Not available	Medium
Fulmar	1	9	- 36	- 3	- 33	Low
Manx shearwater	1	5	Not available	Not available	Not available	Medium
Gannet	1	5	- 1 to + 22	+ 39	+ 34	High

Table 5.22: Information used to determine vulnerability of VORs used to define sensitivity of VORs.

Species	Collision	Displacement associated with structures	Displacement associated with vessels and helicopters	Habitat flexibility	Barrier effects
Kittiwake	High	Low	Low	Medium	Low
Little gull	Medium	Very Low	Very Low	Medium	Low
Great black-backed gull	Very High	Low	Very Low	Medium	Low
Herring gull	Very High	Low	Very Low	High	Low
Lesser black-backed gull	Very High	Low	Very Low	High	Low
Sandwich tern	Very High	Low	Low	Moderate	Very Low
Little tern	Moderate	Low	Low	Low	Very Low
Roseate tern	High	Low	Low	Moderate	Very Low
Common tern	Moderate	Low	Low	Moderate	Very Low
Arctic tern	Moderate	Low	Low	Moderate	Very Low
Great skua	High	Very Low	Very Low	Medium	Low
Arctic skua	High	Very Low	Very Low	Medium	Low
Guillemot	Very Low	High	Medium	Medium	High
Razorbill	Very Low	High	Medium	Medium	High
Puffin	Very Low	Medium	Medium	Medium	High
European storm petrel	Low	Very low	Very low	High	Not available
Leach’s petrel	Low	Very low	Very low	High	Not available
Fulmar	Very Low	Very Low	Very Low	High	Low
Manx shearwater	Very Low	Very Low	Very Low	High	Not available
Gannet	High	High	Very low	High	Very Low

5.6.2.5 The conservation value of ornithological receptors is identified for the majority of species in Volume 4, Annex 5.1 Offshore ornithology baseline characterisation of the Environmental Statement and takes into account two factors: the conservation status of a species and the population importance of a species at the Morgan Generation Assets. The conservation status of a species has been defined taking into consideration of whether the species is a qualifying feature at a designated site with connectivity to the Morgan Generation Assets and if the species is included on various conservation designations (e.g. Annex I of the EU Birds Directive or the Birds of Conservation Concern (Stanbury *et al.,* 2021)). Population importance has been defined by comparing the populations of each species recorded during site-specific surveys to relevant populations (e.g. regional, national and international) in those seasons relevant to each species. These criteria are defined in Volume 4, Annex 5.1 Offshore ornithology baseline characterisation of the Environmental Statement and in Table 5.15.

5.6.2.6 It should be noted that high vulnerability and/or low recoverability are not necessarily linked with high conservation value within a particular impact. A receptor could be categorised as being of high conservation value (e.g. an interest feature of a SPA) but have a low or negligible physical/ecological vulnerability to an effect and vice versa. Determination of sensitivity takes these differing aspects into consideration. Alongside scientific literature, expert judgement has also been used throughout the assessment to identify the sensitivity of all receptors.

Table 5.23: Definition of sensitivity of the receptor.

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

5.6.2.7 The significance of the effect upon offshore ornithology is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The method employed for this assessment is presented in Table 5.24. Where a range of significance of effect is presented in section 5.9, the final assessment for each effect is based upon expert judgement and a precautionary approach.

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

Table 5.24: Matrix used for the assessment of the significance of the effect.

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	Low	Medium	High
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Low	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Negligible or Minor	Minor	Moderate	Moderate or Major
High	Minor	Minor or Moderate	Moderate or Major	Major
Very High	Minor	Moderate or Major	Major	Major

5.6.3 Designated sites

5.6.3.1 Where National Site Network sites and internationally designated sites are considered, this chapter provides the assessments made on the interest features of such sites as described within section 5.5.3 of this chapter (with the assessment on the site itself provided in the E1.3 ISAA Part 3 – SPA assessments). With respect to nationally and locally designated sites, where these sites fall within the boundaries of an internationally designated site (e.g. SSSIs which have not been assessed within the E1.3 ISAA Part 3 – SPA assessments), only the international site has been taken forward for assessment. This is because potential effects on the integrity and conservation status of the nationally designated site are assumed to be inherent within the assessment of the internationally designated site (i.e. a separate assessment for the national site is not undertaken).

5.6.3.2 The E1.3 ISAA Part 3 – SPA assessments has been prepared in accordance with Advice Note Ten: Habitats Regulations Assessment Relevant to Nationally Significant Infrastructure Projects (Planning Inspectorate, 2022) and has been submitted alongside the Environmental Statement.

5.7 Key parameters for assessment

5.7.1 Maximum design scenario

5.7.1.1 The MDS identified in Table 5.25 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. These scenarios have been selected from the Project Design Envelope provided in Volume 1, Chapter 3: Project description of the Environmental Statement. Effects of greater adverse significance are not predicted to arise should any other development scenario, based on details within the Project Design Envelope (e.g. different infrastructure layout), to that assessed here be taken forward in the final design scheme.

Table 5.25: Maximum design scenario considered for the assessment of potential impacts on offshore ornithology.

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

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure.	✓	✓	✓	**Construction phase** Installation of wind turbine foundations, Offshore Substation Platforms (OSPs) foundations, inter-array and interconnector cables in the Morgan Array Area of up to 280 km^2. **Installation of turbines** **<u>Maximum temporal scenario:</u>** Piling at up to 78 locations comprising: 64 wind turbines four-legged jacket foundations, four OSP three-legged jacket foundations and up to 10 gravity based foundations (strengthening piles). Total of 114 days of piling (64 days for jacket foundations, 38 days for gravity base foundations, and 12 days for OSP foundations) estimated as follows: • Wind turbine jacket foundations: – Installation of up to 64 four-legged jacket foundations (with one pile per leg) = a total of 256 piles. – Each pile with a diameter of 3.8 m installed by impact piling. – Maximum hammer energy of up to 4,400 kJ for 16 locations, and up to 3,000 kJ for 48 locations. – Average duration of up to 4.5 hours piling per pile, with a maximum of one foundation (four piles) per day = cumulative total of 64 days (64 foundations x 4 legs x 1 pile per leg x 4.5 hours duration per pile = 1,152 hours) • Wind turbine gravity base foundations – Installation of up to 32 gravity base foundations, up to 10 of which could require piling, leading to = maximum of 150 piles. 15 piles per foundation, each with maximum 4 m diameter. – Maximum hammer energy of up to 3,000 kJ. – Average duration four hours per pile, leading to a maximum cumulative total of up to 600 hours of piling (10 foundations x 15 piles x 4 hours duration per pile = 600 hours) over 38 days (limited by 4 piles per day). • OSPs jacket foundations	Represents the maximum density of wind turbines and structures across the maximum Morgan Array Area that would cause greatest extent of disturbance and displacement to birds or the greatest duration of impact. Represents the maximum underwater sound impacts from impact piling for each of the relevant infrastructure foundation options. Represents the maximum number of vessel and helicopter movements that would cause greatest visual and noise disturbance and displacement to birds from the Morgan Array Area.

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				– Installation of four OSPs (one per 375 MW OSP) with four-legged jacket foundations, with three piles per leg = a total of 48 piles). – Each pile with a diameter of 3.5 m installed by impact piling – Maximum hammer energy of up to 4,400 kJ. – Average duration of up to 4.5 hours piling per pile with a cumulative total of up to 216 hours; installation of OSP foundation over 12 days (limited by four piles per day). **Maximum spatial scenario:** Concurrent piling at a maximum energy with two vessels at a minimum distance of 1.4 km and a maximum distance of 15 km Scenarios considered were: • Concurrent piling of up to 3,000 kJ for two wind turbines Total piling phase (foundation installation) of up to two years within a four year construction programme. **Vessel movements** • Up to 1,929 installation vessel movements (return trips) during construction (521 main installation and support vessels, 74 tug/anchor handlers, 56 cable lay installation and support vessels, 50 guard vessel, 31 survey vessels, 19 seabed preparation vessels, 1,135 CTVs, 41 scour protection installation vessels and two cable protection installation vessels) • Up to a total of 69 construction vessels on site at any one time • Up to 1,095 helicopter movements by up to seven helicopters on site at any one time. **Operations and maintenance phase** *Disturbance and displacement from presence of operations, wind turbines and associated operations and maintenance activity, including increased vessel, helicopter and inspection drone activity:* • Presence of up to 96 operating wind turbines and four OSPs occupying the Morgan Array Area of up to 280 km^2	

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• Minimum spacing of 1400 m between wind turbines • Up to 719 operations and maintenance vessel movements (return trips) each year • Up to a total of 16 operations and maintenance vessels on site at any one time • Up to 639 helicopter return trips per year with up to seven on site at any one time • Up to 214 inspection drones return trips per year (operated from vessel, two inspections per wind turbine per year as a maximum) • Operational lifetime of up to 35 years. **Decommissioning phase** • Vessels used for a range of decommissioning activities such as removal of foundations • Noise from vessels assumed to be as per vessel activity described for construction phase above.	
Indirect impacts from underwater sound affecting prey species	✓	×	✓	**Construction phase** • As described in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement for: - Underwater sound during the construction phase impacting fish and shellfish receptors. **Decommissioning phase** • As described in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement for: – Injury and/or disturbance to fish and shellfish from underwater sound and vibration.	As described in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement.
Temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs)	✓	✓	✓	**Construction phase** • As described in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement for: – Increased suspended sediment concentrations and associated sediment deposition. **Operations and maintenance phase** • As described in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement for:	As described in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement.

Potential impact	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				– Increased suspended sediment concentrations and associated sediment deposition. **Decommissioning phase** • As described in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement for: – Increased suspended sediment concentrations and associated sediment deposition.	
Collision risk	×	✓	×	**Operations and maintenance phase** • Presence of up to 96 wind turbines within the Morgan Array Area • Minimum lower blade tip height of 34 m above Lowest Astronomical Tide(LAT) • Minimum hub height of 159 m above LAT • Maximum blade tip height of 293 m above LAT • Maximum rotor diameter of 250 m • Maximum chord width of 6.8 m • Average rotor speed of 6.2 rpm (with maximum speed of 8.4 rpm) • Operational lifetime of up to 35 years.	The potential for collision risk is derived from wind turbines parameters including rotor diameter, chord width, rotor speed and minimum lower blade tip height. The parameters associated with the most numerous wind turbine parameters (96) represents the MDS because it will result in the greatest potential for collision risk.
Barrier to movement	×	✓	×	**Operations and maintenance phase** • Presence of up to up to 96 wind turbines, four OSPs within the Morgan Array Area of 280 km^2 with a minimum spacing of 1,400 m between rows of wind turbines.	Maximum density of wind turbines and structures across the Morgan Array Area, which maximises the potential barrier to foraging grounds and migration routes for bird species.

5.7.1.2 The MDS when considering the impact on offshore ornithological receptors relates to the largest amount of sea bed area take and the largest amount of material including, greatest number of wind turbines, longest cable route and largest OSP area. This approach would combine scenarios, however, would represent the maximum design scenario as a conservative approach for the assessment of potential impacts.

5.8 Measures adopted as part of the Morgan Generation Assets

5.8.1.1 For the purposes of the EIA process, the term 'measures adopted as part of the project' is used to include the following measures (adapted from The Institute of Environmental Management and Assessment (IEMA), 2016):

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

5.8.1.2 A number of measures (primary and tertiary) have been adopted as part of the Morgan Generation Assets to reduce the potential for impacts on offshore ornithology. These are outlined in Table 5.26. As there is a secured commitment to implementing these measures for the Morgan Generation Assets, they have been considered in the assessment presented in section 5.9 (i.e. the determination of magnitude and therefore significance assumes implementation of these measures).

Table 5.26: Measures adopted as part of the Morgan Generation Assets.

Measures adopted as part of the Morgan Generation Assets	Justification	How the measure will be secured
Primary measures: Measures included as part of the project design		
The Applicant has committed to a minimum lower blade tip height (air draught) of 34 m above LAT.	Air draught is known to be an important factor for collision risk, with typically fewer collisions predicted with increasing air draught.	To be secured within the draft DCO (Document Reference C1).
Tertiary measures: Measures required to meet legislative requirements, or adopted standard industry practice		
Offshore EMP that will include measures to minimise disturbance to rafting birds from transiting vessels.	The development of and adherence to an Offshore EMP which will include measures to minimise disturbance to rafting birds from transiting vessels.	The Offshore EMP is secured within the deemed marine licences of the draft DCO (Document Reference C1).
The Offshore EMP will include a Marine Pollution Contingency Plan (MPCP).	Implementation of an EMP including a MPCP which will include planning for accidental spills, address all potential contaminant releases and include key emergency details.	The Offshore EMP is secured within the deemed marine licences of the draft DCO (Document Reference C1).

5.8.1.3 Bird flight heights are skewed to lower altitudes (Johnston *et al.,* 2014). Historically offshore wind farms have used a lower tip height of 22 m, a limit associated with vessel safety. However, for many recent projects, primarily in the UK North Sea, lower tip heights have been increased to reduce impacts on offshore ornithological receptors. The commitment to a 34 m lower tip height for the Morgan Generation Assets is beyond the minimum required for other receptors and reduces collision risk impacts to ornithological receptors significantly.

5.9 Assessment of significant effects

5.9.1.1 The impacts of the construction, operations and maintenance, and decommissioning phases of the Morgan Generation Assets on offshore ornithology have been assessed. These potential impacts are listed in Table 5.25, along with the MDS against which each impact has been assessed.

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

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

5.9.1.1 The construction, operations and maintenance, and decommissioning phases of the Morgan Generation Assets may lead to disturbance and displacement of birds. The MDS is represented by the maximum density of wind turbines and structures across the maximum array area that would cause the greatest extent of disturbance and displacement to birds, or the greatest duration of impact. The MDS also represents the maximum underwater sound output from impact piling for each of the relevant infrastructure foundation options and the maximum number of vessel and helicopter movements that would cause greatest visual and sound disturbance and displacement to birds from the array area. The MDS is summarised in Table 5.25.

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

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

5.9.1.4 Disturbance as a result of activities during the construction of a wind farm (such as installing foundations, wind turbines, intra-array cabling and associated vessel movements) has the potential to displace birds. Construction activities then result in a point source of disturbance, for example when construction vessels are at a location to undertake piling and install foundations or wind turbines. The level of disturbance associated with each location would vary depending on the activity undertaken. With regards to vessels in the Morgan Generation Assets, there is no method to quantify the displacement impact of the activities due to their highly localised and temporary nature however, consideration is given on a qualitative basis. An offshore EMP that includes measures to minimise disturbance to rafting birds from transiting vessels will be secured within the draft DCO (Table 5.26) and agreed pre-construction.

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

5.9.1.6 The displacement assessment for the Morgan Generation Assets is based on the use of the Displacement Matrix approach (JNCC *et al.,* 2022), which was agreed during consultation with the Offshore Ornithology EWG on 13 July 2022 as part of the Evidence Plan process. As sensitivity to displacement differs considerably between seabird species, species were screened and progressed for the Matrix approach using 'Disturbance Sensitivity' and 'Habitat Specialization' scores from Bradbury *et al.* (2014) and Wade *et al.* (2016) as recommended by the Joint SNCB Interim Displacement Advice Note (JNCC *et al.,* 2022). In addition to the species' sensitivity rating, the importance of a species abundance as recorded during baseline surveys of the Morgan Array Area was considered as to whether species were progressed to the matrix stage (Volume 4, Annex 5.2: Offshore ornithology displacement technical report of the Environmental Statement).

5.9.1.7 For each of the species considered (guillemot, razorbill, kittiwake, gannet, fulmar and Manx shearwater), displacement impacts were quantified for the population derived within the Morgan Array Area plus 2 km buffer.

5.9.1.8 JNCC *et al.* (2022) recommends, for most species, a standard displacement buffer of 2 km with the exception of the species groups that are particularly vulnerable to displacement impacts, divers and seaducks. Red-throated diver and other seaducks were not recorded in the Morgan Generation Assets offshore ornithology study area during the baseline surveys and have therefore been excluded from the assessment of displacement from the Morgan Generation Assets.

5.9.1.9 The full approach of the displacement assessment is detailed in Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

Evidence-based displacement and mortality rates

5.9.1.10 Since displacement sensitivity varies between species, the displacement rates and associated mortality rates used to assess the effects of the operations and maintenance phase of the Morgan Generation Assets have been derived from previous studies, guidance documents and advice received by SNCBs during the Evidence Plan Process. Given that construction is limited both spatially and temporally and that any potential effects are unlikely to reach the same level as during the operations and maintenance phase, the level to be used for the construction phase of the Morgan Generation Assets is a 50% reduction in the displacement rate used for operational phase assessments as recommended by Natural Resource Wales (NRW) during the second EWG (held on 13 July 2022).

5.9.1.11 There is limited empirical evidence on which mortality rate to use when assessing the impacts of displacement of offshore wind farms, however, the current SNCBs guidance, based on expert opinion, is to consider a mortality rate of up to 10% (JNCC *et al.*, 2022). Van Kooten *et al.* (2019) studied the effects of displacement on seabirds using energy-budget models for two scenarios using habitat utilization maps and a fixed 10% mortality rate. The evidence from this study suggests that a 1% mortality rate for displaced birds is more appropriate than the potentially over-precautionary 10% mortality rate. Similarly, Searle *et al.* (2014; 2018) used time and energy budget models to investigate the effects of displacement and barrier effects on breeding populations of seabirds, including auks during the chick rearing period. The study reported changes in time and energy budgets which could impact future survival of auks, however the simulations concluded that the displacement effects were unlikely to result in a mortality rate increase of over 0.5%. Therefore, in line with the advice from the JNCC *et al.* (2022), a 1 to 10% mortality of displaced individuals is presented for all species in this assessment, although the Applicant considers that 1% mortality rate to be the more likely impact based on the studies discussed above. To ensure that the assessments are suitably precautionary for all species, the mortality rates considered for the construction phase remain the same as those used for operational phase impacts.

5.9.1.12 Decommissioning activities associated with the Morgan Generation Assets are considered to be equal to or less than those carried out during the construction phase. Therefore, for the purpose of this assessment it is assumed that the impacts are the same.

Guillemot, razorbill and Manx shearwater

5.9.1.13 Evidence shows that auk species have a moderate vulnerability to displacement from structures and vessel and helicopter traffic (Wade *et al.,* 2016). Furthermore, displacement impacts from post-consent monitoring studies (from 13 different European offshore windfarm sites) have been collated and reviewed by Dierschke *et al.,* (2016), which found auk species to show 'weak displacement' overall, but results were highly variable. Similarly, a recent review submitted by Hornsea Four Offshore Wind Farm (APEM, 2022) summarises all current post consent-monitoring studies undertaken to date within the UK waters and provides an extensive study and analysis of the empirical data from offshore wind farms. This review found that auk displacement varies considerably across different sites, with displacement rates ranging from +112% to -75%. However, this review concluded that a displacement rate of 50% and mortality rate of 1% was appropriate for use in relation to displacement assessments being undertaken for the Hornsea Four offshore wind farm. The review suggests that in areas of high abundance, displacement is limited and postulates that this may be due to higher importance of the underlying habitat to birds meaning birds are more likely to tolerate the presence of structures in the area. For areas with low abundance, displacement rates were increased and the review postulates that this may be that birds are able to forage in other areas as competition between birds is reduced. Although greater than 50% displacement was observed at five developments in the study, all had very low auk abundance of auks within the study area. Where auk abundance was greater, <50% displacement was recorded. Therefore, considering the abundance of auks within the Morgan Generation Assets plus a 2 km buffer, a 50% displacement rate is considered appropriate (and given the findings at Beatrice noted above) precautionary for the Morgan Generation Assets. The conclusions drawn in this review have however been questioned (Natural England, 2022d).

5.9.1.14 Monitoring of impacts at projects in the Irish Sea, indicate weak attraction/weak avoidance of auk species (APEM, 2022). The most recent study on displacement at the Beatrice offshore wind farm utilising an approach investigating the distribution of seabirds in relation to turbine locations suggested that auk species did not avoid turbines (MacArthur Green, 2023). The abundance of both guillemot and razorbill increased significantly from the pre-construction period into the post-construction period. This would suggest that these species are not displaced by offshore wind farms and that the use of a 50% displacement rate, as suggested by APEM (2022) is highly precautionary.

5.9.1.15 Based on the review of the relevant literature, a displacement rate of 50% during the operations and maintenance phase of the Morgan Generation Assets has been deemed appropriate for the auk species (i.e. guillemot and razorbill) considered in this assessment. This rate is considered to be highly precautionary as a study of offshore wind farms in the German North Sea found reduced displacement rates (~20%) of guillemots during the breeding season compared to the non-breeding season (Peschko *et al.,* 2020) and the most recent studies have shown no displacement of auks (MacArthur Green, 2023). This is an important consideration as the mean displacement rates derived from the Dierschke *et al*. (2016) review were primarily from data collected in the non-breeding season. Therefore, by applying a single displacement rate of 50% across all seasons ensures a precautionary rate is used for the assessment.

5.9.1.16 Furthermore, evidence suggests that although auk species are somewhat sensitive to displacement, the effects are short-term, and studies indicate auk habituation to offshore windfarms. For example, a study at Thanet Offshore Windfarm found auk species became habituated and the displacement rate of 75% to 85% in the first year of operations fell to 31% to 41% within years two and three of operations (Royal Haskoning, 2013). Further evidence is emerging through additional post-construction monitoring of offshore windfarms, for instance, there are reports of auk numbers increasing and observations of foraging behaviour within wind farm areas (Leopold and Verdaat, 2018). This suggests the displacement rates of auk species within the Morgan Generation Assets will reduce over time, and, given that the site is close to other offshore wind farms (such as Burbo Bank and West of Duddon Sands), some habituation may have already occurred within local populations that would result in reduced avoidance of the Morgan Generation Assets compared to a new offshore wind farm in a previously unimpacted region.

5.9.1.17 The conclusion from the literature review suggests that a displacement rate of 50% (range 30% to 70%) during the operations and maintenance phase of the Morgan Generation Assets and 2 km buffer is the most applicable for auk species, whilst still being suitably precautionary for assessment. As there is limited evidence regarding displacement rates in Manx shearwater, it was advised by the SNCBs at the Offshore Ornithology EWG meeting (held 13 July 2023, see S42 Consultation, see Annex 5, Chapter 2: Offshore ornithology displacement technical report) that these are to be treated similarly to the auk species, using a 50% (range 30% to 70%) displacement rate. The use of a 50% displacement rate in Manx shearwater is also likely to be highly precautionary since this species shows weak avoidance to offshore wind farms and the population vulnerability to displacement is very low (Dierschke *et al.,* 2016; Wade *et al.,* 2016). If previous guidance (JNCC, 2022) were to be followed this would suggest a far lower displacement rate range of 0-10%.

5.9.1.18 Few studies have provided empirical displacement rates for the construction phase of offshore windfarms. However, studies suggest the displacement rates of auks is either comparable to or significantly lower than that of the operational phase (Vallejo *et al.,* 2017). Although potential disturbance from construction activities within a development can be high during the construction phase, it is likely to be both temporally and spatially restricted compared to the operations and maintenance phase, and thus the resultant displacement rate of the entire site is lower in comparison.

5.9.1.19 Given that the displacement rate used for the construction phase is a 50% reduction from the operational phase displacement rate, the rate used for auks and Manx shearwater during the construction phase is 25% (range 15% to 35%) as agreed with the SNCBs in the second EWG (held on 13/07/2022).

Gannet

5.9.1.20 To assess the effects of the operations and maintenance phase of the Morgan Generation Assets on the gannet population in the area, a displacement rate of 70% (range 60% to 80%) and a mortality rate of 1% (range 1% to 10%) was used.

5.9.1.21 Evidence suggests that gannet show a limited vulnerability to disturbance from ship and helicopter traffic (Wade *et al.,* 2016), however, their avoidance rates to offshore wind farms can be high. Natural England recently reviewed nine studies that reported on gannet avoidance rates using a variation of survey methods (Pavat *et al.,* 2023). The avoidance rates reported range from 61.7% to 100%. Another review by APEM (2022) looked at studies across 25 offshore wind farms, over different seasons, and reported displacement rates of 40% to 60% during the breeding season, and 60% to 80% during the non-breeding season. In light of literature , and following guidance from Natural England (pers. comm., 7 July 2022), using a displacement rate of 70% has been deemed appropriate for this assessment.

5.9.1.22 Given that the displacement rate used for the construction phase is a 50% reduction from the operational phase displacement rate, the rate used for gannet during the construction phase is 35% (range 30% to 40%) as agreed with the EWG.

5.9.1.23 Based on expert judgement a mortality rate of 1% (range 1% to 10%) was selected for this assessment. This decision is supported by additional evidence that suggests that gannet have a large mean-maximum (315 km) and maximum (709 km) foraging range (Woodward *et al.*, 2019) and feed on a diverse range of prey items and thus displaced birds will have access to suitable alternative foraging opportunities despite the potential reduced foraging activities within the Morgan Generation Assets.

Kittiwake

5.9.1.24 Kittiwake are considered to have a moderate habitat flexibility and low vulnerability to displacement (Wade *et al.,* 2016). However, following an agreement through the Evidence Plan Process and at the recommendation of JNCC, the species has been considered within the displacement assessment.

5.9.1.25 Studies regarding the displacement at Egmond aan Zee OWF (Leopold *et al.,* 2011), Bligh Bank OWF and Thorntonbank OWF (Vanermen, 2013). Horns Rev OWF, Princess Amalia Windpark (Furness, 2013) reported no significant displacement of kittiwake.

5.9.1.26 A study by Peschko (2020) used a long-term dataset covering 14 years before and 3 years after the construction of OWFs in the southern North Sea to assess the displacement of kittiwake. They found a 45% decrease in density during the breeding season.

5.9.1.27 The EWG recommended the use of a 30-70% displacement rate range and a 1-10% displacement rate range. NatureScot advise a 30% displacement rate and 1% to 3% mortality rate for kittiwake in both the breeding and non-breeding season (Nature Scot, 2023) and when following joint SNCB guidance (JNCC *et al.,* 2022) a 10-30% displacement rate range would be used. In light of this guidance and additional evidence stated, for the purpose of this assessment, precautionary rates of 50% (range 30% to 70%) for displacement and 1% (range 1% to 10%) for mortality have been used for the operations and maintenance phase of the Morgan Generation Assets. Given that the displacement rate used for the construction phase is a 50% reduction from the operational phase displacement rate, the rate used for kittiwake during the construction phase is 25% (range 15% to 35%) as agreed with the SNCBs in the second EWG (held on 13/07/2022).

Summary

5.9.1.28 A summary of the displacement and mortality rates used in the assessments for each species are provided in Table 5.27.

Table 5.27: Displacement and mortality rates used for assessment.

Species	Displacement rate (%) (evidence-based rate in brackets)		Mortality rate (%) (evidence-based rate in brackets)
	Construction / decommissioning	Operations and maintenance	
Kittiwake	15 to 35 (25)	30 to 70 (50)	1 to 10 (1)
Guillemot	15 to 35 (25)	30 to 70 (50)	1 to10 (1)
Razorbill	15 to 35 (25)	30 to 70 (50)	1 to 10 (1)
Fulmar	0.5 to 5	1 to 10	1 to 10 (1)
Manx shearwater	15 to 35 (25)	30 to 70 (50)	1 to 10 (1)
Gannet	30 to 40 (35)	60 to 80 (70)	1 to 10 (1)

Construction phase

Magnitude of impact

Kittiwake

5.9.1.29 The estimated mortality (when considering a displacement rate range of 15% to 35% and a mortality rate range of 1% to 10%) resulting from displacement during construction was assessed for each season and on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (Table 5.28).

5.9.1.30 In all seasons and on an annual basis, even when using the upper displacement and mortality rates in the ranges recommended by JNCC *et al.* (2022) the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

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

Table 5.28: Kittiwake seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during construction.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of kittiwake subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	791	691,526	108,044	1 to 28	<0.01 to 0.03
Breeding	505	130,017	20,314	1 to 18	<0.01 to 0.09
Post-breeding	1,151	911,586	142,426	2 to 40	<0.01 to 0.03
Annual	-	911,586	142,426	4 to 86	<0.01 to 0.06

Guillemot

5.9.1.32 The estimated mortality (when considering a displacement rate range of 15% to 35% and a mortality rate range of 1% to 10%) resulting from displacement during construction was assessed for each season and on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (Table 5.29).

5.9.1.33 In the non-breeding season and on an annual basis the predicted increase in the baseline mortality rate does not surpass the 1% threshold. In the breeding season, the 1% threshold is surpassed.

Table 5.29: Guillemot seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during construction.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of guillemot subject to mortality (no. of indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Breeding	4,010	76,129	10,107	6 to 140	0.06 to 1.39
Non-breeding	3,824	1,139,220	151,249	6 to 134	<0.01 to 0.09
Annual	-	1,139,220	151,249	12 to 274	0.01 to 0.18

5.9.1.34 Table 5.30 shows where the predicted displacement mortality surpasses the 1% threshold of baseline mortality (101 birds). The 1% threshold is only surpassed when applying a mortality rate of 10% and displacement rates of either 30% or 35%.

Table 5.30: Displacement mortality for guillemot in the breeding season. Highlighted cells indicate an impact greater than 1% of the baseline mortality of the regional breeding population.

Guillemot (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	4	8	20	40	80	120	160	201	241	281	321	361	401
	15	6	12	30	60	120	180	241	301	361	421	481	541	602
	20	8	16	40	80	160	241	321	401	481	561	642	722	802
	25	10	20	50	100	201	301	401	501	602	702	802	902	1003
	30	12	24	60	120	241	361	481	602	722	842	962	1083	1203
	35	14	28	70	140	281	421	561	702	842	982	1123	1263	1404
	40	16	32	80	160	321	481	642	802	962	1123	1283	1444	1604
	50	20	40	100	201	401	602	802	1003	1203	1404	1604	1805	2005
	60	24	48	120	241	481	722	962	1203	1444	1684	1925	2165	2406
	70	28	56	140	281	561	842	1123	1404	1684	1965	2246	2526	2807
	80	32	64	160	321	642	962	1283	1604	1925	2246	2566	2887	3208
	90	36	72	180	361	722	1083	1444	1805	2165	2526	2887	3248	3609
	100	40	80	201	401	802	1203	1604	2005	2406	2807	3208	3609	4010

5.9.1.35 Guillemot is considered to have a lower vulnerability to disturbance from vessels and helicopters than for displacement from structures (Wade *et al.,* 2016) and therefore displacement rates towards the lower end of the range in Table 5.30 are considered appropriate for assessments. A mortality rate of 10% is not considered likely to occur, with the Morgan Generation Assets not considered to represent an important area for guillemot in the breeding season in a regional context (see Volume 4, Annex 5.1: Offshore ornithology baseline characterisation Report of the Environmental Statement). Mortality rates towards the lower end of the range presented in Table 5.30 are therefore considered more representative of the impact magnitude applicable to guillemot.

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

Razorbill

5.9.1.37 The estimated mortality (when considering a displacement rate range of 15% to 35% and a mortality rate range of 1% to 10%) resulting from displacement during construction was assessed for each season and on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (Table 5.31).

5.9.1.38 In all seasons and on an annual basis, even when using the upper displacement and mortality rates in the ranges recommended by JNCC *et al.* (2022) the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

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

Table 5.31: Razorbill seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during construction.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of razorbill subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	328	606,914	104,577	0 to 11	<0.01 to 0.01
Breeding	35	7,891	1,360	0 to 1	<0.01 to 0.09
Post-breeding	254	606,914	104,577	0 to 9	<0.01 to 0.01
Non-breeding	1,170	341,422	58,830	2 to 41	<0.01 to 0.07
Annual	-	606,914	104,577	3 to 63	<0.01 to 0.06

Fulmar

5.9.1.40 The estimated mortality (when considering a displacement rate range of 0.5% to 5% and a mortality rate range of 1% to 10%) resulting from displacement during construction was assessed for each season and on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (Table 5.32).

5.9.1.41 In all seasons and on an annual basis, even when using the upper displacement and mortality rates in the ranges recommended by JNCC *et al.* (2022) the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

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

Table 5.32: Fulmar seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during construction.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of fulmar subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	102	828,194	183,452	0 to 1	<0.01 to <0.01
Breeding	19	231,423	51,262	0 to 0	<0.01 to <0.01
Post-breeding	0	828,194	183,452	0 to 0	<0.01 to <0.01
Non-breeding	23	556,367	123,240	0 to 0	<0.01 to <0.01
Annual	-	828,194	183,452	0 to 1	<0.01 to <0.01

Manx shearwater

5.9.1.43 The estimated mortality (when considering a displacement rate range of 15% to 35% and a mortality rate range of 1% to 10%) resulting from displacement during construction was assessed for each season and on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (Table 5.33).

5.9.1.44 In all seasons and on an annual basis, even when using the upper displacement and mortality rates in the ranges recommended by JNCC *et al.* (2022) the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

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

Table 5.33: Manx shearwater seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during construction.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of Manx shearwater subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	0	1,580,895	205,516	0	0.00
Breeding	1,254	2,230,698	289,991	2 to 44	<0.01 to 0.02
Post-breeding	911	1,580,895	205,516	1 to 32	<0.01 to 0.02
Annual	-	2,230,698	289,991	3 to 76	<0.01 to 0.03

Gannet

5.9.1.46 The estimated mortality (when considering a displacement rate range of 30% to 40% and a mortality rate range of 1% to 10%) resulting from displacement during construction was assessed for each season and on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (Table 5.34).

5.9.1.47 In all seasons and on an annual basis, even when using the upper displacement and mortality rates in the ranges recommended by JNCC *et al.* (2022) the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

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

Table 5.34: Gannet seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during construction.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of gannet subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	35	661,888	127,577	0 to 3	<0.01 to <0.01

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of gannet subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Breeding	154	651,586	125,591	0 to 6	<0.01 to <0.01
Post-breeding	65	545,954	105,231	0 to 1	<0.01 to <0.01
Annual	-	661,888	127,577	1 to 10	<0.01 to 0.01

Sensitivity of the receptor

Kittiwake

5.9.1.49 In terms of behavioural responses to vessel and helicopter at offshore wind farms, kittiwake are considered to have a low vulnerability to displacement (Wade *et al.*, 2016).

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

5.9.1.51 Kittiwake is a qualifying interest for several SPAs likely to be connected to the Morgan Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of international value.

5.9.1.52 Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Guillemot

5.9.1.53 According to Wade *et al.* (2016), guillemot are considered to be moderately vulnerable to disturbance (Wade *et al.,* 2016). Whilst there is evidence from studies that guillemot respond negatively to vessel traffic (Rojek *et al.,* 2007), behavioural response to underwater and airborne sounds resulting from construction activities are unknown. Although guillemot are likely to respond to visual stimuli during the construction phase, the impacts of disturbance/displacement are short-term and guillemot have the ability to return to the baseline abundance and distribution after construction.

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

5.9.1.55 The Morgan Generation Assets are not within the foraging range of guillemot from any SPAs at which the species is a qualifying feature. There are however, a number of smaller colonies (e.g. St Bee's Head and a number of colonies on the Isle of Man) within foraging range. Based on the regional importance of the population recorded during baseline surveys of the Morgan Generation Assets guillemot is considered to be of regional conservation value.

5.9.1.56 Guillemot is deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be **medium**.

Razorbill

5.9.1.57 As with guillemot, razorbill are deemed to be moderately vulnerable to disturbance from vessels and helicopters at offshore wind farms, (Wade *et al.,* 2016). Although razorbill are likely to respond to visual stimuli during the construction, the impacts of disturbance/displacement are short-term and razorbill have the ability to return to the baseline conditions after construction.

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

5.9.1.59 The Morgan Generation Assets are not within the foraging range of razorbill from any SPAs at which the species is a qualifying feature. There are, however, a number of smaller colonies (e.g. St Bee's Head and a number of colonies on the Isle of Man) within foraging range. Based on the regional importance of the population recorded during baseline surveys of the Morgan Generation Assets razorbill is considered to be of regional conservation value.

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

Fulmar

5.9.1.61 In terms of behavioural responses to vessel and helicopter at offshore wind farms, fulmar are considered to have a very low vulnerability to displacement (Wade *et al.*, 2016).

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

5.9.1.63 Fulmar has a low reproductive potential (i.e. only laying one egg and not breeding until nine years old; Robinson, 2005). There has been a moderate decline in the regional and national population of fulmar, with this likely due to a reduction in the amount of offal discarded from fishing vessels, reductions in natural prey and climate change (JNCC, 2020).

5.9.1.64 Fulmar is deemed to be of very low vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Manx shearwater

5.9.1.65 In terms of behavioural responses to vessel and helicopter at offshore wind farms, Manx shearwater are considered to have a very low vulnerability to displacement (Wade *et al.*, 2016).

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

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

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

Gannet

5.9.1.69 Gannet are considered to have a very low vulnerability to sources of disturbance such as ship and helicopter traffic (Wade *et al.,* 2016), and so gannet are considered to be of very low vulnerability.

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

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

5.9.1.72 Gannet is deemed to be of very low vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore, considered, on a precautionary basis, to be **medium**.

Significance of the effect

5.9.1.73 Given that construction activities will only take place within a small area of the Morgan Array Area at any time, displaced birds will be able to resettle within the Morgan Array Area or beyond. As alternative habitats exist, species shown in Table 5.28 are therefore not predicted to suffer a significant decline in bird fitness at a population level. Indeed, the displacement assessment analysis showed the magnitude of the increase in mortality to be negligible and it is considered that the impact for all species in all seasons will be below the 1% threshold increase in all seasons relevant to the species assessed in Table 5.35.

5.9.1.74 For guillemot, which had a magnitude of impact of negligible and sensitivity of medium, negligible was selected from the negligible to minor range. Due to the limited importance of the Morgan Generation Assets for this species in a regional context, the impact magnitude is considered to result in an impact of negligible significance, rather than minor.

5.9.1.75 For kittiwake, razorbill, fulmar, Manx shearwater and gannet, which all had a magnitude of impact of negligible and sensitivity of medium, negligible was selected from the negligible to minor range due the limited importance of the Morgan Generation Assets for these species in a regional context and all impacts not exceeding a 0.1% increase in baseline mortality.

Table 5.35: Summary of the impact of displacement on the significance of effect during the construction phase of the Morgan Generation Assets.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Kittiwake	Negligible	Medium	**Negligible, not significant in EIA terms**
Guillemot	Negligible	Medium	**Negligible, not significant in EIA terms**
Razorbill	Negligible	Medium	**Negligible, not significant in EIA terms**
Fulmar	Negligible	Medium	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**
Gannet	Negligible	Medium	**Negligible, not significant in EIA terms**

Operations and maintenance phase

Magnitude of impact

Kittiwake

5.9.1.76 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during operation was assessed for each season and on an annual basis (Table 5.36).

5.9.1.77 In all three seasons and on an annual basis, the predicted increase in baseline mortalities remains well below the 1% threshold.

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

Table 5.36: Kittiwake seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during operation.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of kittiwake subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	791	691,526	107,878	2 to 55	<0.01 to 0.05
Breeding	505	130,017	20,283	2 to 35	0.01 to 0.17
Post-breeding	1,151	911,586	142,207	3 to 81	<0.01 to 0.06
Annual	-	911,586	142,207	7 to 171	0.01 to 0.12

5.9.1.78 The EWG has requested that impacts on the kittiwake populations of the Pen y Gogarth / Great Ormes Head SSSI and Creigiau Rhiwledyn / Little Ormes Head SSSI be explicitly considered in the assessment. The total impact attributable to the kittiwake population at each of the SSSIs is calculated in Table 5.37 and Table 5.38 respectively using the apportioning values for the site calculated in Appendix A of Volume 4, Annex 5.5: Offshore Ornithology Apportioning Technical Report and the impact values in Volume 4, Annex 5.2: Offshore ornithology displacement technical report. Displacement impacts are calculated using a displacement rate of 50% and a mortality rate of 1% as discussed in paragraphs 5.9.1.24 to 5.9.1.27.

Table 5.37: Calculation of displacement impacts for kittiwake at the Pen y Gogarth / Great Ormes Head SSSI

Season	Displacement impact (no. of birds)	Apportioning value	Apportioned impact	SSSI population (no. of individuals) (year)	Baseline mortality	Increase in baseline mortality (%)
Pre-breeding	4	<0.01	0.01	1,330 (2017)	207.8	<0.01
Breeding	3	0.07	0.17			0.08
Post-breeding	6	<0.01	<0.01			<0.01
Annual	-	-	0.18			0.09

Table 5.38: Calculation of displacement impacts for kittiwake at the Creigiau Rhiwledyn / Little Ormes Head SSSI

Season	Displacement impact (no. of birds)	Apportioning value	Apportioned impact	SSSI population (no. of individuals) (year)	Baseline mortality	Increase in baseline mortality (%)
Pre-breeding	4	<0.01	0.01	654 (2017)	102.2	<0.01
Breeding	3	0.06	0.16			0.10
Post-breeding	6	<0.01	0.01			<0.01
Annual	-	-	0.18			0.10

5.9.1.79 The predicted annual and seasonal impacts associated with the Morgan Generation Assets on the kittiwake populations of the two SSSIs represents less than a 1% increase in the baseline mortality of both populations.

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

Guillemot

5.9.1.81 The estimated mortality (when considering a displacement rate range of 30% to 70% and a mortality rate range of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each season and on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (Table 5.39).

Table 5.39: Guillemot seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during operations.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of guillemot subject to mortality (no. of indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Breeding	4,010	76,129	10,125	12 to 281	0.12 to 2.77
Non-breeding	3,824	1,139,220	151,516	11 to 268	0.01 to 0.18
Annual	-	1,139,220	158,352	24 to 548	0.02 to 0.36

5.9.1.82 Table 5.40 shows where the predicted displacement mortality surpasses the 1% threshold of baseline mortality (101 birds). The 1% threshold is surpassed when applying a mortality rate of 10% and displacement rates of either 30% to 70% or when applying a mortality rate of 5% and displacement rates of 50% to 70%.

Table 5.40: Displacement mortality for guillemot in the breeding season. Highlighted cells indicate an impact greater than 1% of the baseline mortality of the regional breeding population.

Guillemot (breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	8	20	40	80	120	160	201	241	281	321	361	401
15	6	12	30	60	120	180	241	301	361	421	481	541	602
20	8	16	40	80	160	241	321	401	481	561	642	722	802
30	12	24	60	120	241	361	481	602	722	842	962	1083	1203
35	14	28	70	140	281	421	561	702	842	982	1123	1263	1404
40	16	32	80	160	321	481	642	802	962	1123	1283	1444	1604
50	20	40	100	201	401	602	802	1003	1203	1404	1604	1805	2005
60	24	48	120	241	481	722	962	1203	1444	1684	1925	2165	2406
70	28	56	140	281	561	842	1123	1404	1684	1965	2246	2526	2807
80	32	64	160	321	642	962	1283	1604	1925	2246	2566	2887	3208
90	36	72	180	361	722	1083	1444	1805	2165	2526	2887	3248	3609
100	40	80	201	401	802	1203	1604	2005	2406	2807	3208	3609	4010

5.9.1.83 The JNCC (2022) guidance provides an approach to defining displacement and mortality rate ranges for use in displacement assessments which has been followed in the displacement matrix above but also indicates that projects should seek and present emerging sources of empirical evidence to provide support for displacement assessments. As discussed in paragraphs 5.9.1.10 to 5.9.1.19, a displacement rate of 50% and mortality rate of 1% are deemed precautionary for guillemot based on available evidence. Based on the information presented it is considered that the displacement mortality for guillemot will not surpass the 1% threshold of baseline mortality. The impact is predicted to be of local spatial extent, medium-term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

5.9.1.84 The EWG has requested that impacts on the guillemot populations of the Pen y Gogarth / Great Ormes Head SSSI and Creigiau Rhiwledyn / Little Ormes Head SSSI be explicitly considered in the assessment. The total impact attributable to the guillemot population at each of the SSSIs is calculated in Table 5.41 and Table 5.42 respectively using the apportioning values for the site calculated in Appendix A of Volume 4, Annex 5.5: Offshore Ornithology Apportioning Technical Report and the impact values in Volume 4, Annex 5.2: Offshore ornithology displacement technical report. Displacement impacts are calculated using a displacement rate of 50% and a mortality rate of 1% as discussed in paragraphs 5.9.1.13 to 5.9.1.19.

Table 5.41: Calculation of displacement impacts for guillemot at the Pen y Gogarth / Great Ormes Head SSSI

Season	Displacement impact (no. of birds)	Apportioning value	Apportioned impact	SSSI population (no. of individuals) (year)	Baseline mortality	Increase in baseline mortality (%)
Breeding	20	0.02	0.49			0.10
Non-breeding	19	<0.01	0.01	3,508 (2017)	465.8	<0.01
Annual	-	-	0.50			0.11

Table 5.42: Calculation of displacement impacts for guillemot at the Creigiau Rhiwledyn / Little Ormes Head SSSI.

Season	Displacement impact (no. of birds)	Apportioning value	Apportioned impact	SSSI population (no. of individuals) (year)	Baseline mortality	Increase in baseline mortality (%)
Breeding	20	0.02	0.35			0.24
Non-breeding	19	<0.01	0.01	1,019 (2017)	143.2	0.01
Annual	-	-	0.36			0.25

5.9.1.85 The predicted annual and seasonal impacts associated with the Morgan Generation Assets on the guillemot populations of the two SSSIs represents less than a 1% increase in the baseline mortality of both populations.

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

Razorbill

5.9.1.87 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during operation was assessed for each season and on an annual basis (Table 5.43).

5.9.1.88 In all seasons and on an annual basis, the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

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

Table 5.43: Razorbill seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during operation.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of razorbill subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	328	606,914	104,389	1 to 23	<0.01 to 0.02
Breeding	35	7,891	1,357	0 to 2	0.01 to 0.18
Post-breeding	254	606,914	104,389	1 to 18	<0.01 to 0.02
Non-breeding	1,170	341,422	58,725	4 to 82	0.01 to 0.14
Annual	-	606,914	104,389	5 to 125	0.01 to 0.12

5.9.1.89 The EWG has requested that impacts on the razorbill populations of the Pen y Gogarth / Great Ormes Head SSSI and Creigiau Rhiwledyn / Little Ormes Head SSSI be explicitly considered in the assessment. The total impact attributable to the razorbill population at each of the SSSIs is calculated in Table 5.44 and Table 5.45 respectively using the apportioning values for the site calculated in Appendix A of Volume 4, Annex 5.5: Offshore Ornithology Apportioning Technical Report and the impact values in Volume 4, Annex 5.2: Offshore ornithology displacement technical report. Displacement impacts are calculated using a displacement rate of 50% and a mortality rate of 1% as discussed in paragraphs 5.9.1.13 to 5.9.1.19.

Table 5.44: Calculation of displacement impacts for guillemot at the Pen y Gogarth / Great Ormes Head SSSI.

Season	Displacement impact (no. of birds)	Apportioning value	Apportioned impact	SSSI population (no. of individuals) (year)	Baseline mortality	Increase in baseline mortality (%)
Breeding	<1	0.04	0.01	191.6	33.0	0.02
Post-breeding	1	<0.01	<0.01			<0.01
Non-breeding	6	<0.01	<0.01			0.01
Pre-breeding	2	<0.01	<0.01			<0.01
Annual	-	-	0.01			0.03

Table 5.45: Calculation of displacement impacts for guillemot at the Creigiau Rhiwledyn / Little Ormes Head SSSI

Season	Displacement impact (no. of birds)	Apportioning value	Apportioned impact	SSSI population (no. of individuals) (year)	Baseline mortality	Increase in baseline mortality (%)
Breeding	<1	0.01	<0.01			0.03
Post-breeding	1	<0.01	<0.01			<0.01
Non-breeding	6	<0.01	<0.01	33.5	5.8	0.01
Pre-breeding	2	<0.01	<0.01			<0.01
Annual	-	-	<0.01			0.04

5.9.1.90 The predicted annual and seasonal impacts associated with the Morgan Generation Assets on the razorbill populations of the two SSSIs represents less than a 1% increase in the baseline mortality of both populations.

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

Fulmar

5.9.1.92 The estimated mortality (when considering a displacement rate range of 1% to 10% and a mortality rate range of 1% to 10%) resulting from displacement during the operations and maintenance phase was assessed for each season and on an annual basis by combining seasonal impacts and comparing them against the largest regional seasonal population (Table 5.32).

5.9.1.93 In all seasons and on an annual basis, even when using the upper displacement and mortality rates in the ranges recommended by JNCC *et al.* (2022) the predicted increase in the baseline mortality rate does not surpass the 1% threshold.

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

Table 5.46: Fulmar seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during construction.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of Manx shearwater subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	102	828,194	183,452	0 to 1	<0.01 to <0.01
Breeding	19	231,423	51,262	0 to 0	<0.01 to <0.01
Post-breeding	0	828,194	183,452	0 to 0	<0.01 to <0.01
Non-breeding	23	556,367	123,240	0 to 0	<0.01 to <0.01

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population Population	Baseline mortality	Number of Manx shearwater subject to mortality (indiv.)	Increase in baseline mortality (%)
Annual	-	828,194	183,452	0 to 1	<0.01 to <0.01

Manx shearwater

5.9.1.95 The estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) resulting from displacement during operation was assessed for each season and for the combined seasons (Table 5.47) as detailed in Volume 4, Annex 10.2: Offshore ornithology displacement assessment.

5.9.1.96 In all three seasons and on an annual basis, the predicted increase in baseline mortalities does not surpass the 1% threshold.

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

Table 5.47: Manx shearwater seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during operation.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of Manx shearwater subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	0	1,580,895	205,516	0	0.00
Breeding	1,254	2,230,698	289,991	4 to 88	<0.01 to 0.03
Post-breeding	911	1,580,895	205,516	3 to 64	<0.01 to 0.03
Annual	-	2,230,698	289,991	6 to 152	<0.01 to 0.05

Gannet

5.9.1.98 The estimated mortality (when considering a displacement rate of 60% to 80% and a mortality rate of 1% to 10%) resulting from displacement during operation was assessed for each season and on an annual basis (Table 5.48).

5.9.1.99 In all three seasons and on an annual basis, the predicted increase in baseline mortalities remains well the below the 1% threshold.

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

Table 5.48: Gannet seasonal and annual displacement estimates for the Morgan Array Area plus 2 km buffer during operation.

Season	Seasonal Abundance (Morgan Array Area + 2 km buffer)	Regional baseline population		Number of Gannet subject to mortality (indiv.)	Increase in baseline mortality (%)
		Population	Baseline mortality		
Pre-breeding	35	661,888	127,744	0 to 3	<0.01 to <0.01
Breeding	154	651,586	125,756	1 to 12	<0.01 to 0.01
Post-breeding	65	545,954	105,369	0 to 5	<0.01 to <0.01
Annual	-	661,888	123,773	2 to 20	<0.01 to 0.02

Sensitivity of receptor

Kittiwake

5.9.1.101 In terms of behavioural response to wind farm structures, kittiwake are considered have a low vulnerability (Wade *et al.,* 2016).

5.9.1.102 Kittiwake is a qualifying interest for several SPAs likely to be connected to the Morgan Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of international value.

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

5.9.1.104 Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Guillemot

5.9.1.105 Guillemot is considered to have a high vulnerability to displacement from offshore wind farms (Wade *et al.,* 2016).

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

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

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

Razorbill

5.9.1.109 Razorbill is considered to have a high vulnerability to displacement from offshore wind farms (Wade *et al.*, 2016).

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

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

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

Fulmar

5.9.1.113 In terms of behavioural responses to displacement associated with structures at offshore wind farms, fulmar are considered to have a very low vulnerability (Wade *et al.*, 2016).

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

5.9.1.115 Fulmar has a low reproductive potential (i.e. only laying one egg and not breeding until nine years old; Robinson, 2005). There has been a moderate decline in the regional and national population of fulmar, with this likely due to a reduction in the amount of offal discarded from fishing vessels, reductions in natural prey and climate change (JNCC, 2020). The sensitivity of the receptor is therefore, considered to be medium.

5.9.1.116 Fulmar is deemed to be of very low vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be **medium**.

Manx shearwater

5.9.1.117 In terms of behavioural responses to displacement associated with structures at offshore wind farms, Manx shearwater are considered to be of very low vulnerability to displacement (score of one) by Wade *et al.* (2016).

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

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

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

Gannet

5.9.1.121 In terms of behavioural response to wind farm structures, Gannet are considered to have a high vulnerability (Wade *et al.*, 2016). During the breeding season, gannet showed a strong avoidance of offshore wind farms (Peschko *et al.*, 2021).

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

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

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

Significance of effect

5.9.1.125 The period of time and constancy that individuals within a population may be subject to displacement impacts is uncertain. It is likely that the impacts will be felt at greatest intensity during the first year of exposure, before there is any opportunity for habituation. Mortality is likely to be greatest in this year while in subsequent years it is possible that birds may become habituated to a certain extent, thereby reducing mortality rates.

5.9.1.126 The displacement assessment analysis showed the magnitude of the increase in mortality to be negligible and it is considered that the impact for all species in all seasons will be below the 1% threshold increase in all seasons relevant to the species assessed in Table 5.49.

5.9.1.127 For guillemot, which had a magnitude of impact of negligible and sensitivity of medium, negligible was selected from the negligible to minor range. Due to the limited importance of the Morgan Generation Assets for this species in a regional context, the impact magnitude is considered to result in an impact of negligible significance, rather than minor.

5.9.1.128 For kittiwake, razorbill, fulmar, Manx shearwater and gannet, which all had a magnitude of impact of negligible and sensitivity of medium, negligible was selected from the negligible to minor range due the limited importance of the Morgan Generation Assets for this species in a regional context. Further, all impacts do not exceed a 0.2% increase in baseline mortality.

Table 5.49: Summary of the impact of displacement on the significance of effect during the operations and maintenance phase of the Morgan Generation Assets.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Guillemot	Negligible	Medium	**Negligible, not significant in EIA terms**
Razorbill	Negligible	Medium	**Negligible, not significant in EIA terms**
Gannet	Negligible	Medium	**Negligible, not significant in EIA terms**
Kittiwake	Negligible	Medium	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**

Decommissioning phase

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

All receptors

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

5.9.2 Indirect impacts from underwater sound affecting prey species

5.9.2.1 Potential effects on the fish assemblages during the construction and decommissioning phases of the Morgan Generation Assets, as identified in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement, may have indirect effects on offshore ornithology receptors.

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

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

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

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

Table 5.50: Species considered for assessment of underwater sound affecting prey species based on habitat specialisation score (Wade *et al.*, 2016).

Ornithological receptor	Habitat flexibility (Wade *et al.*, 2016; Bradbury *et al.*, 2014)	Population importance in the Morgan Generation Assets offshore ornithology study area	Assessed for significance
Kittiwake	Moderate	Regional	No – no impact pathway
Little gull	Moderate	Regional	No – no impact pathway
Great black-backed gull	Moderate	Regional	No – no impact pathway
Herring gull	High	Regional	No – no impact pathway
Lesser black-backed gull	High	Local	No – no impact pathway
Sandwich tern	Moderate	Negligible	No – species absent in site-specific surveys
Little tern	Low	Negligible	No – species absent in site-specific surveys
Roseate tern	Moderate	Negligible	No – species absent in site-specific surveys
Common tern	Moderate	Local	No – species only present in limited numbers
Arctic tern	Moderate	Local	No – species only present in limited numbers
Great skua	Moderate	Local	No – species only present in limited numbers
Arctic skua	Moderate	Local	No – species only present in limited numbers
Guillemot	Moderate	Regional	Yes
Razorbill	Moderate	Regional	Yes
Puffin	Moderate	Local	Yes
European storm petrel	High	Negligible	No – species absent in site-specific surveys, species not vulnerable to impact
Leach's petrel	High	Negligible	No – species absent in site-specific surveys, species not vulnerable to impact
Fulmar	High	Local	No – species not vulnerable to impact
Manx shearwater	High	Local	No – species not vulnerable to impact
Gannet	High	Local	No – species not vulnerable to impact

Construction phase

Magnitude of impact

Auk species (guillemot, razorbill and puffin)

5.9.2.6 Auks directly responding to visual cues are likely to be displaced during construction; the magnitude of the impact on the baseline mortality has been assessed using a displacement assessment matrix in section 5.9.1. However, in addition to direct visual disturbance, birds may be indirectly displaced due to a reduction in prey availability. Because of the short-term duration of the construction work and localised nature, it is however expected that birds will be able to re-settle in the Morgan Array Area or beyond.

5.9.2.7 Auks may preferentially forage for sandeels, but they also obtain wide-ranging mobile prey species. Whilst there may be intermittent displacement of prey from a region around the wind farm, there is no indication that the overall availability of prey for auk species will be reduced. It is expected that for those periods when auk peak abundance and construction activities coincide that auk species will redistribute themselves in relation to the availability of prey abundance.

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

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

Sensitivity of the receptor

Auk species (guillemot, razorbill and puffin)

5.9.2.10 All three species (guillemot, razorbill and puffin) have a moderate habitat flexibility meaning they are able to exploit a range of habitats with only a slight dependence on particular marine features (Wade *et al.,* 2016). All three species are therefore considered to have a medium vulnerability.

5.9.2.11 Auk species have a medium to high recoverability given their increasing trend in abundance, particularly guillemot and razorbill (JNCC, 2020).

5.9.2.12 Puffin is the only auk species for which there is connectivity between the Morgan Generation Assets and an SPA colony and the species is therefore considered to be of International conservation value. However, very few puffin were recorded during site-specific baseline characterisation surveys (see Volume Volume 4, Annex 5.1 Baseline Characterisation Report of the Environmental Statement). Guillemot and razorbill are considered to be of regional conservation value due to the importance of each species population in the Morgan Generation Assets offshore ornithology study area.

5.9.2.13 Auk species are deemed to be of medium vulnerability, medium to high recoverability and International or Regional value. The sensitivity of guillemot and razorbill considered to be **low**. The sensitivity of puffin is also considered to be **low** due to the limited number of birds observed within the Morgan Generation Assets offshore ornithology study area during site-specific baseline characterisation surveys.

Significance of the effect

Auk species (guillemot, razorbill and puffin)

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

Decommissioning phase

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

Significance of the effect

Auk species (guillemot, razorbill and puffin)

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

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

5.9.3.1 There is potential for temporary, direct benthic habitat loss and disturbance to sediments as a result of activities during all phases (e.g. seabed preparation, Unexploded Ordnance (UXO) detonation, drilling, inter-array cable installation and repair/reburial and removal of infrastructure). This has potential to affect the foraging efficiency of diving birds as well as indirect effects from impacts on fish, shellfish and bivalve prey.

5.9.3.2 Seabirds may be indirectly disturbed and displaced during the construction, operations and maintenance, and decommissioning phases as a result of direct impacts on habitat and increased SSCs (for example from turbine installation), which may result in the loss of a food resource to birds within the Morgan Array Area. The increase in suspended sediments may also reduce the ability of birds to capture prey in the water column. The species assessed in relation to temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs) are the same as those considered in relation to indirect impacts from underwater sound affecting prey species (Table 5.50).

5.9.3.3 Detailed assessments of the following potential impacts have been undertaken in Volume 2, Chapter 3: Fish and shellfish ecology and Volume 2, Chapter 2: Benthic subtidal ecology of the Environmental Statement for key seabird prey species (including cod, sprat, herring, mackerel and sandeel species and bivalves) and include:

- Temporary habitat loss and disturbance from installation and maintenance operations
- Disturbance/remobilisation of sediment-bound contaminants during installation and maintenance activities.

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

5.9.3.5 The potential construction phase impacts on fish, shellfish and bivalve prey are provided in Volume 2, Chapter 2: Benthic subtidal ecology chapter of the Environmental Statement and Volume 2, Chapter 3: Fish and shellfish ecology chapter of the Environmental Statement and include temporary subtidal habitat loss/disturbance and increased SSCs and associated sediment deposition.

5.9.3.6 The species considered in relation to this impact are the same as those considered in relation to indirect impacts from underwater sound affecting prey species (Table 5.50).

Construction phase

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

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

5.9.3.9 The potential construction phase impacts on fish and shellfish receptors are provided in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement and include temporary subtidal habitat loss/disturbance and increased suspended sediment concentrations and associated sediment deposition.

Magnitude of impact

All receptors

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

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

5.9.3.12 Temporary habitat loss could potentially affect spawning, nursery or feeding grounds of fish and shellfish receptors, with demersal fish and shellfish, and demersal spawning species the most vulnerable. The spatial extent of the MDS assessed in Volume 2, Chapter 8: Fish and shellfish ecology of the Environmental Statement represented a very small proportion of the Morgan Generation Assets.

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

Sensitivity of the receptor

All receptors

5.9.3.14 All three species have a moderate habitat flexibility meaning they are able to exploit a range of habitats with only a slight dependence on particular marine features (Wade *et al.,* 2016). All three species are therefore considered to have a medium vulnerability.

5.9.3.15 Auk species have a medium to high recoverability given their increasing trend in abundance, particularly guillemot and razorbill (JNCC, 2020).

5.9.3.16 Puffin is the only auk species for which there is connectivity between the Morgan Generation Assets and an SPA colony and the species is therefore considered to be of International conservation value. However, very few puffin were recorded during site-specific baseline characterisation surveys. Guillemot and razorbill are considered to be of regional conservation value due to the importance of each species population in the Morgan Generation Assets offshore ornithology study area.

5.9.3.17 Auk species are deemed to be of medium vulnerability, medium to high recoverability and International or Regional value. The sensitivity of guillemot and razorbill considered to be **low**. The sensitivity of puffin is also considered to be **low** due to the limited number of birds observed within the Morgan Generation Assets offshore ornithology study area during site-specific baseline characterisation surveys.

Significance of the effect

All receptors

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

Operations and maintenance

Magnitude of impact

All receptors

5.9.3.19 Maintenance activities within Morgan Array Area may lead to increases in SSCs and associated sediment deposition over the operational lifetime of the Morgan Generation Assets. The magnitude of the impacts would be a small fraction of those quantified for the construction phaseand it is expected that any displaced birds will easily re-distribute to other areas.

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

Sensitivity of the receptor

All receptors

5.9.3.21 Auk species have a medium to high recoverability given their increasing trend in abundance, particularly guillemot and razorbill (JNCC, 2020).

5.9.3.22 Puffin is the only auk species for which there is connectivity between the Morgan Generation Assets and an SPA colony and the species is therefore considered to be of International conservation value. However, very few puffin were recorded during site-specific baseline characterisation surveys. Guillemot and razorbill are considered to be of regional conservation value due to the importance of each species population in the Morgan Generation Assets offshore ornithology study area.

5.9.3.23 Auk species are deemed to be of medium vulnerability, medium to high recoverability and international or regional value. The sensitivity of guillemot and razorbill considered to be **low**. The sensitivity of puffin is also considered to be **low** due to the limited number of birds observed within the Morgan Generation Assets offshore ornithology study area during site-specific baseline characterisation surveys.

Significance of the effect

All receptors

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

Decommissioning phase

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

Significance of the effect

All receptors

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

5.9.4 Collision risk

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

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

5.9.4.3 Species differ in their susceptibility to collision risk, depending on their flight behaviour and avoidance responses, and the vulnerability of their populations (Bradbury *et al.* 2014; Wade *et al.*, 2016). As sensitivity to collision differs considerably between species, species were screened and progressed for assessment of significance on the basis of the importance of the population of each species recorded within the Morgan

Generation Assets offshore ornithology study area and consideration of their perceived risk from collision (Bradbury *et al.,* 2014; Wade *et al.*, 2016) (Table 5.22).

5.9.4.4 Six regularly occurring seabird species were identified as potentially at risk of collision due to their recorded abundance in the Morgan Generation Assets offshore ornithology study area and their vulnerability to collision (Bradbury *et al.,* 2014; Wade *et al.,* 2016). The confidence associated with the vulnerability scores in Wade *et al.* (2016) were also considered which resulted in the inclusion of Manx shearwater. Species included were therefore kittiwake, great black-backed gull, herring gull, lesser black-backed gull, Manx shearwater and gannet. Modelling for these species is provided in Volume 4, Annex 5.3: Offshore Ornithology Collision Risk Modelling Technical Report of the Environmental Statement. Additionally, consideration was given to species that may not have been accurately captured during traditional baseline digital aerial surveys. This included migratory seabirds and waterbirds with modelling for these species groups provided in Volume 4, Annex 5.4: Offshore Ornithology Migratory Bird Collision Risk Modelling Technical Report of the Environmental Statement. The magnitude of change was determined by calculating the estimated number of collisions with the wind turbines and the resulting percentage increase in the background mortality rate of the relevant regional population.

5.9.4.5 There is the potential that aviation and navigation lighting on wind turbines might attract seabirds and thus increase the risk of collision. Conversely, aviation and navigation lighting could deter birds from moving through the Morgan Generation Assets. To our knowledge there is little published evidence showing the effects of lighting on seabird collision and displacement. Earlier work on seaducks by Desholm and Kahlert (2005) showed that migrating flocks were more prone to enter the wind farm. However, the higher risk of collision in the dark was counteracted by increasing distance from individual turbines and flying in the corridors between turbines. For true seabirds, there is published evidence showing that seabirds are less active at night compared to daytime (Kotzerka *et al.*, 2010; Furness *et al.*, 2018). Wade *et al.* (2016) ranked vulnerability of seabirds to collision by accounting for the nocturnal activity rate of seabirds. A recent review highlighted that certain species of birds (especially those that nest underground such as shearwaters and petrel species) are often attracted to powerful light sources (Deakin *et al.,* 2022) however, in the examples given, the light sources to which birds were attracted are significantly brighter than the lights associated with an offshore wind farm. Lights on offshore structures, including offshore wind turbines must comply with minimum requirements as set out in the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-117 on 'The Marking of Offshore Wind Farms' for navigation lighting and by the Civil Aviation Authority in the Air Navigation Orders (CAP 393 and guidance in CAP 764). Such lighting is not comparable to the examples given in Deakin *et al.* (2022) and it is therefore considered unlikely that attraction will occur.

5.9.4.6 Collision risk modelling was undertaken using the Stochastic Collision Risk Model (sCRM) developed by Marine Scotland (McGregor *et al.*, 2018). The User Guide for the sCRM Shiny App provided by Marine Scotland (Donovan, 2017) has been followed for the modelling of collision impacts predicted for the Morgan Array Area. The full methodology is provided in Volume 4, Annex 5.3: Offshore Ornithology Collision Risk Modelling Technical Report of the Environmental Statement.

5.9.4.7 Collision risk modelling has incorporated draft guidance on recommended avoidance rates, bird size, flight speed, flight type and nocturnal activity scores from Natural England (Natural England, pers. comm., 7 July 2022). Throughout the document, outputs have been presented alongside other parameter values (e.g. Oszanlav-Harris *et al.*, 2023; Skov *et al.,* 2018) to capture the uncertainty in various parameter values.

In some instances, values for certain species (e.g. Manx shearwater) had not been provided within the Natural England guidance document. Parameters for these species therefore followed best available evidence (e.g. Gibb *et al.,* 2017; Wade *et al.,* 2016; Oszanlav-Harris *et al.,* 2023).

5.9.4.8 It is acknowledged that migratory passage movements are not adequately captured by traditional survey methods. Therefore, a combination of two approaches/tools were followed to quantify the number of birds that may cross the Morgan Array Area during migration periods (Volume 4, Annex 5.4: Offshore Ornithology Migratory Bird Collision Risk Modelling Technical Report of the Environmental Statement):

- The SOSS Migration Assessment Tool (SOSSMAT) was used to assess the population size of migratory waterbird species (e.g. duck, geese, swans, waders, etc.) designated as features of the UK SPA network that may cross the Morgan Array Area; instructions are given in Wright *et al.* (2012)
- An approach used in a strategic assessment of collision risk of Scottish offshore wind (WWT Consulting and MacArthur Green, 2014) to estimate proportions of the migratory seabird population likely to pass through the Morgan Array Area.

5.9.4.9 The resulting number of migratory seabirds and waterbirds estimated to cross the Morgan Array Area was inputted into the Band (2012) single transit CRM.

5.9.4.10 The methodology and detailed results of the collision risk modelling for 53 migratory waterbirds species/sub-species and three migratory seabirds are provided in Volume 4, Annex 5.4: Offshore ornithology migratory bird collision risk modelling technical report of the Environmental Statement.

Operations and maintenance phase

Magnitude of impact

Kittiwake

5.9.4.11 In all three seasons (pre-breeding, breeding and post breeding) and on an annual basis the estimated increase in baseline mortality remains well below the 1% increase threshold. As breeding kittiwake forage mainly in daytime (Wade *et al.,* 2016), aviation and navigation lighting at the Morgan Generation Assets is unlikely to result in additional collision risk.

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

Table 5.51: Assessment of predicted collision risk estimates for kittiwake on seasonal and annual bases against the baseline mortality of relevant regional populations.

Season	Regional baseline population	Baseline mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Pre-breeding	691,526	108,044	3 to 14	<0.01 to 0.01
Breeding	130,017	20,314	2 to 8	0.01 to 0.04
Post-breeding	911,586	142,426	4 to 18	<0.01 to 0.01
Annual	911,586	142,426	9 to 40	0.01 to 0.03

5.9.4.13 The EWG has requested that impacts on the kittiwake populations of the Pen y Gogarth / Great Ormes Head SSSI and Creigiau Rhiwledyn / Little Ormes Head SSSI be explicitly considered in the assessment. The total impact attributable to the kittiwake population at each of the SSSIs is calculated in Table 5.37 and Table 5.38 respectively using the apportioning values for the site calculated in Appendix A of Volume 4, Annex 5.5: Offshore Ornithology Apportioning Technical Report and the impact values in Volume 4, Annex 5.2: Offshore ornithology displacement technical report.

Table 5.52: Calculation of displacement impacts for kittiwake at the Pen y Gogarth / Great Ormes Head SSSI

Season	No. of collisions	Apportioning value	Apportioned impact	SSSI population (no. of individuals) (year)	Baseline mortality	Increase in baseline mortality (%)
Pre-breeding	3 to 14	<0.01	<0.01 to 0.02	1,330 (2017)	207.8	<0.01 to 0.01
Breeding	2 to 8	0.07	0.13 to 0.55			0.06 to 0.27
Post-breeding	4 to 18	<0.01	<0.01 to 0.02			<0.01 to 0.01
Annual	9 to 40	-	0.14 to 0.59			0.07 to 0.28

Table 5.53: Calculation of displacement impacts for kittiwake at the Creigiau Rhiwledyn / Little Ormes Head SSSI

Season	No. of collisions	Apportioning value	Apportioned impact	SSSI population (no. of individuals) (year)	Baseline mortality	Increase in baseline mortality (%)
Pre-breeding	3 to 14	<0.01	<0.01 to 0.02	654 (2017)	102.2	<0.01 to 0.02
Breeding	2 to 8	0.06	0.12 to 0.52			0.12 to 0.51
Post-breeding	4 to 18	<0.01	<0.01 to 0.02			<0.01 to 0.02
Annual	9 to 40	-	0.13 to 0.56			0.13 to 0.55

5.9.4.14 The predicted annual and seasonal impacts associated with the Morgan Generation Assets on the kittiwake populations of the two SSSIs represents less than a 1% increase in the baseline mortality of both populations.

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

Great black-backed gull

5.9.4.16 A predicted impact representing an increase of more than 1% of the baseline mortality of the breeding regional population is associated with some of the collision risk estimates calculated in the breeding season. The collision risk estimates that exceed this threshold were calculated utilising a flight speed value from Alerstam *et al.* (2007) and a grouped avoidance rate for large gull species from Ozsanlav-Harris *et al.* (2023). In addition, the collision risk estimate calculated when using the grouped avoidance rate for large gull species and a flight speed from Skov *et al.* (2018) also represented a 1% increase in baseline mortality of the regional breeding population (when rounded to two decimals places). Collision risk estimates calculated using species-specific avoidance rates from both Ozsanlav-Harris *et al.* (2023) and Bowgen and Cook (2018) alongside flight speed values from Skov *et al.* (2018) did not surpass the 1% threshold of baseline mortality.

5.9.4.17 As discussed in Volume 4, Annex 5.3: Offshore Ornithology Collision Risk Modelling Technical Report, the flight speed values provided by Alerstam *et al.* (2007) are not considered appropriate for use in collision risk modelling. Therefore, it is considered that collision risk estimates calculated using these values are not representative of the risk associated with the Morgan Generation Assets. Similarly, Ozsanlav-Harris *et al.* (2023) presents avoidance rates for great black-backed gull that are species-specific and considered by Cook *et al.* (2021) to be supported by an appropriate amount of data to accurately reflect the flight behaviour of great black-backed gull. Although great black-backed gulls are a large gull they are larger than other species included in the grouped avoidance rate, and this may therefore influence the avoidance rate obtained for this group in Ozsanlav-Harris *et al.* (2023). This has been considered when defining the magnitude of impacts for great black-backed gull.

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

Table 5.54: Assessment of predicted collision risk estimates for great black-backed gull on seasonal and annual bases against the baseline mortality of relevant regional populations.

Season	Regional baseline population	Baseline mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Breeding	999	95	0 to 1	0.15 to 1.21
Non-breeding	17,742	1,682	1 to 5	0.03 to 0.27
Annual	17,742	1,682	1 to 6	0.04 to 0.34

5.9.4.19 As part of the Section 42 responses, the Isle of Man Department of Infrastructure requested that impacts on the great black-backed gull population of the Isle of Man was specifically assessed. The population of great black-backed gull on the Isle of Man was 170 breeding individuals in 2017. This count falls outside of the temporal period used to calculate regional breeding populations to inform this assessment and therefore the Isle of Man population is not included in the regional population as calculated in Table 5.17 and used in Table 5.54. If it is the regional population increases to 1,383 individuals with the Isle of Man population consisting of 384 birds (breeding adults and immatures). The Isle of Man population therefore represents approximately 28% of the total regional breeding population. The total breeding season impact attributable to the Isle of Man population would therefore be less than one bird.

5.9.4.20 In the non-breeding season, the Isle of Man population of great black-backed gull commensurate to the populations used to calculate BDMPS populations in Furness

(2015) is 806 breeding individuals. The Isle of Man population therefore represents 4.5% of the total regional non-breeding population. The total non-breeding season impact attributable to the Isle of Man population would therefore be less than one bird.

5.9.4.21 When the seasonal impacts are combined, the impact attributable to the Isle of Man population is less than one bird on an annual basis.

Herring gull

5.9.4.22 In both seasons (breeding and non-breeding) and on an annual basis, the estimated increase in baseline mortality remains well below the 1% increase threshold. As breeding gulls forage mainly in daytime (Wade *et al.,* 2016), aviation and navigation lighting at the Morgan Generation Assets is unlikely to result in additional collision risk.

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

Table 5.55: Assessment of predicted collision risk estimates for herring gull on seasonal and annual bases against the baseline mortality of relevant regional populations.

Season	Regional baseline population	Baseline mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Breeding	24,286	4,147	1 to 2	0.02 to 0.05
Non-breeding	173,299	29,591	3 to 8	0.01 to 0.03
Annual	173,299	29,591	4 to 10	0.01 to 0.03

Lesser black-backed gull

5.9.4.24 In all four seasons (pre-breeding, breeding, post-breeding and non-breeding) and on an annual basis, the estimated increase in baseline mortality remains well below the 1% increase threshold. As breeding gulls forage mainly in daytime (Wade *et al.,* 2016), aviation and navigation lighting at the Morgan Generation Assets is unlikely to result in additional collision risk.

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

Table 5.56: Assessment of predicted collision risk estimates for lesser black-backed gull on seasonal and annual bases against the baseline mortality of relevant regional populations.

Season	Regional baseline population	Baseline mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Pre-breeding	163,304	19,765	<1 to <1	<0.01 to <0.01
Breeding	87,807	10,627	<1 to <1	<0.01 to <0.01
Post-breeding	163,304	19,765	<1 to <1	<0.01 to <0.01
Non-breeding	41,159	4,981	<1 to <1	<0.01 to <0.01
Annual	163,304	19,765	<1 to 1	<0.01 to 0.01

Manx shearwater

5.9.4.26 In all three seasons (pre-breeding, breeding and post breeding) and on an annual basis the estimated increase in baseline mortality remains well below the 1% increase threshold. Manx shearwater spend more time foraging at night than other species considered in this assessment, however, it is still a lower proportion of time than during the day (Wade *et al.,* 2016). As stated in paragraph 5.9.4.5 however, it is not considered likely that the lighting associated with offshore wind turbines will increase the likelihood of collision.

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

Table 5.57: Assessment of predicted collision risk estimates for Manx shearwater on seasonal and annual bases against the baseline mortality of relevant regional populations.

Season	Regional baseline population	Baseline mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Pre-breeding	1,580,895	205,516	0	0.00
Breeding	2,230,698	289,991	<0.01	<0.01
Post-breeding	1,580,895	205,516	<0.01	<0.01
Annual	2,230,698	289,991	<0.01	<0.01

Gannet

5.9.4.28 In all three seasons (pre-breeding, breeding and post breeding) and on an annual basis the estimated increase in baseline mortality remains well below the 1% increase threshold. As breeding gannet forage mainly in daytime (Furness *et al.,* 2018), aviation and navigation lighting at the Morgan Generation Assets is unlikely to result in additional collision risk.

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

Table 5.58: Assessment of predicted collision risk estimates for gannet on seasonal and annual bases against the baseline mortality of relevant regional populations.

Season	Regional baseline population	Baseline mortality	Collision mortality (number of birds)	Increase in baseline mortality (%)
Pre-breeding	661,888	127,577	<1 to <1	<0.01 to <0.01
Breeding	651,586	125,591	<1 to 1	<0.01 to <0.01
Post-breeding	545,954	105,231	<1 to <1	<0.01 to <0.01
Annual	661,888	123,773	1 to 1	<0.01 to <0.01

Migratory waterbirds

5.9.4.30 Predictions using a range of avoidance rates are provided in Volume 4, Annex 5.4: Offshore Ornithology Migratory Bird Collision Risk Modelling Technical Report of the Environmental Statement. At a 98% avoidance rate, the predicted collision risk estimates did not represent more than a 0.1% increase in baseline mortality for any species, far below the 1% threshold used as the criteria for further consideration.

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

Table 5.59: Assessment of predicted collision risk estimates for migratory waterbirds on an annual basis against the baseline mortality of relevant biogeographic populations.

Species	Scientific name	Collision risk estimate (98% avoidance rate)	Biogeographic population	Mortality rate	Baseline mortality	Percentage increase in baseline mortality (%)
Light-bellied brent goose (Canadian population)	*Branta bernicla hrota*	0.02	710	0.10	71	0.02
Greenland white-fronted goose	*Anser albifrons flavirostris*	0.35	13,000	0.28	3,588	0.01
Bewick's swan	*Cygnus columbianus bewickii*	0.04	380	0.18	68	0.07
Whooper swan	*Cygnus cygnus*	0.93	19,500	0.20	3,881	0.02
Shelduck	*Tadorna tadorna*	0.22	14,610	0.11	1,666	0.01
Shoveler	*Spatula clypeata*	0.04	2,545	0.42	1,069	<0.01
Gadwall	*Mareca strepera*	0.02	630	0.28	176	0.01
Wigeon	*Mareca penelope*	1.10	82,370	0.47	38,714	<0.01
Mallard	*Anas platyrhynchos*	0.54	38,250	0.37	14,267	<0.01
Pintail	*Anas acuta*	0.25	21,235	0.34	7,156	<0.01
Teal	*Anas crecca*	5.17	480,010	0.47	225,605	<0.01
Pochard	*Aythya ferina*	0.52	37,780	0.35	13,223	<0.01
Tufted duck	*Aythya fuligula*	1.95	176,610	0.29	51,217	<0.01
Scaup	*Aythya marila*	0.06	6,400	0.19	1,216	0.01
Common scoter	*Melanitta nigra*	0.09	135,000	0.22	29,295	<0.01

Species	Scientific name	Collision risk estimate (98% avoidance rate)	Biogeographic population	Mortality rate	Baseline mortality	Percentage increase in baseline mortality (%)
Long-tailed duck	*Clangula hyemalis*	0.03	13,500	0.27	3,645	<0.01
Goldeneye	*Bucephala clangula*	0.21	9,665	0.23	2,223	0.01
Red-breasted merganser	*Mergus serrator*	0.11	11,000	0.18	1,980	0.01
Corncrake	*Crex crex*	0.11	2,200	0.71	1,571	0.01
Great crested grebe	*Podiceps cristatus*	0.06	5,385	0.28	1,481	<0.01
Slavonian grebe	*Podiceps auritus*	0.01	995	0.40	398	<0.01
Oystercatcher (breeding)	*Haematopus ostralegus*	3.18	191,000	0.12	22,920	0.01
Oystercatcher (non-breeding)	*Haematopus ostralegus*	5.07	305,000	0.12	36,600	0.01
Lapwing	*Vanellus vanellus*	4.73	207,700	0.30	61,272	0.01
Golden plover (breeding)	*Pluvialis apricaria*	1.54	101,000	0.27	27,270	0.01
Golden plover (non-breeding)	*Pluvialis apricaria*	6.27	410,000	0.27	110,700	0.01
Grey plover	*Pluvialis squatarola*	0.14	6,315	0.14	884	0.02
Ringed plover (breeding)	*Charadrius hiaticula*	0.15	10,900	0.23	2,485	0.01
Ringed plover (non-breeding)	*Charadrius hiaticula*	0.60	42,500	0.23	9,690	0.01
Dotterel	*Charadrius morinellus*	0.02	850	0.27	230	0.01
Whimbrel	*Numenius phaeopus*	0.06	3,840	0.11	422	0.01
Curlew (breeding)	*Numenius arquata*	1.97	117,000	0.10	11,817	0.02
Curlew (non-breeding)	*Numenius arquata*	1.31	54,650	0.10	5,520	0.02
Bar-tailed godwit	*Limosa lapponica*	0.44	16,280	0.29	4,640	0.01
Black-tailed godwit (Icelandic race)	*Limosa limosa islandica*	0.64	41,000	0.06	2,460	0.03

Species	Scientific name	Collision risk estimate (98% avoidance rate)	Biogeographic population	Mortality rate	Baseline mortality	Percentage increase in baseline mortality (%)
Turnstone	*Arenaria interpres*	0.63	43,000	0.14	6,020	0.01
Knot	*Calidris canutus*	3.81	265,000	0.16	42,135	0.01
Ruff	*Calidris pugnax*	0.01	920	0.48	438	<0.01
Sanderling	*Calidris alba*	0.29	20,500	0.17	3,485	0.01
Dunlin (sub-species schinzii and arctica)	*Calidris alpina schinzii/arctica*	14.15	1,000,500	0.26	260,130	0.01
Dunlin (sub-species alpina)	*Calidris alpina alpina*	2.37	88,480	0.26	23,005	0.01
Purple sandpiper	*Calidris maritima*	0.16	9,900	0.21	2,030	0.01
Snipe	*Gallinago gallinago*	15.94	1,100,000	0.52	570,900	<0.01
Red-necked phalarope	*Phalaropus lobatus*	<0.01	128	0.14	18	0.01
Redshank (breeding)	*Tringa totanus*	0.68	44,000	0.26	11,440	0.01
Redshank (Icelandic race - non-breeding)	*Tringa totanus*	6.18	400,000	0.26	104,000	0.01
Wood sandpiper	*Tringa glareola*	<0.01	60	0.46	28	<0.01
Greenshank	*Tringa nebularia*	0.03	1,265	0.26	329	0.01
Bittern	*Botaurus stellaris*	0.02	795	0.30	239	0.01
Osprey	*Pandion haliaetus*	0.01	480	0.15	72	0.01
Hen harrier	*Circus cyaneus*	0.02	1,090	0.19	207	0.01
Short-eared owl	*Asio flammeus*	0.17	4,400	0.31	1,364	0.01
Merlin	*Falco columbarius*	0.07	49,000	0.38	18,620	<0.01

Migratory seabirds

5.9.4.32 Predictions using a range of avoidance rates are provided in Volume 4, Annex 5.4: Offshore Ornithology Migratory Bird Collision Risk Modelling Technical Report of the Environmental Statement. At a 99% avoidance rate, the predicted collision risk estimates did not represent more than a 0.01% increase in baseline mortality for any species, far below the 1% threshold used as the criteria for further consideration.

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

Table 5.60: Assessment of predicted collision risk estimates for migratory seabirds on an annual basis against the baseline mortality of relevant biogeographic populations.

Species	Scientific name	Collision risk estimate (99% avoidance rate)	Biogeographic population (largest BDMPS population)	Mortality rate	Baseline mortality	Proportion of baseline mortality represented by collision risk
Great skua	*Stercorarius skua*	0.12	25,090	0.118	2,961	<0.01
European storm petrel	*Hydrobates pelagicus*	0.65	180,000	0.12	21,600	<0.01
Leach's storm petrel	*Oceanodroma leucorhoa*	1.57	450,000	0.13	58,500	<0.01

Sensitivity of the receptor

Kittiwake

5.9.4.34 Kittiwake was rated as relatively highly vulnerable to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight. In terms of nocturnal activity rate, kittiwake are considered to have a medium rate of activity at night with a score of 3 (out of 5) (Wade *et al.* 2016).

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

5.9.4.36 Kittiwake is a qualifying interest for several SPAs likely to be connected to the Morgan Array Area (within the mean-max + SD foraging range), with several non-SPA colonies within range and so the species is considered to be of International conservation value.

5.9.4.37 Kittiwake is deemed to be of high vulnerability, low recoverability and international conservation value. The sensitivity of the receptor is therefore, considered to be **high**.

Great black-backed gull

5.9.4.38 Great black-backed gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight. In terms of nocturnal activity rate, great black-backed gull are considered to have a medium rate of activity at night with a score of 3 (out of 5) (Wade *et al.* 2016).

5.9.4.39 The abundance of breeding great black-backed gull in the UK has changed relatively little in recent years (JNCC, 2020). The species is deemed to have a medium recoverability due to a relatively high reproductive potential and the stable trend in breeding abundance.

5.9.4.40 Great black-backed gull is considered to be of regional conservation value due to the abundance of the species recorded during site-specific surveys.

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

Herring gull

5.9.4.42 Herring gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight. In terms of nocturnal activity rate, herring gull are considered to have a medium rate of activity at night with a score of 3 (out of 5) (Wade *et al.* 2016).

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

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

5.9.4.45 Herring gull is deemed to be of very high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be **high.**

Lesser black-backed gull

5.9.4.46 Lesser black-backed gull was rated as one of the most vulnerable seabird species to collision impacts by Wade *et al.* (2016), due to the proportion of flights likely to occur at potential risk height and percentage of time in flight. In terms of nocturnal activity rate, lesser black-backed gull are considered to have a medium rate of activity at night with a score of 3 (out of 5) (Wade *et al.* 2016).

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

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

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

Manx shearwater

5.9.4.50 Manx shearwater was rated as the least vulnerable seabirds to collision impacts by Wade *et al.* (2016). In terms of nocturnal activity rate, Manx shearwater are considered to have a medium rate of activity at night with a score of 3 (out of 5) (Wade *et al.* 2016).

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

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

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

Gannet

5.9.4.54 Although the latest scientific guidance showed the species to display a high level of macro-avoidance (Peschko *et al.*, 2021), the species is rated as relatively vulnerable to collision impacts by Wade *et al.* (2016). In terms of nocturnal activity rate, Gannet are considered to have a low rate of activity at night with a score of 2 (out of 5) (Wade *et al.* 2016).

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

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

5.9.4.57 Gannet is deemed to be of high vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore considered, on a precautionary basis to be **high**.

Migratory waterbirds

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

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

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

Migratory seabirds

5.9.4.61 Great skua has a high vulnerability to collision driven by the high proportion of time the specie spends in flight. Great skua also spend a limited proportion of time in flight at hight (Wade *et al.,* 2016). European storm petrel and Leach's petrel are both considered to have a low vulnerability to collision due to both species having a limited proportion of flights at collision height. In terms of nocturnal activity rate, both species are considered to have a medium rate of activity at night with a score of 3 (out of 5) (Wade *et al.* 2016).

5.9.4.62 Due to the large foraging range of great skua there is connectivity between the Morgan Generation Assets and a number of SPAs at which great skua is a qualifying feature however, usage of the Morgan Generation Assets by the species in the breeding species is highly unlikely. Great skua is however, considered to have an international conservation value. European storm petrel and leach's petrel are both listed on Annex I of the EU birds directive and are therefore considered to have a national conservation value.

5.9.4.63 Although great skuas do not start breeding until seven years old, the average clutch size of the species is two eggs and therefore the species is considered to have a moderate reproductive potential. There is no recent national population trend data for great skua although previous comparisons suggested an increasing population. Population trend data has suggested population declines with the species also affected by avian flu in recent years. The species is therefore considered to have a medium recoverability.

5.9.4.64 Both European storm petrel and Leach's petrel have low reproductive potentials (i.e. only laying one egg per year and not breeding until four or five years old; Robinson, 2005). There is an incomplete spatial-temporal coverage of breeding abundance at UK colonies and thus a lack of long-term trend (JNCC, 2020). In the light of uncertainly and low reproductive potential, both species are therefore deemed to have a medium recoverability.

5.9.4.65 Great skua is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be **high.**

5.9.4.66 European storm petrel and Leach's petrel are deemed to be of low vulnerability, medium recoverability and National value. The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of the effect

5.9.4.67 A summary of collision impacts in the operations and maintenance phase on each receptor is presented in Table 5.61. The significance of impacts ranges from **negligible to minor adverse** with no effects considered to be significant in EIA terms. For migratory waterbirds and seabirds, which had a magnitude of impact of negligible and sensitivity of medium, negligible was selected from the negligible to minor range due to the impact not exceeding a 0.1% increase in baseline mortality and hence, was not regarded as a minor significance of effect. For all other species, a conclusion of minor adverse significance was reached.

Table 5.61: Summary of the impact of collisions on the significance of effect during the operations and maintenance phase of the Morgan Generation Assets.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Kittiwake	Negligible	High	**Minor adverse, not significant in EIA terms**

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Great black-backed gull	Low	Medium	**Minor adverse, not significant in EIA terms**
Herring gull	Negligible	High	**Minor adverse, not significant in EIA terms**
Lesser black-backed gull	Negligible	High	**Minor adverse, not significant in EIA terms**
Great skua	Negligible	High	**Minor adverse, not significant in EIA terms**
European storm petrel	Negligible	Medium	**Negligible, not significant in EIA terms**
Leach's petrel	Negligible	Medium	**Negligible, not significant in EIA terms**
Fulmar	Negligible	Medium	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**
Gannet	Negligible	High	**Minor adverse, not significant in EIA terms**
Migratory waterbirds	Negligible	Medium	**Negligible, not significant in EIA terms**

5.9.5 Combined displacement and collision risk

Operations and maintenance phase

Magnitude of impact

5.9.5.1 Two species are known to be adversely affected by both displacement and collision during the operations and maintenance phase, these are kittiwake and gannet. Impacts must be combined in order for the true magnitude of impact to be understood.

5.9.5.2 It is recognised that assessing these two potential impacts together could amount to double counting, as birds that are subject to displacement could not be subject to potential collision risk as they are already assumed to have not entered the Morgan Array Area. Equally, birds estimated to be subject to collision risk mortality would not be subjected to displacement mortality as well. Whilst the methods used to estimate collision risk and displacement mortality for gannet go some way to take this into account (through the reduction of gannet densities in collision risk modelling by 70%), a similar approach is not applied for kittiwake due to a lack of appropriate data to inform the quantification of the likely scale of required reduction. As a more refined method to consider displacement and collision together whilst reducing any double counting of impacts is not agreed with SNCBs and therefore the precautionary and highly unlikely approach is presented in this assessment, as recommended by the EWG.

5.9.5.3 Outputs from the impact assessments from disturbance and displacement (section 5.9.1) and collision risk (section 5.9.4) combined are tabulated and presented in Table 5.62.

Table 5.62: Combined displacement and collision cumulative impacts.

Species	Impact	Pre-breeding	Breeding	Post-breeding	Annual
Kittiwake	Displacement (30 to 70% displacement and 1 to 10% mortality)	2 to 55	2 to 35	3 to 81	7 to 171
	Collision risk	3 to 14	2 to 8	4 to 18	9 to 40

Species	Impact	Pre-breeding	Breeding	Post-breeding	Annual
	Combined estimate	6 to 69	3 to 43	8 to 99	24 to 383
	Regional population baseline mortality	108,044	20,314	142,426	142,426
	Increase in baseline mortality (%)	**0.01 to 0.06**	**0.02 to 0.21**	**0.01 to 0.07**	**0.02 to 0.27**
Gannet	Displacement (60 to 80% displacement and 1 to 10% mortality)	0 to 3	1 to 12	0 to 5	2 to 20
	Collision risk	0 to 0	1 to 1	0 to 0	1 to 1
	Combined estimate	0 to 3	2 to 14	1 to 5	4 to 42
	Combined (minimum estimate)	127,577	125,591	105,231	127,577
	Increase in baseline mortality (%)	**<0.01 to <0.01**	**<0.01 to 0.01**	**<0.01 to 0.01**	**<0.01 to 0.03**

Kittiwake

5.9.5.4 The combined estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) and a range of collision risk estimates was assessed for each season and on an annual basis (Table 5.62).

5.9.5.5 In all three seasons and on an annual basis, the predicted increase in baseline mortality remains well below the 1% threshold.

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

Gannet

5.9.5.7 The combined estimated mortality (when considering a displacement rate of 30% to 70% and a mortality rate of 1% to 10%) and a range of collision risk estimates was assessed for each season and on an annual basis (Table 5.62).

5.9.5.8 In all three seasons and on an annual basis, the predicted increase in baseline mortality remains well the below the 1% threshold.

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

Sensitivity of the receptor

Kittiwake

5.9.5.10 As previously described in displacement (paragraph 5.9.1.104) and collision (paragraph 5.9.4.37), kittiwake is deemed to be of overall medium vulnerability, low recoverability and International value. The sensitivity of the receptor is therefore, considered to be **high**.

Gannet

5.9.5.11 As previously described in displacement (paragraph 5.9.1.124) and collision (paragraph 5.9.4.57), gannet is deemed to be overall of high vulnerability, high recoverability and International value. The sensitivity of the receptor is therefore, on a precautionary basis, considered to be **high**.

Significance of the effect

Kittiwake

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

Gannet

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

5.9.6 Barrier to movement

5.9.6.1 JNCC *et al*. (2022) defines barrier effects as 'A barrier is a physical factor that limits the migration, or free movement of individuals or populations, thus requiring them to divert from their intended path in order to reach their original destination. This effect is expected to increase the energy expenditure of birds if they have to fly around the area in question in order to reach their goal'. It is typically considered to affect birds in flight only, either whilst they are on migration between breeding and wintering areas (for example) or between a breeding colony and a foraging area. The latter of these scenarios may impose an additional energetic cost to movements at a key period in the annual cycle when seabirds are making daily commutes between foraging grounds at sea and breeding sites. Additional energetic costs could have long-term implications for individuals, impacting bird fitness (breeding productivity and survival) and for populations. Barrier effects are considered to be less impactful during when affecting migratory flights as avoidance of a single wind farm may be trivial relative to the total length and cost of the journey.

5.9.6.2 Masden *et al.* (2010) found additional costs, expressed in relation to typical daily energetic expenditures, to be the highest per unit flight for seabirds with high wing loadings, such as gannets. For example, results suggest that increasing gannet flight distance by 2 km increases energetic cost by 1.25%. A 10 km increase may result in a 4.50% increase in energy expenditure. However, this is based on a foraging range of 160 km, where 10 km represents a 6.25% increase in distance flown. Scaling this to the mean maximum plus 1 SD foraging range of 709 km (Woodward et al., 2019), an additional flight distance of 10 km (4.5%) represents a scaled 1.02% increase in expenditure. This minimal increase in energy expenditure is unlikely to result in notable mortalities. Most importantly the authors found costs of extra flight to avoid a wind farm to appear to be much less than those imposed by low food abundance or adverse weather, although such costs will be additive to these.

5.9.6.3 It is considered unlikely that the project will represent a barrier to foraging movements. The Morgan Generation Assets are not considered to be located between notable seabird colonies and foraging areas as illustrated in Volume 4, Annex 5.1 Baseline Characterisation Report of the Environmental Statement.

5.9.6.4 All VORs are considered in relation to barrier effects and because the magnitude of the effect is likely to be similar amongst bird species moving through the area, receptors are grouped in the assessment of the barrier effect.

Operations and maintenance phase

Magnitude of impact

All receptors

5.9.6.5 In the absence of quantitative information available, the magnitude is considered qualitatively for all receptors.

5.9.6.6 It is considered unlikely that the project will represent a barrier to foraging movements. The Morgan Generation Assets are not considered to be located between notable seabird colonies and foraging areas as illustrated in Volume 4, Annex 5.1 Baseline Characterisation Report of the Environmental Statement. The location of the Morgan Generation Assets within the Irish Sea is unlikely to represent a barrier to movements for seabirds breeding on the English, Isle of Man and Welsh coasts of the Irish Sea. There are very few large colonies present, with the exception of those designated for lesser black-backed gull and herring gull (e.g. South Walney, Ribble Estuary, Bowland Fells) and those that are the features exhibit limited connectivity with the marine environment or do not forage beyond the Morgan Generation Assets (Clewley *et al.* 2021). Breeding seabirds at colonies outside of the Irish Sea that may have connectivity with the Morgan Generation Assets have connectivity due to large foraging ranges. However species associated with these SPAs forage widely (Woodward *et al.,* 2019) and the Morgan Generation Assets are unlikely to represent a significant barrier to movement. There are no known important foraging areas for seabirds inshore of the Morgan Generation Assets (e.g. similar to the Irish Sea Front SPA) and therefore the Morgan Generation Assets will not represent a barrier to movement of birds between these colonies and foraging areas.

5.9.6.7 The diversion of flight lines as a result of a barrier effect created by the presence of Morgan Generation Assets for migratory birds is considered far less of an impact than for those barrier effects to daily foraging flights. Speakman *et al.*, (2009) and Masden *et al.*, (2010, 2012) calculated that the costs of one-off avoidances during migration were small, accounting for less than 2% of available fat reserves.

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

Sensitivity of receptor

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

5.9.6.10 Overall breeding seabirds and migratory birds are deemed to be of low to high vulnerability, low to high recoverability and Regional to International value (Table 5.63). The sensitivity of the receptor is therefore, considered to be **medium.**

Significance of effect

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

Table 5.63: Summary of the impact of barrier effects on the significance of effect during the operations and maintenance phase of the Morgan Generation Assets.

Species	Magnitude of impact	Sensitivity of receptor	Significance of effect
Kittiwake	Negligible	Medium	**Negligible, not significant in EIA terms**
Little gull	Negligible	Medium	**Negligible, not significant in EIA terms**
Great black-backed gull	Negligible	Medium	**Negligible, not significant in EIA terms**
Herring gull	Negligible	Medium	**Negligible, not significant in EIA terms**
Lesser black-backed gull	Negligible	Medium	**Negligible, not significant in EIA terms**
Sandwich tern	Negligible	Medium	**Negligible, not significant in EIA terms**
Little tern	Negligible	Medium	**Negligible, not significant in EIA terms**
Roseate tern	Negligible	Medium	**Negligible, not significant in EIA terms**
Common tern	Negligible	Medium	**Negligible, not significant in EIA terms**
Arctic tern	Negligible	Medium	**Negligible, not significant in EIA terms**
Great skua	Negligible	Medium	**Negligible, not significant in EIA terms**
Arctic skua	Negligible	Medium	**Negligible, not significant in EIA terms**
Guillemot	Negligible	Medium	**Negligible, not significant in EIA terms**
Razorbill	Negligible	Medium	**Negligible, not significant in EIA terms**
Puffin	Negligible	Medium	**Negligible, not significant in EIA terms**
European storm petrel	Negligible	Medium	**Negligible, not significant in EIA terms**
Leach's petrel	Negligible	Medium	**Negligible, not significant in EIA terms**
Fulmar	Negligible	Medium	**Negligible, not significant in EIA terms**
Manx shearwater	Negligible	Medium	**Negligible, not significant in EIA terms**
Gannet	Negligible	Medium	**Negligible, not significant in EIA terms**

5.9.7 Future monitoring

5.9.7.1 Based on the predicted impacts it is considered that no future monitoring is required given the level of certainty around the potential effects. The project will continue to engage through the Evidence Plan process to explain the context of this approach.

5.10 Cumulative effects assessment methodology

5.10.1 Methodology

5.10.1.1 The CEA takes into account the impact associated with the Morgan Generation Assets together with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets, the Morecambe Offshore Windfarm Generation Assets, and other projects and plans. The projects and plans selected as relevant to the CEA presented within this chapter are based upon the results of a screening exercise (see Volume 5, Annex 5.1: CEA screening matrix of the Environmental Statement). Each project has been considered on a case by case basis for screening in or out of this chapter's assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved.

5.10.1.2 The offshore ornithology CEA methodology has followed the methodology set out in Volume 1, Chapter 5: EIA methodology of the Environmental Statement. The cumulative assessment considers three scenarios;

- Scenario 1: Morgan Generation Assets plus Morgan and Morecambe Offshore Wind Farms: Transmission Assets
- Scenario 2: Morgan Generation Assets plus Morgan and Morecambe Offshore Wind Farms: Transmission Assets and the Morecambe Offshore Windfarm: Generation Assets
- Scenario 3: Morgan Generation Assets plus Morgan and Morecambe Offshore Wind Farms: Transmission Assets plus:
  - Tier 1
    - Under construction
    - Permitted application
    - Submitted application
    - Those currently operational that were not operational when baseline data were collected, and/or those that are operational but have an ongoing impact
  - Tier 2
    - Scoping report has been submitted and is in the public domain
  - Tier 3
    - Scoping report has not been submitted and is not in the public domain
    - Identified in the relevant Development Plan
    - Identified in other plans and programmes.

5.10.1.3 This approach to CEA has been developed to provide an assessment of the Morgan Generation Assets together with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets (Scenario 1) and the Morecambe Offshore Windfarm: Generation Assets (Scenario 2) in order to identify, as far as possible, the combined effects of these three applications separately from the assessment that includes all other projects, plans and activities (Scenario 3).

5.10.1.4 The specific projects, plans and activities screened into the CEA are outlined in Table 5.64. Tier 2 projects are only included in the following cumulative assessments if information is available to provide either a quantitative or qualitative assessment. In practice, this requires that an assessment has been published for Tier 2 projects.

Without an assessment it is not possible to provide an indication as to the impact of the project as information such as baseline characterisation and project design are unavailable (for example the proposed Tier 2 Mooir Vannin offshore wind farm project in IoM Waters where a Scoping report has been submitted but no assessment is yet available). The location of screened in projects and their proximity to the Morgan Generation Assets are further shown in Figure 5.2. Projects screened out are detailed within Volume 3, Annex 5.1 CEA screening annex of the Environmental Statement. Tier 3 projects have not yet reached a stage at which detailed information will be available and are therefore not considered in the cumulative assessments presented.

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

5.10.1.6 In addition, some of the projects considered cumulatively only have potential to impact species during a specific season (e.g. breeding or non-breeding seasons). During the breeding season, projects within a species' foraging range were considered as there is the potential for individuals to have connectivity to the Morgan Generation Assets Cumulative Study Area and the other plans/ projects specific to each species. Foraging ranges presented in Volume 4, Annex 5.1: Offshore ornithology baseline characterisation of the Environmental Statement were used (Woodward *et al.*, 2019). Within the non-breeding season all developments within the BDMPS area relevant to a species (Furness, 2015) are included. As such, all 'breeding season' projects are also included within the non-breeding period given that the BDMPS areas defined by Furness (2015) are larger than the breeding foraging ranges. Additional projects not included within a breeding season assessment may be included within the non-breeding season assessment. Projects considered for each species during each season are presented within the CEA below.

5.10.1.7 It should be noted that the Arklow Bank Phase 1, Barrow, North Hoyle and Rhyl Flats are currently operational however, the operational consents for these projects expires before the Morgan Generation Assets become operational. These projects are therefore discounted from the CEA as there is no temporal overlap between the operational phases of these projects and the Morgan Generation Assets.

5.10.1.8 Other aspects, namely indirect impacts associated with prey distribution and availability are very difficult to quantify, and although it is acknowledged that cumulative effects are possible, the magnitude of these impacts is not considered to be significant at a population level for any offshore ornithology receptor in relation to those activities that would not be considered part of the baseline (i.e. fishing activities). They are therefore not considered further within the CEA. The impacts excluded from the cumulative assessment are:

- Indirect impacts (affecting prey species) from airborne noise, underwater sound and the presence of vessels at any phase of the Morgan Generation Assets as they will be spatially limited and all were predicted as negligible
- Temporary habitat loss/disturbance and increased SSCs at any phase of the Morgan Generation Assets as there is low potential for cumulative effect because the contribution from the Morgan Generation Assets and surrounding

wind farms is small (and even if these occurred at the same time this would not constitute a significant effect).

5.10.1.9 Impacts considered in the cumulative assessment are as follows:

- Disturbance and displacement from infrastructure (and barrier effects) (all project phases)
- Collision risk (operations and maintenance phase only)
- Combined displacement and collision risk (operations and maintenance phase only).

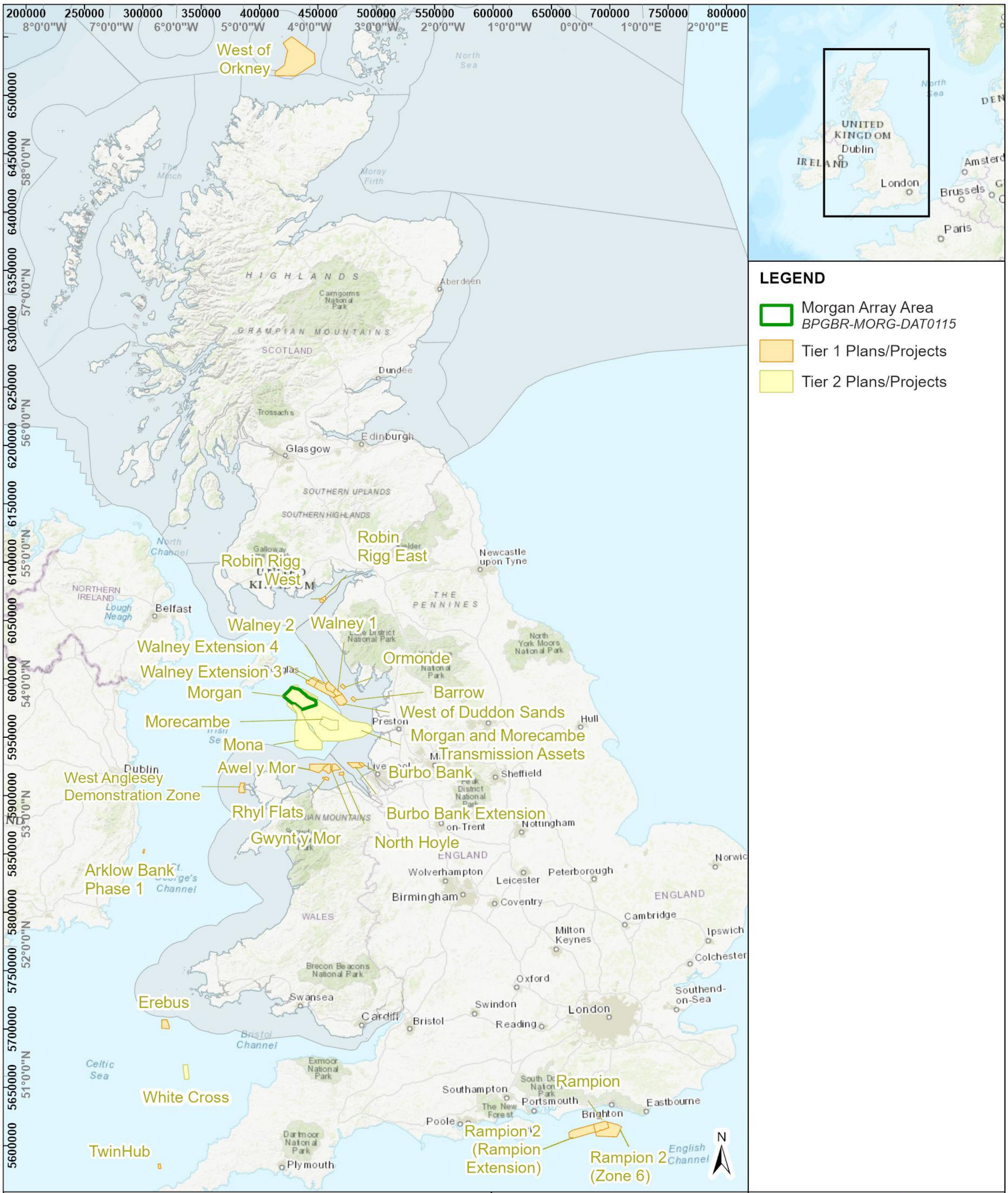
Table 5.64: List of other projects, plans and activities considered within the offshore ornithology CEA.

Project/Plan	Status	Distance from the Morgan Array Area (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Morgan Offshore Wind Project (temporal or physical)
Tier 1						
Walney Extension 3 offshore wind farm	Operational	8.1	40 8.25 MW wind turbines. Hub height 113 m. Rotor diameter 164 m.	2017	2018 to 2039	Project Operations and maintenance Phase temporal overlap.
Walney Extension 4 offshore wind farm	Operational	9.9	47 7 MW wind turbines. Hub height 111 m. Rotor diameter 154 m.	2017	2018 to 2039	Project Operations and maintenance Phase temporal overlap.
Walney 2 offshore wind farm	Operational	13.3	51 3.6 MW wind turbines. Hub height 84 m. Rotor diameter 107 m.	2011	2012 to 2032	Project Operations and maintenance Phase temporal overlap.
West of Duddon Sands offshore wind farm	Operational	15.3	108 3.6 MW wind turbines. Hub height 90 m Rotor diameter 120 m.	2013	2014 to 2033	Project Operations and maintenance Phase temporal overlap.
Walney 1 offshore wind farm	Operational	16.3	51 3.6 MW wind turbines. Hub height 84 m. Rotor diameter 107 m.	2010	2011 to 2032	Project Operations and maintenance Phase temporal overlap.

Project/Plan	Status	Distance from the Morgan Array Area (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Morgan Offshore Wind Project (temporal or physical)
Ormonde offshore wind farm	Operational	24.4	30 5 MW wind turbines. Hub Height 100 m. Rotor diameter 126 m.	2010	2012 to 2036	Project Operations and maintenance Phase temporal overlap.
Awel y Môr offshore wind farm	Submitted application	46.9	1,100 MW capacity.	2026 to 2029	2030 onwards	Potential Construction Phase temporal Overlap with Proposed Development Construction Phase. Project Operations and maintenance Phase temporal Overlap.
Gwynt y Môr offshore wind farm	Operational	52.1	160 3 MW wind turbines. Hub height 98 m. Rotor diameter 107 m.	2012	2015 to 2033	Project Operations and maintenance Phase temporal overlap.
Burbo Bank Extension offshore wind farm	Operational	56.0	32 8.0 MW wind turbines. Hub height 105 m. Rotor diameter 160 m	2016	2017 to 2045	Project Operations and maintenance Phase temporal overlap.
Burbo Bank offshore wind farm	Operational	61.6	23 3.6 MW wind turbines. Hub height 78 m. Rotor diameters 107 m.	2006	2007 to 2039	Project Operations and maintenance Phase temporal overlap.
Robin Rigg offshore wind farm	Operational	76.8	58 3 MW wind turbines. Hub height 80 m Rotor diameter 90 m.	2009	2010 to 2035	Project Operations and maintenance Phase temporal overlap.

Project/Plan	Status	Distance from the Morgan Array Area (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Morgan Offshore Wind Project (temporal or physical)
Erebus offshore wind farm	Submitted application	289.9	100 MW capacity.	2025	2026 to 2051	Potential Construction Phase temporal Overlap with Proposed Development Construction Phase. Project Operations and maintenance Phase temporal Overlap.
Rampion offshore wind farm	Operational	431.6	400 MW capacity. Hub height 80 m. Rotor diameter 112 m.	2015	2018 to 2039	Project Operations and maintenance Phase temporal overlap.
White Cross offshore wind farm	Submitted application	319.6	Test and Demonstration Floating Wind Farm.	unknown	unknown	Potential Construction Phase temporal Overlap. Project Operations and maintenance Phase temporal overlap.
TwinHub (Wave Hub Floating Wind Farm)	Consent granted	407.8	Two floating offshore wind platforms, each with two wind turbines. Installed capacity of 32 MW.	unknown	unknown	Project Operations and maintenance Phase temporal overlap.
Rampion 2 Offshore Wind Farm	Submitted application	428.5	Up to 1,200 MW capacity. Area - 270 km^2.	2025 to 2028	2029 to unknown	Potential Construction Phase temporal Overlap with Proposed Development Construction Phase. Project Operations and maintenance Phase temporal Overlap.

Project/Plan	Status	Distance from the Morgan Array Area (km)	Description of project/plan	Dates of construction (if applicable)	Dates of operation (if applicable)	Overlap with the Morgan Offshore Wind Project (temporal or physical)
West of Orkney Windfarm	Submitted application	524.2	Offshore wind project comprising up to 125 wind turbines, 30 km from the coast of Orkney.	2027	unknown	Project Operations and maintenance Phase temporal overlap.
West Anglesey Demonstration Zone tidal site (Morlais)	Consent granted	79.7	240 MW tidal project	unknown	unknown	Project Operations and maintenance Phase temporal overlap.
Mona Offshore Wind Project	Submitted application	5.5	1,500 MW capacity.	2026-2029	2030-2065	Potential Construction Phase temporal Overlap with Proposed Development Construction Phase. Project Operations and maintenance Phase temporal Overlap.
Tier 2						
Morecambe Generation Assets Offshore Wind Project	Pre-application	11.2	480 MW capacity, Area: 497 km^2.	2026	unknown	Potential Construction Phase temporal Overlap with Proposed Development Construction Phase. Project Operations and maintenance Phase temporal Overlap.
Morgan and Morecambe Offshore Wind Farms: Transmission Assets	Pre-application	0	n/a	2026 to 2029	2029 to 2065	Potential Construction Phase temporal Overlap with Proposed Development Construction Phase.



Service Layer Credits: World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS	**Data Sources:** Client	
Project Name: MORGAN OFFSHORE WIND PROJECT	0 20 40 60 80 nm; 0 50 100 150 km	**Drawing Number:** NIRA-MG-ORN-040-02
Drawing Title: Plans and projects to be considered for cumulative assessment	**Geodetic Information:** Datum: ETRS 1989; Projection: ETRS 1989 UTM Zone 30N; Scale@160mmx220mm: 1:5,500,000	

VER	DATE	DETAILS	BY	CHECK
01	12/12/23	First Issue	JOSW	HAZ
02	05/02/24	Revision 1	JOSW	HAZ

Figure 5.2: Other projects, plans and activities screened into the cumulative effects assessment.

5.10.2 Maximum Design Scenario

5.10.2.1 The MDSs identified in Table 5.65 have been selected as those having the potential to result in the greatest effect on an identified receptor or receptor group. The cumulative effects presented and assessed in this section have been selected from the MDS table above (Table 5.25) due to there being a potential for cumulative effects. Effects of greater adverse significance are not predicted to arise should any other development scenario (e.g. different turbine layout) for the Morgan Generation Assets, to that assessed here, be taken forward in the final design scheme. It should be noted that the projects of relevance to each species and associated seasons will not necessarily include all projects identified in Table 5.65. Projects considered for each species and associated season are identified in the species-specific assessment sections below.

Table 5.65: Maximum design scenario considered for the assessment of potential cumulative effects on offshore ornithology.

a C=construction, O=operations and maintenance, D=decommissioning. Development phases of the Morgan Generation Assets

Potential cumulative effect	Phase[a] C	O	D	Maximum Design Scenario	Justification
Disturbance and displacement from infrastructure	✓	✓	✓	**Construction** **Scenario 1** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. **Scenario 2** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and the Morecambe Offshore Windfarm: Generation Assets. **Scenario 3** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and the following other projects/plans: Tier 1 • Awel y Môr • Erebus. • Mona Offshore Wind Project • Rampion 2 offshore wind farm • White Cross. Tier 2 • Morecambe Offshore Wind Farm Generation Assets **Operations and maintenance Phase:**	There is a possibility that the construction and decommissioning phases of the Morgan Generation Assets could overlap temporally with Awel y Môr, the Mona Offshore Wind Project, Morecambe Generation Assets, Erebus and White Cross. However, the impact from construction and decommissioning are of small, temporary magnitude. There is potential for a cumulative effect from operations and maintenance activities and so a quantitative cumulative effect assessment is required.

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				Scenario 1 Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. **Scenario 2** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and the Morecambe Offshore Windfarm: Generation Assets. **Scenario 3** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and the following other projects/plans: Tier 1 • Awel y Môr • Burbo Bank • Burbo Bank Extension • Erebus • Gwynt y Môr • Mona Offshore Wind Project • Ormonde • Rampion • Rampion 2 • Robin Rigg • Twinhub • Walney 1	

Potential cumulative effect	Phase[a] C	O	D	Maximum Design Scenario	Justification
				• Walney 2 • Walney 3 • Walney 4 • West of Duddon Sands. • West of Orkney • White Cross <u>Tier 2</u> • Morecambe Offshore Wind Farm: Generation Assets. **Decommissioning Phase** **Scenario 1** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. **Scenario 2** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and the Morecambe Offshore Windfarm: Generation Assets. **Scenario 3** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and the following other projects/plans: <u>Tier 1</u> • Awel y Môr • Erebus • Mona Offshore Wind Project	

Potential cumulative effect	Phase[a] C	O	D	Maximum Design Scenario	Justification
				• White Cross. Tier 2 • Morecambe Offshore Wind Farm: Generation Assets.	
Collision risk	×	✓	×	**Operations and maintenance Phase:** **Scenario 1** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets. **Scenario 2** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and the Morecambe Offshore Windfarm: Generation Assets. **Scenario 3** Maximum design scenario as described for the Morgan Generation Assets (Table 5.25) assessed cumulatively with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and the following other projects/plans: Tier 1 • Awel y Môr • Burbo Bank • Burbo Bank Extension • Erebus • Gwynt y Môr • Mona Offshore Wind Project • Ormonde	There is potential for a cumulative effect from operations and maintenance activities, so a detailed, quantitative cumulative effect assessment is required.

Potential cumulative effect	Phase[a]			Maximum Design Scenario	Justification
	C	O	D		
				• Rampion • Rampion 2 • Robin Rigg • Twinhub • Walney 1 • Walney 2 • Walney 3 • Walney 4 • West of Duddon Sands. • West of Orkney • White Cross Tier 2 • Morecambe Offshore Wind Farm: Generation Assets.	

5.11 Cumulative effects assessment

5.11.1 Overview

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

5.11.1.2 The CEA is presented in a series of tables (one for each potential cumulative impact), and considers the following:

- Scenario 1: Morgan Generation Assets together with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets
- Scenario 2: Morgan Generation Assets together with the Morecambe Offshore Windfarm Generation Assets and the Morgan and Morecambe Offshore Wind Farms: Transmission Assets
- Scenario 3: Tier 1, Tier 2 and Tier 3: Morgan Generation Assets together with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and other relevant projects and plans.

5.11.1.3 The CEA is limited by the data available upon which to base the assessment. Due to the age of developments in the Irish Sea and surrounding areas which have the potential to have a cumulative impact upon receptors, few have comparable datasets upon which to base an assessment. However, every effort has been made to obtain quantitative estimates for both displacement and collision from project-specific documentation. For displacement impacts this includes following the approach applied by many previous offshore wind farms using any available population data to calculate mean-pack or peak population estimates for use in displacement analyses.

5.11.1.4 Additionally, older developments did not carry out certain impact assessments (e.g. displacement and/or collision risk) for species for which cumulative assessments with the Morgan Generation Assets are required due to limited data at the time of assessment on the species' behavioural response to the presence of offshore wind turbines. As such, the CEA is carried out using data from wind farms with available species data to do so. For projects in early stages (i.e. Tier 3) there was insufficient project information in the public domain to allow the effects to be reasonably understood and a cumulative assessment undertaken. Tier 3 projects have therefore not been included in the cumulative assessment below.

5.11.1.5 For the cumulative assessment, impacts from Tier 1 and Tier 2 projects have been assessed together to provide the most precautionary impact on the population. This remains so irrespective of whether any Tier 2 project included in this assessment does not get consented/built.

5.11.1.6 Cumulative assessments incorporate projects located across large spatial scales with projects considered cumulatively potentially affecting different populations of birds than the focal project. This therefore has implications for the biogeographic populations against which impacts are assessed. Previous offshore wind farm assessments have used the same regional populations for project alone and cumulative assessments accepting that this has the potential within cumulative assessments to over-estimate the potential impact. The derivation of regional populations has been a topic of discussion as part of the EWG meetings and through these discussions the Applicant has decided to utilise a different approach to the calculation of regional breeding populations for cumulative assessments (when compared to the approach applied for the project alone assessments) which attempts to account for the larger number of colonies potentially impacted by cumulative projects and is consistent with the approach recommended by the EWG.

5.11.1.7 The approach to calculating regional breeding populations for the cumulative assessment utilises the population data from Furness (2015). The breeding adult and immature populations at those colonies within the relevant BDMPS area for each species are totalled to provide the total regional breeding population. The calculation for each species is provided in Table 5.66.

Table 5.66: Regional breeding populations for use in cumulative assessments.

Species	BDMPS area of relevance (Furness, 2015)	Total number of breeding adults	Total number of immature birds	Regional breeding population (no. of birds)
Kittiwake	UK western waters and Channel	130,444	114,790	245,234
Guillemot	UK western waters	658,338	487,190	1,145,528
Razorbill	UK western waters	113,696	85,273	198,969
Lesser black-backed gull	UK western waters	143,304	97,446	240,750
Herring gull	UK western waters	103,908	113,259	217,167
Great black-backed gull	UK south-west and Channel waters	19,802	24,951	44,753
Manx shearwater	UK western waters and Channel	989,970	831,574	1,821,544
Gannet	UK western waters	288,888	234,000	522,888

5.11.1.8 The regional populations defined in Table 5.17 for the post-breeding, non-breeding and pre-breeding seasons for relevant species remain the same and are used throughout the cumulative assessment.

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

5.11.2.1 There is potential for cumulative displacement as a result of construction and operational activities associated with the Morgan Generation Assets cumulatively with other developments.

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

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

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

5.11.2.5 The species assessed for cumulative displacement impacts were kittiwake, guillemot, razorbill, Manx shearwater and gannet. The predicted impact for fulmar from the Morgan Generation Assets represented less than 0.01% of the baseline mortality of all seasonal and annual regional populations. It is therefore considered that the Morgan Generation Assets will not materially contribute to any existing cumulative impact on this species.

5.11.2.6 The cumulative results are presented as displacement matrices ranging from 1% to 100% mortality and 10% to 100% displacement (depending on the species) and the range of displacement rates considered in the project alone assessment. Each cell presents potential cumulative bird mortality following displacement from the Morgan Generation Assets cumulatively with other offshore wind farm projects during each season. Light blue highlighted cells are based on the displacement and mortality rates used in the project alone displacement assessment Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

5.11.2.7 With regards to vessels in the Morgan Generation Assets, there is no method to quantify the displacement impact of the activities due to their local and temporary nature. An offshore EMP that will contain measures to minimise disturbance to rafting birds from transiting vessels will be secured as a requirement of the draft DCO/Marine Licences. It is therefore expected that impacts of vessels on seabirds are negligible due to the management of vessel traffic.

Construction phase

Magnitude of impact

Kittiwake

5.11.2.8 The estimated cumulative abundance of kittiwake from relevant projects is presented in Table 5.67.

Table 5.67: Kittiwake cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Note: Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Pre-breeding cumulative abundance	Breeding season cumulative abundance	Post-breeding cumulative abundance
Tier 1			
Awel y Môr	421	477	181
Erebus	508	2	2,022
Mona Offshore Wind Project	884	355	560
Rampion 2	286	5	97

Project	Pre-breeding cumulative abundance	Breeding season cumulative abundance	Post-breeding cumulative abundance
West of Orkney	1,217	690	Unavailable
White Cross	432	38	83
Tier 2			
Morecambe Offshore Wind Farm: Generation Assets.	568	2,625	2,574
Morgan Generation Assets	791	505	1,151
Scenario Totals			
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	**1,359**	**3,130**	**3,725**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	**5,106**	**4,697**	**6,667**

5.11.2.9 The following displacement matrices provide the estimated cumulative mortality of kittiwake predicted to occur due to displacement during construction. Table 5.68 to Table 5.70 provide outputs for Scenario 2 with Table 5.71 to Table 5.73 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue. The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

Table 5.68: Construction phase cumulative kittiwake mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 2).

Kittiwake (pre-breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	3	7	14	27	41	54	68	82	95	109	122	136
15	2	4	10	20	41	61	82	102	122	143	163	183	204
20	3	5	14	27	54	82	109	136	163	190	217	245	272
25	3	7	17	34	68	102	136	170	204	238	272	306	340
30	4	8	20	41	82	122	163	204	245	285	326	367	408
35	5	10	24	48	95	143	190	238	285	333	380	428	476
40	5	11	27	54	109	163	217	272	326	380	435	489	544
50	7	14	34	68	136	204	272	340	408	476	544	612	679
60	8	16	41	82	163	245	326	408	489	571	652	734	815
70	10	19	48	95	190	285	380	476	571	666	761	856	951
80	11	22	54	109	217	326	435	544	652	761	870	978	1087
90	12	24	61	122	245	367	489	612	734	856	978	1101	1223
100	14	27	68	136	272	408	544	679	815	951	1087	1223	1359

Table 5.69: Construction phase cumulative kittiwake mortality following displacement from offshore wind farms in the breeding season (Scenario 2).

Kittiwake (breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	3	6	16	31	63	94	125	157	188	219	250	282	313
15	5	9	23	47	94	141	188	235	282	329	376	423	470
20	6	13	31	63	125	188	250	313	376	438	501	563	626
25	8	16	39	78	157	235	313	391	470	548	626	704	783
30	9	19	47	94	188	282	376	470	563	657	751	845	939
35	11	22	55	110	219	329	438	548	657	767	876	986	1096
40	13	25	63	125	250	376	501	626	751	876	1002	1127	1252
50	16	31	78	157	313	470	626	783	939	1096	1252	1409	1565
60	19	38	94	188	376	563	751	939	1127	1315	1502	1690	1878
70	22	44	110	219	438	657	876	1096	1315	1534	1753	1972	2191
80	25	50	125	250	501	751	1002	1252	1502	1753	2003	2254	2504
90	28	56	141	282	563	845	1127	1409	1690	1972	2254	2535	2817
100	31	63	157	313	626	939	1252	1565	1878	2191	2504	2817	3130

Table 5.70: Construction phase cumulative kittiwake mortality following displacement from offshore wind farms in the post-breeding season (Scenario 2).

Kittiwake (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	4	7	19	37	74	112	149	186	223	261	298	335	372
	15	6	11	28	56	112	168	223	279	335	391	447	503	559
	20	7	15	37	74	149	223	298	372	447	521	596	670	745
	25	9	19	47	93	186	279	372	466	559	652	745	838	931
	30	11	22	56	112	223	335	447	559	670	782	894	1006	1117
	35	13	26	65	130	261	391	521	652	782	913	1043	1173	1304
	40	15	30	74	149	298	447	596	745	894	1043	1192	1341	1490
	50	19	37	93	186	372	559	745	931	1117	1304	1490	1676	1862
	60	22	45	112	223	447	670	894	1117	1341	1564	1788	2011	2235
	70	26	52	130	261	521	782	1043	1304	1564	1825	2086	2346	2607
	80	30	60	149	298	596	894	1192	1490	1788	2086	2384	2682	2980
	90	34	67	168	335	670	1006	1341	1676	2011	2346	2682	3017	3352
	100	37	74	186	372	745	1117	1490	1862	2235	2607	2980	3352	3725

Table 5.71: Construction phase cumulative kittiwake mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 3).

Kittiwake (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	5	10	26	51	102	153	204	255	306	357	408	460	511
	15	8	15	38	77	153	230	306	383	460	536	613	689	766
	20	10	20	51	102	204	306	408	511	613	715	817	919	1021
	25	13	26	64	128	255	383	511	638	766	894	1021	1149	1276
	30	15	31	77	153	306	460	613	766	919	1072	1225	1379	1532
	35	18	36	89	179	357	536	715	894	1072	1251	1430	1608	1787
	40	20	41	102	204	408	613	817	1021	1225	1430	1634	1838	2042
	50	26	51	128	255	511	766	1021	1276	1532	1787	2042	2298	2553
	60	31	61	153	306	613	919	1225	1532	1838	2144	2451	2757	3063
	70	36	71	179	357	715	1072	1430	1787	2144	2502	2859	3217	3574
	80	41	82	204	408	817	1225	1634	2042	2451	2859	3268	3676	4085
	90	46	92	230	460	919	1379	1838	2298	2757	3217	3676	4136	4595
	100	51	102	255	511	1021	1532	2042	2553	3063	3574	4085	4595	5106

Table 5.72: Construction phase cumulative kittiwake mortality following displacement from offshore wind farms in the breeding season (Scenario 3).

Kittiwake (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	5	9	23	47	94	141	188	235	282	329	376	423	470
	15	7	14	35	70	141	211	282	352	423	493	564	634	705
	20	9	19	47	94	188	282	376	470	564	658	751	845	939
	25	12	23	59	117	235	352	470	587	705	822	939	1057	1174
	30	14	28	70	141	282	423	564	705	845	986	1127	1268	1409
	35	16	33	82	164	329	493	658	822	986	1151	1315	1479	1644
	40	19	38	94	188	376	564	751	939	1127	1315	1503	1691	1879
	50	23	47	117	235	470	705	939	1174	1409	1644	1879	2114	2348
	60	28	56	141	282	564	845	1127	1409	1691	1973	2254	2536	2818
	70	33	66	164	329	658	986	1315	1644	1973	2301	2630	2959	3288
	80	38	75	188	376	751	1127	1503	1879	2254	2630	3006	3382	3757
	90	42	85	211	423	845	1268	1691	2114	2536	2959	3382	3804	4227
	100	47	94	235	470	939	1409	1879	2348	2818	3288	3757	4227	4697

Table 5.73: Construction phase cumulative kittiwake mortality following displacement from offshore wind farms in the post-breeding season (Scenario 3).

Kittiwake (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	7	13	33	67	133	200	267	333	400	467	533	600	667
	15	10	20	50	100	200	300	400	500	600	700	800	900	1000
	20	13	27	67	133	267	400	533	667	800	933	1067	1200	1333
	25	17	33	83	167	333	500	667	833	1000	1167	1333	1500	1667
	30	20	40	100	200	400	600	800	1000	1200	1400	1600	1800	2000
	35	23	47	117	233	467	700	933	1167	1400	1633	1867	2100	2333
	40	27	53	133	267	533	800	1067	1333	1600	1867	2133	2400	2667
	50	33	67	167	333	667	1000	1333	1667	2000	2333	2667	3000	3333
	60	40	80	200	400	800	1200	1600	2000	2400	2800	3200	3600	4000
	70	47	93	233	467	933	1400	1867	2333	2800	3267	3733	4200	4667
	80	53	107	267	533	1067	1600	2133	2667	3200	3733	4267	4800	5333
	90	60	120	300	600	1200	1800	2400	3000	3600	4200	4800	5400	6000
	100	67	133	333	667	1333	2000	2667	3333	4000	4667	5333	6000	6667

Table 5.74: Cumulative assessment for kittiwake in relation to cumulative disturbance and displacement impacts during the construction phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Construction			
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets, Morgan and Morecambe Offshore Wind Farms: Transmission Assets The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets, Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets. The displacement mortality associated with the range of displacement and mortality rates considered for kittiwake in all seasons do not surpass the 1% threshold of relevant regional populations. The 1% threshold is also not surpassed when seasonal impacts are combined and assessed against the largest regional population. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The displacement mortality associated with the range of displacement and mortality rates considered for kittiwake in all seasons do not surpass the 1% threshold of relevant regional populations. The 1% threshold is also not surpassed when seasonal impacts are combined and assessed against the largest regional population. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	
Sensitivity of receptor	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.49 to 5.9.1.52). Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.49 to 5.9.1.52). Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.49 to 5.9.1.52). Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Guillemot

5.11.2.10 The estimated mean peak cumulative abundances of guillemot from the relevant projects (projects that potentially overlap in their construction activities with Morgan Generation Assets) during each season are presented in Table 5.75.

Table 5.75: Guillemot cumulative abundances for potential overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Note: Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Breeding season cumulative abundance	Non-breeding season cumulative abundance
Tier 1		
Awel y Môr	1,569	2,919
Erebus	7,001	28,338
Mona Offshore Wind Project	4,220	3,756
West of Orkney	7,973	4,393
White Cross	3,304	1,059
Tier 2		
Morecambe Offshore Wind Farm: Generation Assets.	4,050	7,647
Morgan Generation Assets	4,010	3,824
Scenario Totals		
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	**8,060**	**11,471**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	**32,127**	**51,936**

5.11.2.11 The following displacement matrices provide the estimated cumulative mortality of guillemot predicted to occur due to displacement during construction. Table 5.76 and Table 5.77 provide outputs for Scenario 2 with Table 5.78 and Table 5.79 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

Table 5.76: Construction phase cumulative guillemot mortality following displacement from offshore wind farms in the breeding season – (Scenario 2).

Guillemot (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	8	16	40	81	161	242	322	403	484	564	645	725	806
	15	12	24	60	121	242	363	484	605	725	846	967	1088	1209
	20	16	32	81	161	322	484	645	806	967	1128	1290	1451	1612
	25	20	40	101	202	403	605	806	1008	1209	1411	1612	1814	2015
	30	24	48	121	242	484	725	967	1209	1451	1693	1934	2176	2418
	35	28	56	141	282	564	846	1128	1411	1693	1975	2257	2539	2821
	40	32	64	161	322	645	967	1290	1612	1934	2257	2579	2902	3224
	50	40	81	202	403	806	1209	1612	2015	2418	2821	3224	3627	4030
	60	48	97	242	484	967	1451	1934	2418	2902	3385	3869	4352	4836
	70	56	113	282	564	1128	1693	2257	2821	3385	3949	4514	5078	5642
	80	64	129	322	645	1290	1934	2579	3224	3869	4514	5158	5803	6448
	90	73	145	363	725	1451	2176	2902	3627	4352	5078	5803	6529	7254
	100	81	161	403	806	1612	2418	3224	4030	4836	5642	6448	7254	8060

Table 5.77: Construction phase cumulative guillemot mortality following displacement from offshore wind farms in the non-breeding season – (Scenario 2).

Guillemot (non-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	11	23	57	115	229	344	459	574	688	803	918	1032	1147
	15	17	34	86	172	344	516	688	860	1032	1204	1376	1549	1721
	20	23	46	115	229	459	688	918	1147	1376	1606	1835	2065	2294
	25	29	57	143	287	574	860	1147	1434	1721	2007	2294	2581	2868
	30	34	69	172	344	688	1032	1376	1721	2065	2409	2753	3097	3441
	35	40	80	201	401	803	1204	1606	2007	2409	2810	3212	3613	4015
	40	46	92	229	459	918	1376	1835	2294	2753	3212	3671	4129	4588
	50	57	115	287	574	1147	1721	2294	2868	3441	4015	4588	5162	5735
	60	69	138	344	688	1376	2065	2753	3441	4129	4818	5506	6194	6882
	70	80	161	401	803	1606	2409	3212	4015	4818	5621	6424	7226	8029
	80	92	184	459	918	1835	2753	3671	4588	5506	6424	7341	8259	9176
	90	103	206	516	1032	2065	3097	4129	5162	6194	7226	8259	9291	10324
	100	115	229	574	1147	2294	3441	4588	5735	6882	8029	9176	10324	11471

Table 5.78: Construction phase cumulative guillemot mortality following displacement from offshore wind farms in the breeding season – (Scenario 3).

Guillemot (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	32	64	161	321	643	964	1285	1606	1928	2249	2570	2891	3213
	15	48	96	241	482	964	1446	1928	2409	2891	3373	3855	4337	4819
	20	64	129	321	643	1285	1928	2570	3213	3855	4498	5140	5783	6425
	25	80	161	402	803	1606	2409	3213	4016	4819	5622	6425	7228	8032
	30	96	193	482	964	1928	2891	3855	4819	5783	6747	7710	8674	9638
	35	112	225	562	1124	2249	3373	4498	5622	6747	7871	8995	10120	11244
	40	129	257	643	1285	2570	3855	5140	6425	7710	8995	10280	11566	12851
	50	161	321	803	1606	3213	4819	6425	8032	9638	11244	12851	14457	16063
	60	193	386	964	1928	3855	5783	7710	9638	11566	13493	15421	17348	19276
	70	225	450	1124	2249	4498	6747	8995	11244	13493	15742	17991	20240	22489
	80	257	514	1285	2570	5140	7710	10280	12851	15421	17991	20561	23131	25701
	90	289	578	1446	2891	5783	8674	11566	14457	17348	20240	23131	26023	28914
	100	321	643	1606	3213	6425	9638	12851	16063	19276	22489	25701	28914	32127

Table 5.79: Construction phase cumulative guillemot mortality following displacement from offshore wind farms in the non-breeding season – (Scenario 3).

Guillemot (non-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	52	104	260	519	1039	1558	2077	2597	3116	3635	4155	4674	5194
	15	78	156	390	779	1558	2337	3116	3895	4674	5453	6232	7011	7790
	20	104	208	519	1039	2077	3116	4155	5194	6232	7271	8310	9348	10387
	25	130	260	649	1298	2597	3895	5194	6492	7790	9089	10387	11685	12984
	30	156	312	779	1558	3116	4674	6232	7790	9348	10906	12465	14023	15581
	35	182	364	909	1818	3635	5453	7271	9089	10906	12724	14542	16360	18177
	40	208	415	1039	2077	4155	6232	8310	10387	12465	14542	16619	18697	20774
	50	260	519	1298	2597	5194	7790	10387	12984	15581	18177	20774	23371	25968
	60	312	623	1558	3116	6232	9348	12465	15581	18697	21813	24929	28045	31161
	70	364	727	1818	3635	7271	10906	14542	18177	21813	25448	29084	32719	36355
	80	415	831	2077	4155	8310	12465	16619	20774	24929	29084	33239	37394	41548
	90	467	935	2337	4674	9348	14023	18697	23371	28045	32719	37394	42068	46742
	100	519	1039	2597	5194	10387	15581	20774	25968	31161	36355	41548	46742	51936

Table 5.80: Cumulative assessment for guillemot in relation to cumulative disturbance and displacement impacts during the construction phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets . The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets. The displacement mortality associated with the range of displacement and mortality rates considered for guillemot in all seasons do not surpass the 1% threshold of relevant regional populations. The 1% threshold is also not surpassed when seasonal impacts are combined and assessed against the largest regional population. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects The displacement mortality associated with the range of displacement and mortality rates considered for guillemot in all seasons and when all seasons are combined does not surpass the 1% threshold of relevant regional populations with the exception of when applying the upper rates in both displacement and mortality rates in the breeding season. As discussed in paragraphs 5.9.1.13 to 5.9.1.19 it is considered that a displacement rate of 25% and mortality rate of 1% is appropriate for guillemot in the construction phase. As a result it is considered that impacts in all seasons and when combined will not surpass the 1% baseline mortality threshold for the relevant regional populations. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		totals for individual projects and between projects.	likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.
Sensitivity of receptor	The sensitivity of guillemot is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.53 to 5.9.1.56). Guillemot is deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of guillemot is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.53 to 5.9.1.56). Guillemot is deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of guillemot is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.53 to 5.9.1.56). Guillemot is deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Razorbill

5.11.2.12 The estimated cumulative abundance of razorbill from the relevant projects (projects that overlap in their construction activities with Morgan) are presented in Table 5.81.

Table 5.81: Razorbill cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Note: Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Pre-breeding cumulative abundance	Breeding season cumulative abundance	Post-breeding cumulative abundance	Non-breeding cumulative abundance
Tier 1				
Awel y Môr	336	140	66	150
Erebus	896	194	1,708	1,069
Mona Offshore Wind Project	1,924	83	91	421
West of Orkney	74	141	112	19
White Cross	345	40	40	361
Tier 2				
Morecambe Offshore Wind Farm: Generation Assets.	389	222	674	596
Morgan Generation Assets	328	35	254	1,170
Scenario Totals				
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	**717**	**257**	**928**	**1,766**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	4,291	855	2,945	3,786

5.11.2.13 The following displacement matrices provide the estimated cumulative mortality of razorbill predicted to occur due to displacement during construction. Table 5.82 to Table 5.85 provide outputs for Scenario 2 with Table 5.86 to Table 5.89 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

Table 5.82: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Razorbill (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	1	4	7	14	22	29	36	43	50	57	65	72
	15	1	2	5	11	22	32	43	54	65	75	86	97	108
	20	1	3	7	14	29	43	57	72	86	100	115	129	143
	25	2	4	9	18	36	54	72	90	108	125	143	161	179
	30	2	4	11	22	43	65	86	108	129	151	172	194	215
	35	3	5	13	25	50	75	100	125	151	176	201	226	251
	40	3	6	14	29	57	86	115	143	172	201	229	258	287
	50	4	7	18	36	72	108	143	179	215	251	287	323	358
	60	4	9	22	43	86	129	172	215	258	301	344	387	430
	70	5	10	25	50	100	151	201	251	301	351	401	452	502
	80	6	11	29	57	115	172	229	287	344	401	459	516	573
	90	6	13	32	65	129	194	258	323	387	452	516	581	645
	100	7	14	36	72	143	215	287	358	430	502	573	645	717

Table 5.83: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Razorbill (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	1	1	3	5	8	10	13	15	18	21	23	26
	15	0	1	2	4	8	12	15	19	23	27	31	35	39
	20	1	1	3	5	10	15	21	26	31	36	41	46	51
	25	1	1	3	6	13	19	26	32	39	45	51	58	64
	30	1	2	4	8	15	23	31	39	46	54	62	69	77
	35	1	2	4	9	18	27	36	45	54	63	72	81	90
	40	1	2	5	10	21	31	41	51	62	72	82	92	103
	50	1	3	6	13	26	39	51	64	77	90	103	116	128
	60	2	3	8	15	31	46	62	77	92	108	123	139	154
	70	2	4	9	18	36	54	72	90	108	126	144	162	180
	80	2	4	10	21	41	62	82	103	123	144	164	185	205
	90	2	5	12	23	46	69	92	116	139	162	185	208	231
	100	3	5	13	26	51	77	103	128	154	180	205	231	257

Table 5.84: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the post-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Razorbill (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	2	5	9	19	28	37	46	56	65	74	83	93
	15	1	3	7	14	28	42	56	70	83	97	111	125	139
	20	2	4	9	19	37	56	74	93	111	130	148	167	186
	25	2	5	12	23	46	70	93	116	139	162	186	209	232
	30	3	6	14	28	56	83	111	139	167	195	223	250	278
	35	3	6	16	32	65	97	130	162	195	227	260	292	325
	40	4	7	19	37	74	111	148	186	223	260	297	334	371
	50	5	9	23	46	93	139	186	232	278	325	371	417	464
	60	6	11	28	56	111	167	223	278	334	390	445	501	557
	70	6	13	32	65	130	195	260	325	390	454	519	584	649
	80	7	15	37	74	148	223	297	371	445	519	594	668	742
	90	8	17	42	83	167	250	334	417	501	584	668	751	835
	100	9	19	46	93	186	278	371	464	557	649	742	835	928

Table 5.85: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the non-breeding season (Scenario 2).

Razorbill (non-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	2	4	9	18	35	53	71	88	106	124	141	159	177
	15	3	5	13	26	53	79	106	132	159	185	212	238	265
	20	4	7	18	35	71	106	141	177	212	247	283	318	353
	25	4	9	22	44	88	132	177	221	265	309	353	397	442
	30	5	11	26	53	106	159	212	265	318	371	424	477	530
	35	6	12	31	62	124	185	247	309	371	433	494	556	618
	40	7	14	35	71	141	212	283	353	424	494	565	636	706
	50	9	18	44	88	177	265	353	442	530	618	706	795	883
	60	11	21	53	106	212	318	424	530	636	742	848	954	1060
	70	12	25	62	124	247	371	494	618	742	865	989	1113	1236
	80	14	28	71	141	283	424	565	706	848	989	1130	1272	1413
	90	16	32	79	159	318	477	636	795	954	1113	1272	1430	1589
	100	18	35	88	177	353	530	706	883	1060	1236	1413	1589	1766

Table 5.86: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 3).

Razorbill (pre-breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	9	21	43	86	129	172	215	257	300	343	386	429
15	6	13	32	64	129	193	257	322	386	451	515	579	644
20	9	17	43	86	172	257	343	429	515	601	687	772	858
25	11	21	54	107	215	322	429	536	644	751	858	966	1073
30	13	26	64	129	257	386	515	644	772	901	1030	1159	1287
35	15	30	75	150	300	451	601	751	901	1051	1202	1352	1502
40	17	34	86	172	343	515	687	858	1030	1202	1373	1545	1717
50	21	43	107	215	429	644	858	1073	1287	1502	1717	1931	2146
60	26	51	129	257	515	772	1030	1287	1545	1802	2060	2317	2575
70	30	60	150	300	601	901	1202	1502	1802	2103	2403	2704	3004
80	34	69	172	343	687	1030	1373	1717	2060	2403	2746	3090	3433
90	39	77	193	386	772	1159	1545	1931	2317	2704	3090	3476	3862
100	43	86	215	429	858	1287	1717	2146	2575	3004	3433	3862	4291

Table 5.87: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the breeding season (Scenario 3).

Razorbill (breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	1	2	4	9	17	26	34	43	51	60	68	77	85
15	1	3	6	13	26	38	51	64	77	90	103	115	128
20	2	3	9	17	34	51	68	85	103	120	137	154	171
25	2	4	11	21	43	64	85	107	128	150	171	192	214
30	3	5	13	26	51	77	103	128	154	180	205	231	256
35	3	6	15	30	60	90	120	150	180	209	239	269	299
40	3	7	17	34	68	103	137	171	205	239	274	308	342
50	4	9	21	43	85	128	171	214	256	299	342	385	427
60	5	10	26	51	103	154	205	256	308	359	410	462	513
70	6	12	30	60	120	180	239	299	359	419	479	539	598
80	7	14	34	68	137	205	274	342	410	479	547	616	684
90	8	15	38	77	154	231	308	385	462	539	616	693	769
100	9	17	43	85	171	256	342	427	513	598	684	769	855

Table 5.88: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the post-breeding season (Scenario 3).

Razorbill (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	3	6	15	29	59	88	118	147	177	206	236	265	294
	15	4	9	22	44	88	133	177	221	265	309	353	398	442
	20	6	12	29	59	118	177	236	294	353	412	471	530	589
	25	7	15	37	74	147	221	294	368	442	515	589	663	736
	30	9	18	44	88	177	265	353	442	530	618	707	795	883
	35	10	21	52	103	206	309	412	515	618	721	825	928	1031
	40	12	24	59	118	236	353	471	589	707	825	942	1060	1178
	50	15	29	74	147	294	442	589	736	883	1031	1178	1325	1472
	60	18	35	88	177	353	530	707	883	1060	1237	1414	1590	1767
	70	21	41	103	206	412	618	825	1031	1237	1443	1649	1855	2061
	80	24	47	118	236	471	707	942	1178	1414	1649	1885	2120	2356
	90	27	53	133	265	530	795	1060	1325	1590	1855	2120	2385	2650
	100	29	59	147	294	589	883	1178	1472	1767	2061	2356	2650	2945

Table 5.89: Construction phase cumulative razorbill mortality following displacement from offshore wind farms in the non-breeding season (Scenario 3).

Razorbill (non-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	4	8	19	38	76	114	151	189	227	265	303	341	379
	15	6	11	28	57	114	170	227	284	341	398	454	511	568
	20	8	15	38	76	151	227	303	379	454	530	606	682	757
	25	9	19	47	95	189	284	379	473	568	663	757	852	947
	30	11	23	57	114	227	341	454	568	682	795	909	1022	1136
	35	13	27	66	133	265	398	530	663	795	928	1060	1193	1325
	40	15	30	76	151	303	454	606	757	909	1060	1212	1363	1515
	50	19	38	95	189	379	568	757	947	1136	1325	1515	1704	1893
	60	23	45	114	227	454	682	909	1136	1363	1590	1817	2045	2272
	70	27	53	133	265	530	795	1060	1325	1590	1855	2120	2385	2650
	80	30	61	151	303	606	909	1212	1515	1817	2120	2423	2726	3029
	90	34	68	170	341	682	1022	1363	1704	2045	2385	2726	3067	3408
	100	38	76	189	379	757	1136	1515	1893	2272	2650	3029	3408	3786

Table 5.90: Cumulative assessment for razorbill in relation to cumulative disturbance and displacement impacts during the construction phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Construction			
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets . The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets. The displacement mortality associated with the range of displacement and mortality rates considered for razorbill all seasons do not surpass the 1% threshold of relevant regional populations. The 1% threshold is also not surpassed when seasonal impacts are combined and assessed against the largest regional population. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The displacement mortality associated with the range of displacement and mortality rates considered for razorbill all seasons do not surpass the 1% threshold of relevant regional populations. The 1% threshold is also not surpassed when seasonal impacts are combined and assessed against the largest regional population. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		totals for individual projects and between projects.	
Sensitivity of receptor	The sensitivity of razorbill is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.57 to 5.9.1.60). Razorbill is deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of razorbill is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.57 to 5.9.1.60). Razorbill is deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of razorbill is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.57 to 5.9.1.60). Razorbill is deemed to be of medium vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Manx shearwater

5.11.2.14 The estimated cumulative abundance of Manx shearwater from relevant projects is presented in Table 5.67.

Table 5.91: Manx shearwater cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Pre-breeding cumulative abundance	Breeding season cumulative abundance	Post-breeding cumulative abundance
Tier 1			
Awel y Môr	177	26	214
Erebus	18	1,540	557
Mona Offshore Wind Project	3	1,249	182
West of Orkney	0	12	3
White Cross	33	12,126	22
Tier 2			
Morecambe Offshore Wind Farm: Generation Assets.	0	7,577	6
Morgan Generation Assets	0	1,254	911
Scenario totals			
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	**0**	**8,831**	**917**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	**231**	**23,784**	**1,895**

5.11.2.15 The following displacement matrices provide the estimated cumulative mortality of Manx shearwater predicted to occur due to displacement during construction. Table 5.92 to Table 5.94 provide outputs for Scenario 2 with Table 5.95 to Table 5.97 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

Table 5.92: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 2) (All entries are zero).

Manx shearwater (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	0	0	0	0	0	0	0	0	0	0	0	0
	15	0	0	0	0	0	0	0	0	0	0	0	0	0
	20	0	0	0	0	0	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0	0	0	0	0	0
	40	0	0	0	0	0	0	0	0	0	0	0	0	0
	50	0	0	0	0	0	0	0	0	0	0	0	0	0
	60	0	0	0	0	0	0	0	0	0	0	0	0	0
	70	0	0	0	0	0	0	0	0	0	0	0	0	0
	80	0	0	0	0	0	0	0	0	0	0	0	0	0
	90	0	0	0	0	0	0	0	0	0	0	0	0	0
	100	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5.93: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the breeding season (Scenario 2).

Manx shearwater (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	9	18	44	88	177	265	353	442	530	618	706	795	883
	15	13	26	66	132	265	397	530	662	795	927	1060	1192	1325
	20	18	35	88	177	353	530	706	883	1060	1236	1413	1590	1766
	30	26	53	132	265	530	795	1060	1325	1590	1855	2119	2384	2649
	35	31	62	155	309	618	927	1236	1545	1855	2164	2473	2782	3091
	40	35	71	177	353	706	1060	1413	1766	2119	2473	2826	3179	3532
	50	44	88	221	442	883	1325	1766	2208	2649	3091	3532	3974	4415
	60	53	106	265	530	1060	1590	2119	2649	3179	3709	4239	4769	5299
	70	62	124	309	618	1236	1855	2473	3091	3709	4327	4945	5564	6182
	80	71	141	353	706	1413	2119	2826	3532	4239	4945	5652	6358	7065
	90	79	159	397	795	1590	2384	3179	3974	4769	5564	6358	7153	7948
	100	88	177	442	883	1766	2649	3532	4415	5299	6182	7065	7948	8831

Table 5.94: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the post-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Manx shearwater (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	2	5	9	18	28	37	46	55	64	73	83	92
	15	1	3	7	14	28	41	55	69	83	96	110	124	138
	20	2	4	9	18	37	55	73	92	110	128	147	165	183
	30	3	6	14	28	55	83	110	138	165	193	220	248	275
	35	3	6	16	32	64	96	128	160	193	225	257	289	321
	40	4	7	18	37	73	110	147	183	220	257	293	330	367
	50	5	9	23	46	92	138	183	229	275	321	367	413	459
	60	6	11	28	55	110	165	220	275	330	385	440	495	550
	70	6	13	32	64	128	193	257	321	385	449	514	578	642
	80	7	15	37	73	147	220	293	367	440	514	587	660	734
	90	8	17	41	83	165	248	330	413	495	578	660	743	825
	100	9	18	46	92	183	275	367	459	550	642	734	825	917

Table 5.95: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 3) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Manx shearwater (pre-breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	0	0	1	2	5	7	9	12	14	16	18	21	23
15	0	1	2	3	7	10	14	17	21	24	28	31	35
20	0	1	2	5	9	14	18	23	28	32	37	42	46
30	1	1	3	7	14	21	28	35	42	49	55	62	69
35	1	2	4	8	16	24	32	40	49	57	65	73	81
40	1	2	5	9	18	28	37	46	55	65	74	83	92
50	1	2	6	12	23	35	46	58	69	81	92	104	116
60	1	3	7	14	28	42	55	69	83	97	111	125	139
70	2	3	8	16	32	49	65	81	97	113	129	146	162
80	2	4	9	18	37	55	74	92	111	129	148	166	185
90	2	4	10	21	42	62	83	104	125	146	166	187	208
100	2	5	12	23	46	69	92	116	139	162	185	208	231

Table 5.96: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the breeding season (Scenario 3).

Manx shearwater (breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	24	48	119	238	476	714	951	1189	1427	1665	1903	2141	2378
15	36	71	178	357	714	1070	1427	1784	2141	2497	2854	3211	3568
20	48	95	238	476	951	1427	1903	2378	2854	3330	3805	4281	4757
30	71	143	357	714	1427	2141	2854	3568	4281	4995	5708	6422	7135
35	83	166	416	832	1665	2497	3330	4162	4995	5827	6659	7492	8324
40	95	190	476	951	1903	2854	3805	4757	5708	6659	7611	8562	9513
50	119	238	595	1189	2378	3568	4757	5946	7135	8324	9513	10703	11892
60	143	285	714	1427	2854	4281	5708	7135	8562	9989	11416	12843	14270
70	166	333	832	1665	3330	4995	6659	8324	9989	11654	13319	14984	16649
80	190	381	951	1903	3805	5708	7611	9513	11416	13319	15222	17124	19027
90	214	428	1070	2141	4281	6422	8562	10703	12843	14984	17124	19265	21405
100	238	476	1189	2378	4757	7135	9513	11892	14270	16649	19027	21405	23784

Table 5.97: Construction phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the post-breeding season (Scenario 3) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Manx shearwater (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	2	4	9	19	38	57	76	95	114	133	152	171	189
	15	3	6	14	28	57	85	114	142	171	199	227	256	284
	20	4	8	19	38	76	114	152	189	227	265	303	341	379
	30	6	11	28	57	114	171	227	284	341	398	455	512	568
	35	7	13	33	66	133	199	265	332	398	464	531	597	663
	40	8	15	38	76	152	227	303	379	455	531	606	682	758
	50	9	19	47	95	189	284	379	474	568	663	758	853	947
	60	11	23	57	114	227	341	455	568	682	796	909	1023	1137
	70	13	27	66	133	265	398	531	663	796	928	1061	1194	1326
	80	15	30	76	152	303	455	606	758	909	1061	1213	1364	1516
	90	17	34	85	171	341	512	682	853	1023	1194	1364	1535	1705
	100	19	38	95	189	379	568	758	947	1137	1326	1516	1705	1895

Table 5.98: Cumulative assessment for Manx shearwater in relation to cumulative disturbance and displacement impacts during the construction phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Construction			
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets . The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets. The displacement mortality associated with the range of displacement and mortality rates considered for Manx shearwater in all seasons do not surpass the 1% threshold of relevant regional populations. The 1% threshold is also not surpassed when seasonal impacts are combined and assessed against the largest regional population. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The displacement mortality associated with the range of displacement and mortality rates considered for Manx shearwater in all seasons do not surpass the 1% threshold of relevant regional populations. The 1% threshold is also not surpassed when seasonal impacts are combined and assessed against the largest regional population. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		totals for individual projects and between projects.	
Sensitivity of receptor	The sensitivity of Manx shearwater is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.65 to 5.9.1.68). Manx shearwater is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of Manx shearwater is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.65 to 5.9.1.68). Manx shearwater is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of Manx shearwater is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.65 to 5.9.1.68). Manx shearwater is deemed to be of low vulnerability, low recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Gannet

5.11.2.16 The estimated cumulative abundance of gannet from relevant projects is presented in Table 5.99.

Table 5.99: Gannet cumulative abundances for overlapping construction phase offshore wind projects for disturbance and displacement assessment.

Project	Pre-breeding cumulative abundance	Breeding season cumulative abundance	Post-breeding cumulative abundance
Tier 1			
Awel y Môr	0	328	201
Erebus	100	224	334
Mona Offshore Wind Project	28	251	58
West of Orkney	140	852	1,368
White Cross	57	239	141
Tier 2			
Morecambe Offshore Wind Farm: Generation Assets.	0	748	164
Morgan Generation Assets	35	154	65
Scenario Totals			
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	**35**	**902**	**229**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	**360**	**2,796**	**2,331**

5.11.2.17 The following displacement matrices provide the estimated cumulative mortality of gannet predicted to occur due to displacement during construction. Table 5.100 to Table 5.102 provide outputs for Scenario 2 with Table 5.103 to Table 5.105 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

Table 5.100: Construction phase cumulative gannet mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Gannet (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	0	0	0	1	1	1	2	2	2	3	3	4
	20	0	0	0	1	1	2	3	4	4	5	6	6	7
	30	0	0	1	1	2	3	4	5	6	7	8	9	11
	35	0	0	1	1	2	4	5	6	7	9	10	11	12
	40	0	0	1	1	3	4	6	7	8	10	11	13	14
	50	0	0	1	2	4	5	7	9	11	12	14	16	18
	60	0	0	1	2	4	6	8	11	13	15	17	19	21
	70	0	0	1	2	5	7	10	12	15	17	20	22	25
	80	0	1	1	3	6	8	11	14	17	20	22	25	28
	90	0	1	2	3	6	9	13	16	19	22	25	28	32
	100	0	1	2	4	7	11	14	18	21	25	28	32	35

Table 5.101: Construction phase cumulative gannet mortality following displacement from offshore wind farms in the breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Gannet (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	2	5	9	18	27	36	45	54	63	72	81	90
	20	2	4	9	18	36	54	72	90	108	126	144	162	180
	30	3	5	14	27	54	81	108	135	162	189	216	243	271
	35	3	6	16	32	63	95	126	158	189	221	253	284	316
	40	4	7	18	36	72	108	144	180	216	253	289	325	361
	50	5	9	23	45	90	135	180	225	271	316	361	406	451
	60	5	11	27	54	108	162	216	271	325	379	433	487	541
	70	6	13	32	63	126	189	253	316	379	442	505	568	631
	80	7	14	36	72	144	216	289	361	433	505	577	649	721
	90	8	16	41	81	162	243	325	406	487	568	649	730	812
	100	9	18	45	90	180	271	361	451	541	631	721	812	902

Table 5.102: Construction phase cumulative gannet mortality following displacement from offshore wind farms in the post-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Gannet (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	0	1	2	5	7	9	11	14	16	18	21	23
	20	0	1	2	5	9	14	18	23	27	32	37	41	46
	30	1	1	3	7	14	21	27	34	41	48	55	62	69
	35	1	2	4	8	16	24	32	40	48	56	64	72	80
	40	1	2	5	9	18	27	37	46	55	64	73	82	92
	50	1	2	6	11	23	34	46	57	69	80	92	103	115
	60	1	3	7	14	27	41	55	69	82	96	110	124	137
	70	2	3	8	16	32	48	64	80	96	112	128	144	160
	80	2	4	9	18	37	55	73	92	110	128	147	165	183
	90	2	4	10	21	41	62	82	103	124	144	165	186	206
	100	2	5	11	23	46	69	92	115	137	160	183	206	229

Table 5.103: Construction phase cumulative gannet mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 3) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Gannet (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	1	2	4	7	11	14	18	22	25	29	32	36
	20	1	1	4	7	14	22	29	36	43	50	58	65	72
	30	1	2	5	11	22	32	43	54	65	76	86	97	108
	35	1	3	6	13	25	38	50	63	76	88	101	113	126
	40	1	3	7	14	29	43	58	72	86	101	115	129	144
	50	2	4	9	18	36	54	72	90	108	126	144	162	180
	60	2	4	11	22	43	65	86	108	129	151	173	194	216
	70	3	5	13	25	50	76	101	126	151	176	201	227	252
	80	3	6	14	29	58	86	115	144	173	201	230	259	288
	90	3	6	16	32	65	97	129	162	194	227	259	291	324
	100	4	7	18	36	72	108	144	180	216	252	288	324	360

Table 5.104: Construction phase cumulative gannet mortality following displacement from offshore wind farms in the breeding season (Scenario 3).

Gannet (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	3	6	14	28	56	84	112	140	168	196	224	252	280
	20	6	11	28	56	112	168	224	280	335	391	447	503	559
	30	8	17	42	84	168	252	335	419	503	587	671	755	839
	35	10	20	49	98	196	294	391	489	587	685	783	881	978
	40	11	22	56	112	224	335	447	559	671	783	895	1006	1118
	50	14	28	70	140	280	419	559	699	839	978	1118	1258	1398
	60	17	34	84	168	335	503	671	839	1006	1174	1342	1510	1677
	70	20	39	98	196	391	587	783	978	1174	1370	1565	1761	1957
	80	22	45	112	224	447	671	895	1118	1342	1565	1789	2013	2236
	90	25	50	126	252	503	755	1006	1258	1510	1761	2013	2264	2516
	100	28	56	140	280	559	839	1118	1398	1677	1957	2236	2516	2796

Table 5.105: Construction phase cumulative gannet mortality following displacement from offshore wind farms in the post-breeding season (Scenario 3)

Gannet (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	2	5	12	23	47	70	93	117	140	163	186	210	233
	20	5	9	23	47	93	140	186	233	280	326	373	420	466
	30	7	14	35	70	140	210	280	350	420	490	559	629	699
	35	8	16	41	82	163	245	326	408	490	571	653	734	816
	40	9	19	47	93	186	280	373	466	559	653	746	839	932
	50	12	23	58	117	233	350	466	583	699	816	932	1049	1166
	60	14	28	70	140	280	420	559	699	839	979	1119	1259	1399
	70	16	33	82	163	326	490	653	816	979	1142	1305	1469	1632
	80	19	37	93	186	373	559	746	932	1119	1305	1492	1678	1865
	90	21	42	105	210	420	629	839	1049	1259	1469	1678	1888	2098
	100	23	47	117	233	466	699	932	1166	1399	1632	1865	2098	2331

Table 5.106: Cumulative assessment for gannet in relation to cumulative disturbance and displacement impacts during the construction phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Construction			
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets . The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets. The displacement mortality associated with the range of displacement and mortality rates considered for gannet in all seasons do not surpass the 1% threshold of relevant regional populations. The 1% threshold is also not surpassed when seasonal impacts are combined and assessed against the largest regional population. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The displacement mortality associated with the range of displacement and mortality rates considered for gannet in all seasons do not surpass the 1% threshold of relevant regional populations. The 1% threshold is also not surpassed when seasonal impacts are combined and assessed against the largest regional population. The impact is predicted to be of short-term duration and affecting only a localised area meaning that the expected mortality rate is likely to be on the lower end of the range considered. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		totals for individual projects and between projects.	
Sensitivity of receptor	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.69 to 5.9.1.72). Gannet is deemed to be of very low vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore, considered, on a precautionary basis, to be medium.	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.69 to 5.9.1.72). Gannet is deemed to be of very low vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore, considered, on a precautionary basis, to be medium.	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.69 to 5.9.1.72). Gannet is deemed to be of very low vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore, considered, on a precautionary basis, to be medium.
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Operations and maintenance phase

Magnitude of impact

Kittiwake

5.11.2.18 The estimated cumulative abundance of kittiwake from relevant projects is presented in Table 5.107 There are several projects for which there are no, or limited, data on the number of kittiwake predicted to be displaced, for some of the earlier developments these are discussed in Table 5.114.

Table 5.107: Kittiwake cumulative abundances for offshore wind projects for disturbance and displacement assessment during operations.

Note: Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Pre-breeding season cumulative abundance	Breeding season cumulative abundance	Post-breeding season cumulative abundance
Tier 1			
Awel y Môr	421	477	181
Burbo Bank	Unavailable – see Table 5.114		
Burbo Bank Extension	140	1,318	276
Erebus	508	2	2,022
Gwynt y Môr	Unavailable – see Table 5.114		
Mona Offshore Wind Project	884	355	560
Ormonde	Unavailable – see Table 5.114	60	Unavailable – see Table 5.114
Rampion	375	401	429
Rampion 2	286	5	97
Robin Rigg	Unavailable – see Table 5.114	162	Unavailable – see Table 5.114
Twinhub	Unavailable	9	106
Walney 1 & 2	Unavailable – see Table 5.114		
Walney 3 & 4	336	161	645
West of Duddon Sands	Unavailable – see Table 5.114	454	Unavailable – see Table 5.114
West of Orkney	1,217	690	Unavailable
White Cross	432	38	83
Tier 2			
Morecambe Offshore Wind Farm: Generation Assets	568	2,625	2,574
Morgan Generation Assets	791	505	1,151

Project	Pre-breeding season cumulative abundance	Breeding season cumulative abundance	Post-breeding season cumulative abundance
Scenario Totals			
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	1,359	3,130	3,725
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	5,957	7,263	8,122

5.11.2.19 The following displacement matrices provide the estimated cumulative mortality of kittiwake predicted to occur due to displacement during the operations and maintenance phase. Table 5.108 to Table 5.110 provide outputs for Scenario 2 with Table 5.108 to Table 5.113 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

Table 5.108: Operations and maintenance phase cumulative kittiwake mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 2).

Kittiwake (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	3	7	14	27	41	54	68	82	95	109	122	136
	15	2	4	10	20	41	61	82	102	122	143	163	183	204
	20	3	5	14	27	54	82	109	136	163	190	217	245	272
	30	4	8	20	41	82	122	163	204	245	285	326	367	408
	35	5	10	24	48	95	143	190	238	285	333	380	428	476
	40	5	11	27	54	109	163	217	272	326	380	435	489	544
	50	7	14	34	68	136	204	272	340	408	476	544	612	679
	60	8	16	41	82	163	245	326	408	489	571	652	734	815
	70	10	19	48	95	190	285	380	476	571	666	761	856	951
	80	11	22	54	109	217	326	435	544	652	761	870	978	1087
	90	12	24	61	122	245	367	489	612	734	856	978	1101	1223
	100	14	27	68	136	272	408	544	679	815	951	1087	1223	1359

Table 5.109: Operations and maintenance phase cumulative kittiwake mortality following displacement from offshore wind farms in the breeding season (Scenario 2).

Kittiwake (breeding)	Mortality rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	3	6	16	31	63	94	125	157	188	219	250	282	313
15	5	9	23	47	94	141	188	235	282	329	376	423	470
20	6	13	31	63	125	188	250	313	376	438	501	563	626
30	9	19	47	94	188	282	376	470	563	657	751	845	939
35	11	22	55	110	219	329	438	548	657	767	876	986	1096
40	13	25	63	125	250	376	501	626	751	876	1002	1127	1252
50	16	31	78	157	313	470	626	783	939	1096	1252	1409	1565
60	19	38	94	188	376	563	751	939	1127	1315	1502	1690	1878
70	22	44	110	219	438	657	876	1096	1315	1534	1753	1972	2191
80	25	50	125	250	501	751	1002	1252	1502	1753	2003	2254	2504
90	28	56	141	282	563	845	1127	1409	1690	1972	2254	2535	2817
100	31	63	157	313	626	939	1252	1565	1878	2191	2504	2817	3130

Table 5.110: Operations and maintenance phase cumulative kittiwake mortality following displacement from offshore wind farms in the post-breeding season (Scenario 2).

Kittiwake (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	4	7	19	37	74	112	149	186	223	261	298	335	372
	15	6	11	28	56	112	168	223	279	335	391	447	503	559
	20	7	15	37	74	149	223	298	372	447	521	596	670	745
	30	11	22	56	112	223	335	447	559	670	782	894	1006	1117
	35	13	26	65	130	261	391	521	652	782	913	1043	1173	1304
	40	15	30	74	149	298	447	596	745	894	1043	1192	1341	1490
	50	19	37	93	186	372	559	745	931	1117	1304	1490	1676	1862
	60	22	45	112	223	447	670	894	1117	1341	1564	1788	2011	2235
	70	26	52	130	261	521	782	1043	1304	1564	1825	2086	2346	2607
	80	30	60	149	298	596	894	1192	1490	1788	2086	2384	2682	2980
	90	34	67	168	335	670	1006	1341	1676	2011	2346	2682	3017	3352
	100	37	74	186	372	745	1117	1490	1862	2235	2607	2980	3352	3725

Table 5.111: Operations and maintenance phase cumulative kittiwake mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 3).

Kittiwake (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	6	12	30	60	119	179	238	298	357	417	477	536	596
	15	9	18	45	89	179	268	357	447	536	625	715	804	894
	20	12	24	60	119	238	357	477	596	715	834	953	1072	1191
	30	18	36	89	179	357	536	715	894	1072	1251	1430	1608	1787
	35	21	42	104	208	417	625	834	1042	1251	1459	1668	1876	2085
	40	24	48	119	238	477	715	953	1191	1430	1668	1906	2144	2383
	50	30	60	149	298	596	894	1191	1489	1787	2085	2383	2681	2978
	60	36	71	179	357	715	1072	1430	1787	2144	2502	2859	3217	3574
	70	42	83	208	417	834	1251	1668	2085	2502	2919	3336	3753	4170
	80	48	95	238	477	953	1430	1906	2383	2859	3336	3812	4289	4765
	90	54	107	268	536	1072	1608	2144	2681	3217	3753	4289	4825	5361
	100	60	119	298	596	1191	1787	2383	2978	3574	4170	4765	5361	5957

Table 5.112: Operations and maintenance phase cumulative kittiwake mortality following displacement from offshore wind farms in the breeding season (Scenario 3).

Kittiwake (breeding)	Mortality rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	7	15	36	73	145	218	291	363	436	508	581	654	726
15	11	22	54	109	218	327	436	545	654	763	872	981	1090
20	15	29	73	145	291	436	581	726	872	1017	1162	1307	1453
30	22	44	109	218	436	654	872	1090	1307	1525	1743	1961	2179
35	25	51	127	254	508	763	1017	1271	1525	1780	2034	2288	2542
40	29	58	145	291	581	872	1162	1453	1743	2034	2324	2615	2905
50	36	73	182	363	726	1090	1453	1816	2179	2542	2905	3269	3632
60	44	87	218	436	872	1307	1743	2179	2615	3051	3486	3922	4358
70	51	102	254	508	1017	1525	2034	2542	3051	3559	4068	4576	5084
80	58	116	291	581	1162	1743	2324	2905	3486	4068	4649	5230	5811
90	65	131	327	654	1307	1961	2615	3269	3922	4576	5230	5883	6537
100	73	145	363	726	1453	2179	2905	3632	4358	5084	5811	6537	7263

Table 5.113: Operations and maintenance phase cumulative kittiwake mortality following displacement from offshore wind farms in the post-breeding season (Scenario 3).

Kittiwake (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displ acem	10	8	16	41	81	162	244	325	406	487	569	650	731	812
	15	12	24	61	122	244	365	487	609	731	853	975	1096	1218
	20	16	32	81	162	325	487	650	812	975	1137	1300	1462	1624
	30	24	49	122	244	487	731	975	1218	1462	1706	1949	2193	2437
	35	28	57	142	284	569	853	1137	1421	1706	1990	2274	2558	2843
	40	32	65	162	325	650	975	1300	1624	1949	2274	2599	2924	3249
	50	41	81	203	406	812	1218	1624	2031	2437	2843	3249	3655	4061
	60	49	97	244	487	975	1462	1949	2437	2924	3411	3899	4386	4873
	70	57	114	284	569	1137	1706	2274	2843	3411	3980	4548	5117	5685
	80	65	130	325	650	1300	1949	2599	3249	3899	4548	5198	5848	6498
	90	73	146	365	731	1462	2193	2924	3655	4386	5117	5848	6579	7310
	100	81	162	406	812	1624	2437	3249	4061	4873	5685	6498	7310	8122

Table 5.114: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of displacement impacts was not undertaken in project-specific documentation for kittiwake.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Burbo Bank (Seascape Energy Ltd., 2002)	Disturbance impacts considered qualitatively.	Surveys of the project comprised aerial and boat-based surveys both of which were undertaken during winter months (aerial undertaken during November to April and boat-based undertaken during December and February). Aerial surveys covered a large area encompassing the Liverpool Bay SPA with boat-based surveys covering the project area. The surveys were undertaken to provide abundance and distribution data for those species considered to be of most importance, namely common scoter and red-throated diver. Low numbers of kittiwake were recorded during boat-based surveys with relatively low numbers also recorded during aerial surveys.	Kittiwake was not considered to be a species of International or National importance in the context of the assessments undertaken. Although kittiwake was not specifically assessed due to the species being considered of limited importance, low levels of disturbance were predicted for other species with conclusions of a negligible magnitude and very low significance reached.
Walney 1 & 2 (RPS, 2006a)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of kittiwake recorded in the project area plus 2 km buffer during aerial surveys was 44 birds. In boat-based surveys the equivalent population was 205 birds. Kittiwake was deemed to be a species of low importance (termed sensitivity in the Walney 1 & 2 assessments).	It was considered that the wind farm area did not represent a favoured foraging habitat and the magnitude of any impact was considered to be negligible. The species was considered to be of low sensitivity. The overall significance of impacts associated with the project was considered to be very low.
Robin Rigg (Natural Power, 2002)	Disturbance impacts considered qualitatively.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of kittiwake during boat-based surveys in the wind farm was 4.5 birds with a peak of 46 birds. Kittiwake was considered to be of local importance based on the populations recorded in the wind farm.	The magnitude of the effect was considered to be low with a low significance.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
West of Duddon Sands (RPS, 2006b)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of kittiwake recorded in the project area plus 2 km buffer during aerial surveys was 14 birds. In boat-based surveys the equivalent population was 454 birds. Kittiwake was deemed to be a species of low importance (termed sensitivity in the West of Duddon Sands assessments).	The magnitude of impacts was considered to be negligible. Kittiwake was considered to be of low importance (termed sensitivity in the assessments for the project). The significance of all impacts was considered to be very low.
Gwynt y Môr (RWE Group and Npower Renewables, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys undertaken in support of the project included boat-based surveys undertaken between February 2003 and March 2005. Surveys between February 2003 and February 2004 covered a large area along the Welsh coast incorporating the project area with surveys between March2004 and March 2005 more focussed on the project area. The assessment also used data from aerial surveys undertaken between 2000 and 2005 which were targeted at recording common scoter. The highest populations of kittiwake were recorded between March and May.	It was considered that displacement (termed avoidance of turbines in the assessments conducted) would result in an impact of negligible to low significance for kittiwake due to the low densities of kittiwake present at the project.
Ormonde (Ecology Consulting, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken monthly between May 2004 and April 2005. In addition, three aerial surveys were conducted during the summer of 2004 with four further aerial surveys in the winter of 2004/5. The peak population of kittiwake recorded in the wind farm plus a 2 km buffer during boat-based surveys was 60 birds. During aerial surveys the equivalent population was 2 birds. The species was recorded throughout the year during boat-based surveys with the highest numbers in April. Numbers in aerial surveys peaked in October with no records in the mid-winter period. The species was considered to be regionally important in the context of the assessments conducted.	The magnitude of the effect for kittiwake was considered to be negligible with a very low significance.

Table 5.115: Cumulative assessment for kittiwake in relation to cumulative disturbance and displacement impacts during the operations and maintenance phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets The displacement mortality associated with the range of displacement and mortality rates considered for kittiwake in all seasons and when all seasons are combined does not surpass the 1% threshold of relevant regional populations with the exception of when applying the upper rates in both displacement and mortality rates in the breeding season. Wade *et al.* (2016) identifies the vulnerability of kittiwake to displacement as low and the species' habitat flexibility as moderate. Following JNCC *et al.* (2022) guidance would suggest based on the vulnerability scores in Wade *et al.* (2016) that displacement rates towards the lower end of the range presented would be applicable. Dierschke *et al.* (2016), which reviewed the response of seabird species to offshore wind farms identified kittiwake as a species that exhibited weak avoidance to offshore wind farms. This also suggests that lower	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects The displacement mortality associated with the range of displacement and mortality rates considered for kittiwake in all seasons and when all seasons are combined does not surpass the 1% threshold of relevant regional populations with the exception of when applying the upper rates in both displacement and mortality rates in the breeding season. Wade *et al.* (2016) identifies the vulnerability of kittiwake to displacement as low and the species' habitat flexibility as moderate. As discussed in paragraphs 5.9.1.24 to 5.9.1.27 the upper rates of displacement and mortality are not considered appropriate for kittiwake. Following JNCC *et al.* (2022) guidance would suggest based on the vulnerability scores in Wade *et al.* (2016) that displacement rates towards the lower end of the range presented would be applicable. Dierschke *et al.* (2016), which reviewed the response of seabird species to offshore wind farms identified kittiwake as a species that exhibited weak avoidance to offshore wind farms. This also suggests that lower displacement rates are applicable to this species. It was concluded in paragraphs

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		displacement rates are applicable to this species. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	5.9.1.24 to 5.9.1.27 that a displacement rate of 50% and mortality rate of 1% was appropriate for use in assessments and when these are applied the 1% threshold is not surpassed. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. There are some projects for which abundance data are not available. For the majority of these projects the wind farm areas were not considered to be of importance for kittiwake. It is therefore considered that the inclusion of these projects would not alter the impact magnitude concluded. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects. In addition, no account is taken of the potential habituation by kittiwake which, due to the age of many of the projects considered cumulatively could affect the estimated impact.
Sensitivity of receptor	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.101 to 5.9.1.104). Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.101 to 5.9.1.104). Kittiwake is deemed to be of low vulnerability, low recoverability and international value. The	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.101 to 5.9.1.104). Kittiwake is deemed to be of low vulnerability, low recoverability and international value. the

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
	sensitivity of the receptor is therefore, considered to be medium.	sensitivity of the receptor is therefore, considered to be medium.	sensitivity of the receptor is therefore, considered to be medium.
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of negligible significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of negligible significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of negligible significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Guillemot

5.11.2.20 The estimated cumulative abundance of guillemot from the relevant projects with available data is presented in Table 5.116. There are several projects for which there are no, or limited, data on the number of guillemot predicted to be displaced, for some of the earlier developments these are discussed in Table 5.121.

Table 5.116: Guillemot cumulative abundances for offshore wind projects for disturbance and displacement assessment during operations.

Note: Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Breeding season cumulative abundance	Non-breeding season cumulative abundance
Tier 1		
Awel y Môr	1,569	2,919
Burbo Bank	Unavailable – see Table 5.122	
Burbo Bank Extension	1,000	1,561
Erebus	7,001	28,338
Gwynt y Môr	Unavailable – see Table 5.122	
Mona Offshore Wind Project	4,220	3,756
Ormonde	912	Unavailable – see Table 5.122
Robin Rigg	138	Unavailable – see Table 5.122
Twinhub	39	217
Walney 1 & 2	Unavailable – see Table 5.122	
Walney 3 & 4	4,169	1,927
West of Duddon Sands	1,321	Unavailable – see Table 5.122
West of Orkney	7,973	4,393
White Cross	3,304	1,059
Tier 2		
Morecambe Offshore Wind Farm: Generation Assets	4,050	7,647
Morgan Generation Assets	4,010	3,824
Scenario Totals		
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	**8,060**	**11,471**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	**39,705**	**55,641**

5.11.2.21 The following displacement matrices provide the estimated cumulative mortality of guillemot predicted to occur due to displacement during the operations and maintenance phase. Table 5.117 and Table 5.118 provide outputs for Scenario 2 with

Table 5.119 and Table 5.120 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue. The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

5.11.2.22 In addition to impacts associated with offshore wind farms consideration in this section is also given to disturbance and underwater collision impacts associated with tidal projects, specifically the Minesto and Morlais projects.

5.11.2.23 In the breeding season, the total mortality of guillemot associated with disturbance at the Morlais project was predicted to be 0-4 birds with 0 birds in the non-breeding season. For collision risk impacts, the assessments presented predicted a total mortality of 12 to 62 birds in the breeding season and 3 to 13 in the non-breeding season.

5.11.2.24 Disturbance impacts associated with the Minesto projects were only considered qualitatively. The total predicted annual mortality associated with collision risk impacts at the Minesto project was 15.9 birds.

Table 5.117: Operations and maintenance phase cumulative guillemot mortality following displacement from offshore wind farms in the breeding season – (Scenario 2).

Guillemot (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	8	16	40	81	161	242	322	403	484	564	645	725	806
	15	12	24	60	121	242	363	484	605	725	846	967	1088	1209
	20	16	32	81	161	322	484	645	806	967	1128	1290	1451	1612
	30	24	48	121	242	484	725	967	1209	1451	1693	1934	2176	2418
	35	28	56	141	282	564	846	1128	1411	1693	1975	2257	2539	2821
	40	32	64	161	322	645	967	1290	1612	1934	2257	2579	2902	3224
	50	40	81	202	403	806	1209	1612	2015	2418	2821	3224	3627	4030
	60	48	97	242	484	967	1451	1934	2418	2902	3385	3869	4352	4836
	70	56	113	282	564	1128	1693	2257	2821	3385	3949	4514	5078	5642
	80	64	129	322	645	1290	1934	2579	3224	3869	4514	5158	5803	6448
	90	73	145	363	725	1451	2176	2902	3627	4352	5078	5803	6529	7254
	100	81	161	403	806	1612	2418	3224	4030	4836	5642	6448	7254	8060

Table 5.118: Operations and maintenance phase cumulative guillemot mortality following displacement from offshore wind farms in the non-breeding season – (Scenario 2).

Guillemot (non-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	11	23	57	115	229	344	459	574	688	803	918	1032	1147
	15	17	34	86	172	344	516	688	860	1032	1204	1376	1549	1721
	20	23	46	115	229	459	688	918	1147	1376	1606	1835	2065	2294
	30	34	69	172	344	688	1032	1376	1721	2065	2409	2753	3097	3441
	35	40	80	201	401	803	1204	1606	2007	2409	2810	3212	3613	4015
	40	46	92	229	459	918	1376	1835	2294	2753	3212	3671	4129	4588
	50	57	115	287	574	1147	1721	2294	2868	3441	4015	4588	5162	5735
	60	69	138	344	688	1376	2065	2753	3441	4129	4818	5506	6194	6882
	70	80	161	401	803	1606	2409	3212	4015	4818	5621	6424	7226	8029
	80	92	184	459	918	1835	2753	3671	4588	5506	6424	7341	8259	9176
	90	103	206	516	1032	2065	3097	4129	5162	6194	7226	8259	9291	10324
	100	115	229	574	1147	2294	3441	4588	5735	6882	8029	9176	10324	11471

Table 5.119: Operations and maintenance phase cumulative guillemot mortality following displacement from offshore wind farms in the breeding season – (Scenario 3).

Guillemot (breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	40	79	199	397	794	1191	1588	1985	2382	2779	3176	3573	3971
15	60	119	298	596	1191	1787	2382	2978	3573	4169	4765	5360	5956
20	79	159	397	794	1588	2382	3176	3971	4765	5559	6353	7147	7941
30	119	238	596	1191	2382	3573	4765	5956	7147	8338	9529	10720	11912
35	139	278	695	1390	2779	4169	5559	6948	8338	9728	11117	12507	13897
40	159	318	794	1588	3176	4765	6353	7941	9529	11117	12706	14294	15882
50	199	397	993	1985	3971	5956	7941	9926	11912	13897	15882	17867	19853
60	238	476	1191	2382	4765	7147	9529	11912	14294	16676	19058	21441	23823
70	278	556	1390	2779	5559	8338	11117	13897	16676	19456	22235	25014	27794
80	318	635	1588	3176	6353	9529	12706	15882	19058	22235	25411	28588	31764
90	357	715	1787	3573	7147	10720	14294	17867	21441	25014	28588	32161	35735
100	397	794	1985	3971	7941	11912	15882	19853	23823	27794	31764	35735	39705

Table 5.120: Operations and maintenance phase cumulative guillemot mortality following displacement from offshore wind farms in the non-breeding season – (Scenario 3).

Guillemot (non-breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	56	111	278	556	1113	1669	2226	2782	3338	3895	4451	5008	5564
15	83	167	417	835	1669	2504	3338	4173	5008	5842	6677	7512	8346
20	111	223	556	1113	2226	3338	4451	5564	6677	7790	8903	10015	11128
30	167	334	835	1669	3338	5008	6677	8346	10015	11685	13354	15023	16692
35	195	389	974	1947	3895	5842	7790	9737	11685	13632	15579	17527	19474
40	223	445	1113	2226	4451	6677	8903	11128	13354	15579	17805	20031	22256
50	278	556	1391	2782	5564	8346	11128	13910	16692	19474	22256	25038	27821
60	334	668	1669	3338	6677	10015	13354	16692	20031	23369	26708	30046	33385
70	389	779	1947	3895	7790	11685	15579	19474	23369	27264	31159	35054	38949
80	445	890	2226	4451	8903	13354	17805	22256	26708	31159	35610	40062	44513
90	501	1002	2504	5008	10015	15023	20031	25038	30046	35054	40062	45069	50077
100	556	1113	2782	5564	11128	16692	22256	27821	33385	38949	44513	50077	55641

Table 5.121: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of displacement impacts was not undertaken in project-specific documentation for guillemot.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Burbo Bank (Seascape Energy Ltd., 2002)	Disturbance impacts considered qualitatively.	Surveys of the project comprised aerial and boat-based surveys both of which were undertaken during winter months (aerial surveys undertaken November to April and boat-based undertaken during December and February). Aerial surveys covered a large area encompassing the Liverpool Bay SPA with boat-based surveys covering the project area. The surveys were undertaken to provide abundance and distribution data for those species considered to be of most importance, namely common scoter and red-throated diver. Guillemots were recorded in all months during which aerial surveys were undertaken however, there is no information on the numbers recorded within the wind farm. During boat-based surveys, which were undertaken across a much smaller area, numbers of guillemot were far smaller with a highest count of 34 birds.	Low levels of disturbance were predicted resulting in a conclusion of a negligible magnitude and a very low significance.
Walney 1 & 2 (RPS, 2006a)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29th October 2005. The peak population of guillemot recorded in the project area plus 2 km buffer during aerial surveys was 30 birds with a peak count of 391 auk species in the same area. In boat-based surveys the equivalent populations were 1,256 guillemot and 65 auk species.	It was considered that the wind farm area did not represent a favoured foraging habitat and the magnitude of any impact was considered to be low. The species was considered to be of medium importance (termed sensitivity in the Walney 1 & 2 assessments). The overall significance of impacts associated with the project was considered to be low.
Gwynt y Môr (RWE Group and Npower Renewables, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys undertaken in support of the project included boat-based surveys undertaken between February 2003 and March 2005. Surveys between February 2003 and February 2004 covered a large area along the Welsh coast incorporating the project area with surveys between March 2004 and March 2005 more focussed on the project area. The assessment also used data from aerial surveys undertaken between 2000 and 2005 which were targeted at recording common scoter.	It was considered that displacement (termed avoidance of turbines in the assessments conducted) would result in an impact of low significance for auk species.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
		The majority of guillemot identified to species level during aerial surveys occurred in July and August. Based on the aerial survey data collected during the November 2004 survey, 32 guillemot were estimated to be present in the wind farm area. Birds were seen in or around the wind fam area in most months during which boat-based survey were undertaken with fewer observed between June and September.	
West of Duddon Sands (RPS, 2006b)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between01 October and 29 October 2005. The peak population of guillemot recorded in the project area plus a 2 km buffer during boat-based surveys was 1,230 birds with an additional 40 auk species recorded. Based on the distribution of guillemot it was considered that the wind farm was not a favoured foraging area.	The magnitude of impacts was considered to be low. Guillemot was considered to be of medium importance (termed sensitivity in the assessments for the project). The significance of all impacts was considered to be low.
Ormonde (Ecology Consulting, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken monthly between May 2004 and April 2005. In addition, three aerial surveys were conducted during the summer of 2004 with four further aerial surveys in the winter of 2004/5. The peak population of guillemot recorded in the wind farm plus a 2 km buffer during boat-based surveys was 238 birds. During aerial surveys the equivalent population was 0, although 1,086 auk species were recorded. Peak numbers occurred in autumn months (September or November). The species was considered to be regionally important in the context of the assessments conducted.	The magnitude of the effect for guillemot was considered to be low with a low significance.
Robin Rigg (Natural Power, 2002)	Disturbance impacts considered qualitatively.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of guillemot during boat-based surveys in the wind farm was 7.9 (and 0.4 for auk species) birds with a peak of 39 birds (3 for auk species). Guillemot was considered to be of local importance based on the populations recorded in the wind farm. Aerial surveys undertaken in the non-breeding season recorded a maximum of two auks.	The magnitude of the effect was considered to be low with a low significance.

Table 5.122: Cumulative assessment for guillemot in relation to cumulative disturbance and displacement impacts during the operations and maintenance phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets The displacement mortality associated with the range of displacement and mortality rates considered for guillemot in all seasons and when all seasons are combined does not surpass the 1% threshold of relevant regional populations. As discussed in paragraphs 5.9.1.13 to 5.9.1.19 it is considered that a displacement rate of 50% and mortality rate of 1% is appropriate for guillemot. As a result it is considered that impacts in all seasons and when combined will not surpass the 1% baseline mortality threshold for the relevant regional populations. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible.	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects The displacement mortality associated with the range of displacement and mortality rates considered for guillemot in all seasons and when all seasons are combined does not surpass the 1% threshold of relevant regional populations with the exception of when applying the upper rates in both displacement and mortality rates in the breeding season. As discussed in paragraphs 5.9.1.13 to 5.9.1.19 it is considered that a displacement rate of 50% and mortality rate of 1% is appropriate for guillemot. As a result it is considered that impacts in all seasons and when combined will not surpass the 1% baseline mortality threshold for the relevant regional populations. When disturbance and underwater collision risk impacts associated with the Morlais and Minesto projects are combined with the displacement impact from offshore wind farms using a 50% displacement rate and 1% mortality rate the 1% threshold of the regional population is also not surpassed. The cumulative impact is predicted to be of local spatial extent, medium to long term

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. There are some projects for which abundance data are not available. For the majority of these projects the wind farm areas were not considered to be of importance for guillemot. It is therefore considered that the inclusion of these projects would not alter the impact magnitude concluded. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects. In addition, no account is taken of the potential habituation by guillemot which, due to the age of many of the projects considered cumulatively could affect the estimated impact.
Sensitivity of receptor	The sensitivity of guillemot is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.105 to 5.9.1.108) Guillemot is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is, therefore, considered to be medium.	The sensitivity of guillemot is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.105 to 5.9.1.108). Guillemot is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is, therefore, considered to be medium.	The sensitivity of guillemot is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.105 to 5.9.1.108). Guillemot is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is, therefore, considered to be medium.
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
	negligible adverse significance, which is not significant in EIA terms.	**negligible adverse** significance, which is not significant in EIA terms.	**negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Razorbill

5.11.2.25 The estimated cumulative abundance of razorbill from the relevant projects with available data is presented in Table 5.123. There are several projects for which there are no, or limited, data on the number of razorbill predicted to be displaced, for some of the earlier developments these are discussed in Table 5.132.

Table 5.123: Razorbill cumulative abundances for offshore wind projects for disturbance and displacement assessment during operations.

Note: Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Pre-breeding cumulative abundance	Breeding season cumulative abundance	Post-breeding cumulative abundance	Non-breeding cumulative abundance
Tier 1				
Awel y Môr	336	140	66	150
Burbo Bank	Unavailable – see Table 5.132			
Burbo Bank Extension	Unavailable – project considered breeding and non-breeding only	64	Unavailable – project considered breeding and non-breeding only	29
Erebus	896	194	1,708	1,069
Gwynt y Môr	Unavailable – see Table 5.132			
Mona Offshore Wind Project	1,924	83	91	421
Ormonde	Unavailable – see Table 5.132	174	Unavailable – see Table 5.132	
Robin Rigg	Unavailable – see Table 5.132	63	Unavailable – see Table 5.132	
Twinhub	Unavailable	12	Unavailable	53
Walney 1 & 2	Unavailable – see Table 5.132			
Walney 3 & 4	Incorporated into non-breeding season	76	874	3,066
West of Duddon Sands	Unavailable – see Table 5.132			202
West of Orkney	74	141	112	19
White Cross	345	40	40	361
Tier 2				
Morecambe Offshore Wind Farm: Generation Assets	389	222	674	596
Morgan Generation Assets	328	35	254	1,170
Scenario Totals				

Project	Pre-breeding cumulative abundance	Breeding season cumulative abundance	Post-breeding cumulative abundance	Non-breeding cumulative abundance
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	**717**	**257**	**928**	**1,766**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	**4,291**	**1,245**	**3,818**	**7,136**

5.11.2.26 The following displacement matrices provide the estimated cumulative mortality of razorbill predicted to occur due to displacement during the operations and maintenance phase. Table 5.124 to Table 5.127 provide outputs for Scenario 2 with Table 5.128 and Table 5.131 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

5.11.2.27 In addition to impacts associated with offshore wind farms consideration in this section is also given to disturbance and underwater collision impacts associated with tidal projects, specifically the Minesto and Morlais projects.

5.11.2.28 In the breeding season, the total mortality of guillemot associated with disturbance at the Morlais project was predicted to be zero birds in both the breeding and non-breeding seasons. For collision risk impacts, the assessments presented predicted a total mortality of 4 to 20 birds in the breeding season and 4 to 20 in the non-breeding season.

5.11.2.29 Disturbance impacts associated with the Minesto projects were only considered qualitatively. The total predicted annual mortality associated with collision risk impacts at the Minesto project was 1.6 birds.

Table 5.124: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Razorbill (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	1	4	7	14	22	29	36	43	50	57	65	72
	15	1	2	5	11	22	32	43	54	65	75	86	97	108
	20	1	3	7	14	29	43	57	72	86	100	115	129	143
	30	2	4	11	22	43	65	86	108	129	151	172	194	215
	35	3	5	13	25	50	75	100	125	151	176	201	226	251
	40	3	6	14	29	57	86	115	143	172	201	229	258	287
	50	4	7	18	36	72	108	143	179	215	251	287	323	358
	60	4	9	22	43	86	129	172	215	258	301	344	387	430
	70	5	10	25	50	100	151	201	251	301	351	401	452	502
	80	6	11	29	57	115	172	229	287	344	401	459	516	573
	90	6	13	32	65	129	194	258	323	387	452	516	581	645
	100	7	14	36	72	143	215	287	358	430	502	573	645	717

Table 5.125: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the breeding season (Scenario 2). (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Razorbill (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	1	1	3	5	8	10	13	15	18	21	23	26
	15	0	1	2	4	8	12	15	19	23	27	31	35	39
	20	1	1	3	5	10	15	21	26	31	36	41	46	51
	30	1	2	4	8	15	23	31	39	46	54	62	69	77
	35	1	2	4	9	18	27	36	45	54	63	72	81	90
	40	1	2	5	10	21	31	41	51	62	72	82	92	103
	50	1	3	6	13	26	39	51	64	77	90	103	116	128
	60	2	3	8	15	31	46	62	77	92	108	123	139	154
	70	2	4	9	18	36	54	72	90	108	126	144	162	180
	80	2	4	10	21	41	62	82	103	123	144	164	185	205
	90	2	5	12	23	46	69	92	116	139	162	185	208	231
	100	3	5	13	26	51	77	103	128	154	180	205	231	257

Table 5.126: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the post-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Razorbill (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	2	5	9	19	28	37	46	56	65	74	83	93
	15	1	3	7	14	28	42	56	70	83	97	111	125	139
	20	2	4	9	19	37	56	74	93	111	130	148	167	186
	30	3	6	14	28	56	83	111	139	167	195	223	250	278
	35	3	6	16	32	65	97	130	162	195	227	260	292	325
	40	4	7	19	37	74	111	148	186	223	260	297	334	371
	50	5	9	23	46	93	139	186	232	278	325	371	417	464
	60	6	11	28	56	111	167	223	278	334	390	445	501	557
	70	6	13	32	65	130	195	260	325	390	454	519	584	649
	80	7	15	37	74	148	223	297	371	445	519	594	668	742
	90	8	17	42	83	167	250	334	417	501	584	668	751	835
	100	9	19	46	93	186	278	371	464	557	649	742	835	928

Table 5.127: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the non-breeding season (Scenario 2).

Razorbill (non-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	2	4	9	18	35	53	71	88	106	124	141	159	177
	15	3	5	13	26	53	79	106	132	159	185	212	238	265
	20	4	7	18	35	71	106	141	177	212	247	283	318	353
	30	5	11	26	53	106	159	212	265	318	371	424	477	530
	35	6	12	31	62	124	185	247	309	371	433	494	556	618
	40	7	14	35	71	141	212	283	353	424	494	565	636	706
	50	9	18	44	88	177	265	353	442	530	618	706	795	883
	60	11	21	53	106	212	318	424	530	636	742	848	954	1060
	70	12	25	62	124	247	371	494	618	742	865	989	1113	1236
	80	14	28	71	141	283	424	565	706	848	989	1130	1272	1413
	90	16	32	79	159	318	477	636	795	954	1113	1272	1430	1589
	100	18	35	88	177	353	530	706	883	1060	1236	1413	1589	1766

Table 5.128: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 3).

Razorbill (pre-breeding)	Mortality rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	9	21	43	86	129	172	215	257	300	343	386	429
15	6	13	32	64	129	193	257	322	386	451	515	579	644
20	9	17	43	86	172	257	343	429	515	601	687	772	858
30	13	26	64	129	257	386	515	644	772	901	1030	1159	1287
35	15	30	75	150	300	451	601	751	901	1051	1202	1352	1502
40	17	34	86	172	343	515	687	858	1030	1202	1373	1545	1717
50	21	43	107	215	429	644	858	1073	1287	1502	1717	1931	2146
60	26	51	129	257	515	772	1030	1287	1545	1802	2060	2317	2575
70	30	60	150	300	601	901	1202	1502	1802	2103	2403	2704	3004
80	34	69	172	343	687	1030	1373	1717	2060	2403	2746	3090	3433
90	39	77	193	386	772	1159	1545	1931	2317	2704	3090	3476	3862
100	43	86	215	429	858	1287	1717	2146	2575	3004	3433	3862	4291

Table 5.129: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the breeding season (Scenario 3).

Razorbill (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	2	6	12	25	37	50	62	75	87	100	112	125
	15	2	4	9	19	37	56	75	93	112	131	149	168	187
	20	2	5	12	25	50	75	100	125	149	174	199	224	249
	30	4	7	19	37	75	112	149	187	224	261	299	336	374
	35	4	9	22	44	87	131	174	218	261	305	349	392	436
	40	5	10	25	50	100	149	199	249	299	349	398	448	498
	50	6	12	31	62	125	187	249	311	374	436	498	560	623
	60	7	15	37	75	149	224	299	374	448	523	598	672	747
	70	9	17	44	87	174	261	349	436	523	610	697	784	872
	80	10	20	50	100	199	299	398	498	598	697	797	897	996
	90	11	22	56	112	224	336	448	560	672	784	897	1009	1121
	100	12	25	62	125	249	374	498	623	747	872	996	1121	1245

Table 5.130: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the post-breeding season (Scenario 3).

Razorbill (post-breeding)	Mortality rate (%)												
Displacement rate (%)	1	2	5	10	20	30	40	50	60	70	80	90	100
10	4	8	19	38	76	115	153	191	229	267	305	344	382
15	6	11	29	57	115	172	229	286	344	401	458	515	573
20	8	15	38	76	153	229	305	382	458	535	611	687	764
30	11	23	57	115	229	344	458	573	687	802	916	1031	1146
35	13	27	67	134	267	401	535	668	802	935	1069	1203	1336
40	15	31	76	153	305	458	611	764	916	1069	1222	1375	1527
50	19	38	95	191	382	573	764	955	1146	1336	1527	1718	1909
60	23	46	115	229	458	687	916	1146	1375	1604	1833	2062	2291
70	27	53	134	267	535	802	1069	1336	1604	1871	2138	2406	2673
80	31	61	153	305	611	916	1222	1527	1833	2138	2444	2749	3055
90	34	69	172	344	687	1031	1375	1718	2062	2406	2749	3093	3437
100	38	76	191	382	764	1146	1527	1909	2291	2673	3055	3437	3818

Table 5.131: Operations and maintenance phase cumulative razorbill mortality following displacement from offshore wind farms in the non-breeding season (Scenario 3).

Razorbill (non-breeding)	Mortality rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	7	14	36	71	143	214	285	357	428	500	571	642	714
15	11	21	54	107	214	321	428	535	642	749	856	963	1070
20	14	29	71	143	285	428	571	714	856	999	1142	1285	1427
30	21	43	107	214	428	642	856	1070	1285	1499	1713	1927	2141
35	25	50	125	250	500	749	999	1249	1499	1748	1998	2248	2498
40	29	57	143	285	571	856	1142	1427	1713	1998	2284	2569	2854
50	36	71	178	357	714	1070	1427	1784	2141	2498	2854	3211	3568
60	43	86	214	428	856	1285	1713	2141	2569	2997	3425	3854	4282
70	50	100	250	500	999	1499	1998	2498	2997	3497	3996	4496	4995
80	57	114	285	571	1142	1713	2284	2854	3425	3996	4567	5138	5709
90	64	128	321	642	1285	1927	2569	3211	3854	4496	5138	5780	6423
100	71	143	357	714	1427	2141	2854	3568	4282	4995	5709	6423	7136

Table 5.132: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of displacement impacts was not undertaken in project-specific documentation for razorbill.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Burbo Bank (Seascape Energy Ltd., 2002)	Disturbance impacts considered qualitatively.	Surveys of the project comprised aerial and boat-based surveys both of which were undertaken during winter months (aerial undertaken during November to April and boat-based undertaken during December and February). Aerial surveys covered a large area encompassing the Liverpool Bay SPA with boat-based surveys covering the project area. The surveys were undertaken to provide abundance and distribution data for those species considered to be of most importance, namely common scoter and red-throated diver. Razorbill was not identified during aerial surveys however, it is likely that any razorbill present were recorded as auk species with this group recorded in all months during which aerial surveys were undertaken. There is however, no information on the numbers recorded within the wind farm. During boat-based surveys, only three razorbill were seen.	Low levels of disturbance were predicted resulting in a conclusion of a negligible magnitude and a very low significance.
Walney 1 & 2 (RPS, 2006a)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of razorbill recorded in the project area plus 2 km buffer during aerial surveys was 2 birds with a peak count of 391 auk species in the same area. In boat-based surveys the equivalent populations were 292 razorbill and 65 auk species.	It was considered that the wind farm area did not represent a favoured foraging habitat and the magnitude of any impact was considered to be low. The species was considered to be of medium sensitivity. The overall significance of impacts associated with the project was considered to be low.
Robin Rigg (Natural Power, 2002)	Disturbance impacts considered qualitatively.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of razorbill during boat-based surveys in the wind farm was 2.0 (and 0.4 for auk species) birds with a peak of 18 birds (3 for auk species). Razorbill was considered to be of local importance based on the populations recorded in the	The magnitude of the effect was considered to be low with a low significance.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
		wind farm. Aerial surveys undertaken in the non-breeding season recorded a maximum of two auks.	
West of Duddon Sands (RPS, 2006b)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of razorbill recorded in the project area plus a 2 km buffer during boat-based surveys was 202 birds with an additional 40 auk species recorded. Based on the distribution of razorbill it was considered that the wind farm was not a favoured foraging area.	The magnitude of impacts was considered to be low. Razorbill was considered to be of medium importance (termed sensitivity in the assessments for the project). The significance of all impacts was considered to be low.
Gwynt y Môr (RWE Group and Npower Renewables, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys undertaken in support of the project included boat-based surveys undertaken between February 2003 and March 2005. Surveys between February 2003 and February 2004 covered a large area along the Welsh coast incorporating the project area with surveys between March 2004 and March 2005 more focussed on the project area. The assessment also used data from aerial surveys undertaken between 2000 and 2005 which were targeted at recording common scoter. The number of razorbill recorded during surveys was lower than the number of guillemot recorded. The greatest numbers recorded during boat-based surveys was between October and March with only three observations in the wind farm area between June and September with all in September.	It was considered that displacement (termed avoidance of turbines in the assessments conducted) would result in an impact of low significance for auk species.
Ormonde (Ecology Consulting, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken monthly between May 2004 and April 2005. In addition, three aerial surveys were conducted during the summer of 2004 with four further aerial surveys in the winter of 2004/5. The peak population of razorbill recorded in the wind farm plus a 2 km buffer during boat-based surveys was 85 birds. During aerial surveys the equivalent population was 0, although 1,086 auk species were recorded. Peak numbers occurred in autumn months (November). The species was considered to be regionally important in the context of the assessments conducted.	The magnitude of the effect for razorbill was considered to be low with a low significance.

Table 5.133: Cumulative assessment for razorbill in relation to cumulative disturbance and displacement impacts during the operations and maintenance phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets . The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets. In the breeding season the predicted cumulative displacement mortality associated with displacement and mortality rates at the upper end of the ranges considered surpass the 1% threshold of baseline mortality for the regional breeding population. The displacement mortality associated with the range of displacement and mortality rates considered for razorbill in the post-, non- and pre-breeding seasons and when all seasons are combined do not surpass the 1% threshold of relevant regional populations. As discussed in paragraphs 5.9.1.83 to 5.9.1.83 for guillemot it is considered that displacement and mortality rates towards the lower end of the range represent the likely impact magnitude. This is also considered relevant to razorbill. As a result it is considered that impacts in all seasons and when combined will not surpass the 1% baseline mortality threshold for the relevant regional populations. The area is also	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The displacement mortality associated with the range of displacement and mortality rates considered for razorbill in all seasons and when all seasons are combined does not surpass the 1% threshold of relevant regional populations, except when applying the upper rates in both displacement and mortality rates for impacts on an annual basis. As discussed in paragraphs 5.9.1.13 to 5.9.1.19 it is considered that a displacement rate of 50% and mortality rate of 1% is appropriate for razorbill. As a result it is considered that impacts in all seasons and when combined will not surpass the 1% baseline mortality threshold for the relevant regional populations. When disturbance and underwater collision risk impacts associated with the Morlais and Minesto projects are combined with the displacement impact from offshore wind farms using a 50% displacement rate and 1% mortality rate the 1% threshold of the regional population is also not surpassed. The cumulative impact is predicted to be of local spatial extent, medium to long term

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		not considered to represent an important area for razorbill in the breeding season in a regional context (see Volume 4, Annex 5.1: Offshore ornithology baseline characterisation Report of the Environmental Statement). The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. There are some projects for which abundance data are not available. For the majority of these projects the wind farm areas were not considered to be of importance for razorbill. It is therefore considered that the inclusion of these projects would not alter the impact magnitude concluded. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects. In addition, no account is taken of the potential habituation by razorbill which, due to the age of many of the projects considered cumulatively could affect the estimated impact.
Sensitivity of receptor	The sensitivity of razorbill is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.109 to 5.9.1.112). Razorbill is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of razorbill is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.109 to 5.9.1.112). Razorbill is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of razorbill is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.109 to 5.9.1.112). Razorbill is deemed to be of high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
	negligible adverse significance, which is not significant in EIA terms.	**negligible adverse** significance, which is not significant in EIA terms.	**negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Manx shearwater

5.11.2.30 The estimated cumulative abundance of Manx shearwater from relevant projects is presented in Table 5.134. There are several projects for which there are no, or limited, data on the number of Manx shearwater predicted to be displaced, for some of the earlier developments these are discussed in Table 5.141.

Table 5.134: Manx shearwater cumulative abundances for offshore wind projects for disturbance and displacement assessment during operations.

Note: Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Pre-breeding season cumulative abundance	Breeding season cumulative abundance	Post-breeding season cumulative abundance
Tier 1			
Awel y Môr	177	26	214
Burbo Bank	Unavailable – see Table 5.141		
Burbo Bank Extension	Unavailable – see Table 5.141	443	Unavailable – see Table 5.141
Erebus	18	1,540	557
Gwynt y Môr	Unavailable – see Table 5.141		
Mona Offshore Wind Project	3	1,249	182
Ormonde	Unavailable – see Table 5.141	1,001	Unavailable – see Table 5.141
Rampion	Unavailable – see Table 5.141		
Robin Rigg	Unavailable – see Table 5.141	138	Unavailable – see Table 5.141
Twinhub	Unavailable	1,270	3
Walney 1 & 2	Unavailable – see Table 5.141		
Walney 3 & 4	Unavailable	588	324
West of Duddon Sands	Unavailable – see Table 5.141	544	Unavailable – see Table 5.141
West of Orkney	0	12	3
White Cross	33	12,126	22
Tier 2			
Morecambe Offshore Wind Farm: Generation Assets	0	7,577	6
Morgan Generation Assets	0	1,254	911
Scenario Totals			
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	0	8,831	917

Project	Pre-breeding season cumulative abundance	Breeding season cumulative abundance	Post-breeding season cumulative abundance
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	231	27,768	2,222

5.11.2.31 The following displacement matrices provide the estimated cumulative mortality of Manx shearwater predicted to occur due to displacement during the operations and maintenance phase. Table 5.135 to Table 5.137 provide outputs for Scenario 2 with Table 5.138 to Table 5.140 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue. The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

5.11.2.32 In addition to impacts associated with offshore wind farms consideration in this section is also given to underwater collision impacts associated with tidal projects, specifically the Minesto and Morlais projects. Manx shearwater was not considered vulnerable to disturbance at these projects.

5.11.2.33 In the breeding season, the total mortality of Manx shearwater associated with underwater collision risk impacts at the Morlais project, was predicted to be less than one bird in the breeding season. Manx shearwater was not considered quantitatively as part of the underwater collision risk assessment undertaken for the Minesto project.

Table 5.135: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 2) (all entries are zero).

Manx shearwater (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	0	0	0	0	0	0	0	0	0	0	0	0
	15	0	0	0	0	0	0	0	0	0	0	0	0	0
	20	0	0	0	0	0	0	0	0	0	0	0	0	0
	30	0	0	0	0	0	0	0	0	0	0	0	0	0
	35	0	0	0	0	0	0	0	0	0	0	0	0	0
	40	0	0	0	0	0	0	0	0	0	0	0	0	0
	50	0	0	0	0	0	0	0	0	0	0	0	0	0
	60	0	0	0	0	0	0	0	0	0	0	0	0	0
	70	0	0	0	0	0	0	0	0	0	0	0	0	0
	80	0	0	0	0	0	0	0	0	0	0	0	0	0
	90	0	0	0	0	0	0	0	0	0	0	0	0	0
	100	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5.136: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the breeding season (Scenario 2).

Manx shearwater (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	9	18	44	88	177	265	353	442	530	618	706	795	883
	15	13	26	66	132	265	397	530	662	795	927	1060	1192	1325
	20	18	35	88	177	353	530	706	883	1060	1236	1413	1590	1766
	30	26	53	132	265	530	795	1060	1325	1590	1855	2119	2384	2649
	35	31	62	155	309	618	927	1236	1545	1855	2164	2473	2782	3091
	40	35	71	177	353	706	1060	1413	1766	2119	2473	2826	3179	3532
	50	44	88	221	442	883	1325	1766	2208	2649	3091	3532	3974	4415
	60	53	106	265	530	1060	1590	2119	2649	3179	3709	4239	4769	5299
	70	62	124	309	618	1236	1855	2473	3091	3709	4327	4945	5564	6182
	80	71	141	353	706	1413	2119	2826	3532	4239	4945	5652	6358	7065
	90	79	159	397	795	1590	2384	3179	3974	4769	5564	6358	7153	7948
	100	88	177	442	883	1766	2649	3532	4415	5299	6182	7065	7948	8831

Table 5.137: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the post-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Manx shearwater (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	2	5	9	18	28	37	46	55	64	73	83	92
	15	1	3	7	14	28	41	55	69	83	96	110	124	138
	20	2	4	9	18	37	55	73	92	110	128	147	165	183
	30	3	6	14	28	55	83	110	138	165	193	220	248	275
	35	3	6	16	32	64	96	128	160	193	225	257	289	321
	40	4	7	18	37	73	110	147	183	220	257	293	330	367
	50	5	9	23	46	92	138	183	229	275	321	367	413	459
	60	6	11	28	55	110	165	220	275	330	385	440	495	550
	70	6	13	32	64	128	193	257	321	385	449	514	578	642
	80	7	15	37	73	147	220	293	367	440	514	587	660	734
	90	8	17	41	83	165	248	330	413	495	578	660	743	825
	100	9	18	46	92	183	275	367	459	550	642	734	825	917

Table 5.138: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 3) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Manx shearwater (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	0	1	2	5	7	9	12	14	16	18	21	23
	15	0	1	2	3	7	10	14	17	21	24	28	31	35
	20	0	1	2	5	9	14	18	23	28	32	37	42	46
	30	1	1	3	7	14	21	28	35	42	49	55	62	69
	35	1	2	4	8	16	24	32	40	49	57	65	73	81
	40	1	2	5	9	18	28	37	46	55	65	74	83	92
	50	1	2	6	12	23	35	46	58	69	81	92	104	116
	60	1	3	7	14	28	42	55	69	83	97	111	125	139
	70	2	3	8	16	32	49	65	81	97	113	129	146	162
	80	2	4	9	18	37	55	74	92	111	129	148	166	185

Manx shearwater (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
	90	2	4	10	21	42	62	83	104	125	146	166	187	208
	100	2	5	12	23	46	69	92	116	139	162	185	208	231

Table 5.139: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the breeding season (Scenario 3).

Manx shearwater (breeding)	Mortality rate (%)												
	1	2	5	10	20	30	40	50	60	70	80	90	100
10	28	56	139	278	555	833	1111	1388	1666	1944	2221	2499	2777
15	42	83	208	417	833	1250	1666	2083	2499	2916	3332	3749	4165
20	56	111	278	555	1111	1666	2221	2777	3332	3887	4443	4998	5554
30	83	167	417	833	1666	2499	3332	4165	4998	5831	6664	7497	8330
35	97	194	486	972	1944	2916	3887	4859	5831	6803	7775	8747	9719
40	111	222	555	1111	2221	3332	4443	5554	6664	7775	8886	9996	11107
50	139	278	694	1388	2777	4165	5554	6942	8330	9719	11107	12495	13884
60	167	333	833	1666	3332	4998	6664	8330	9996	11662	13329	14995	16661
70	194	389	972	1944	3887	5831	7775	9719	11662	13606	15550	17494	19437
80	222	444	1111	2221	4443	6664	8886	11107	13329	15550	17771	19993	22214
90	250	500	1250	2499	4998	7497	9996	12495	14995	17494	19993	22492	24991
100	278	555	1388	2777	5554	8330	11107	13884	16661	19437	22214	24991	27768

Table 5.140: Operations and maintenance phase cumulative Manx shearwater mortality following displacement from offshore wind farms in the post-breeding season (Scenario 3).

Manx shearwater (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	2	4	11	22	44	67	89	111	133	156	178	200	222
	15	3	7	17	33	67	100	133	167	200	233	267	300	333
	20	4	9	22	44	89	133	178	222	267	311	356	400	444
	30	7	13	33	67	133	200	267	333	400	467	533	600	667
	35	8	16	39	78	156	233	311	389	467	545	622	700	778
	40	9	18	44	89	178	267	356	444	533	622	711	800	889

Manx shearwater (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
	50	11	22	56	111	222	333	444	556	667	778	889	1000	1111
	60	13	27	67	133	267	400	533	667	800	933	1067	1200	1333
	70	16	31	78	156	311	467	622	778	933	1089	1245	1400	1556
	80	18	36	89	178	356	533	711	889	1067	1245	1422	1600	1778
	90	20	40	100	200	400	600	800	1000	1200	1400	1600	1800	2000
	100	22	44	111	222	444	667	889	1111	1333	1556	1778	2000	2222

Table 5.141: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of displacement impacts was not undertaken in project-specific documentation for Manx shearwater.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Burbo Bank (Seascape Energy Ltd., 2002)	Disturbance impacts considered qualitatively.	Surveys of the project comprised aerial and boat-based surveys both of which were undertaken during winter months (aerial undertaken during November to April and boat-based undertaken during December and February). Aerial surveys covered a large area encompassing the Liverpool Bay SPA with boat-based surveys covering the project area. The surveys were undertaken to provide abundance and distribution data for those species considered to be of most importance, namely common scoter and red-throated diver. Manx shearwater was not considered to be a species of International or National importance in the context of the assessments undertaken. It does not appear that the species was recorded during site-specific surveys, with no mention of the species in project-specific documentation.	Although Manx shearwater was not specifically assessed due to the species being considered of limited importance, low levels of disturbance were predicted for other species with conclusions of a negligible magnitude and very low significance reached.
Walney 1 & 2 (RPS, 2006a)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of Manx shearwater recorded in the project area plus 2 km buffer during aerial surveys was 135 birds. In boat-based surveys the equivalent population was 3,673 birds. Manx shearwater was deemed to be a species of high importance (termed sensitivity in the Walney 1 & 2 assessments).	With no evidence for the likely sensitivity of Manx shearwater to displacement impacts when the assessments for Walney 1+2 were undertaken the assessment assumed that Manx shearwater would avoid the wind farm area. However, although it was assumed that displacement effects would be high it was considered that this would lead to a high impact magnitude due to the short temporal period during which Manx shearwaters would be present in the wind farm area, the low importance of the wind farm area for the species and the large foraging range of the species leading to a conclusion of low magnitude. The overall significance of impacts associated with the project was considered to be low.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Robin Rigg (Natural Power, 2002)	Disturbance impacts considered qualitatively.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of Manx shearwater during boat-based surveys in the wind farm was 3.0 birds with a peak of 39 birds. Manx shearwater was considered to be present in the wind farm area in regionally important numbers.	The magnitude of the effect was considered to be negligible with a very low significance.
West of Duddon Sands (RPS, 2006b)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of Manx shearwater recorded in the project area plus 2 km buffer during aerial surveys was 104 birds. In boat-based surveys the equivalent population was 544 birds. Manx shearwater was deemed to be a species of high importance (termed sensitivity in the West of Duddon Sands assessments).	With no evidence for the likely sensitivity of Manx shearwater to displacement impacts when the assessments for West of Duddon Sands were undertaken the assessment assumed that Manx shearwater would avoid the wind farm area. However, although it was assumed that displacement effects would be high it was considered that this would lead to a high impact magnitude due to the short temporal period during which Manx shearwaters would be present in the wind farm area, the low importance of the wind farm area for the species and the large foraging range of the species leading to a conclusion of low magnitude. The overall significance of impacts associated with the project was considered to be low.
Gwynt y Môr (RWE Group and Npower Renewables, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys undertaken in support of the project included boat-based surveys undertaken between February 2003 and March 2005. Surveys between February 2003 and February 2004 covered a large area along the Welsh coast incorporating the project area with surveys between March 2004 and March 2005 more focussed on the project area. The assessment also used data from aerial surveys undertaken between 2000 and 2005 which were targeted at recording common scoter.	It was considered that displacement (termed avoidance of turbines in the assessments conducted) would result in an impact of low significance for Manx shearwater due to the very extensive areas across which the species forages and the limited importance of the project area for the species.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
		Manx shearwaters were recorded during boat-based surveys particularly in April and May 2004. In other months only single birds or small flocks were recorded.	
Ormonde (Ecology Consulting, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken monthly between May 2004 and April 2005. In addition, three aerial surveys were conducted during the summer of 2004 with four further aerial surveys in the winter of 2004/5. The peak population of Manx shearwater recorded in the wind farm plus a 2 km buffer during boat-based surveys was 1,001 birds. During aerial surveys the equivalent population was 0 birds. Peak numbers were recorded in August, although the majority of birds were outside of the wind farm area in deeper waters to the west of the study area. The species was considered to be of high importance (termed sensitivity) in the context of the assessments conducted.	The magnitude of the effect for Manx shearwater was considered to be negligible with a low significance.

Table 5.142: Cumulative assessment for Manx shearwater in relation to cumulative disturbance and displacement impacts during the operations and maintenance phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets . The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets. The displacement mortality associated with the range of displacement and mortality rates considered for Manx shearwater in all seasons and when all seasons are combined does not surpass the 1% threshold of relevant regional populations. Wade *et al.* (2016) identifies the vulnerability of Manx shearwater to displacement as very low and the species' habitat flexibility as high. Following JNCC *et al.* (2022) guidance would suggest based on the vulnerability scores in Wade *et al.* (2016) that much lower displacement rates than advised by the EWG would be applicable (i.e. 1-10%). Dierschke *et al.* (2016), which reviewed the response of seabird species to offshore wind farms identified Manx shearwater as a species that exhibited weak avoidance to offshore wind farms, with birds observed inside wind farms within the Celtic Sea. This also suggests that lower displacement rates are applicable to this species.	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The displacement mortality associated with the range of displacement and mortality rates considered for Manx shearwater in all seasons and when all seasons are combined do not surpass the 1% threshold of relevant regional populations. The addition of impacts associated with the Morlais and Minesto tidal projects has a negligible effect on the cumulative impact which remains below the 1% threshold of baseline mortality. Wade *et al.* (2016) identifies the vulnerability of Manx shearwater to displacement as very low and the species' habitat flexibility as high. Following JNCC *et al.* (2022) guidance would suggest based on the vulnerability scores in Wade *et al.* (2016) that much lower displacement rates than advised by the EWG would be applicable (i.e. 1-10%). Dierschke *et al.* (2016), which reviewed the response of seabird species to offshore wind farms identified Manx shearwater as a species that exhibited weak avoidance to offshore wind farms, with birds observed inside wind farms within the Celtic Sea. This also suggests that

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	lower displacement rates are applicable to this species. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. There are some projects for which abundance data are not available. For the majority of these projects the wind farm areas were not considered to be of importance for gannet. It is therefore considered that the inclusion of these projects would not alter the impact magnitude concluded. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects. In addition, no account is taken of the potential habituation by gannet which, due to the age of many of the projects considered cumulatively could affect the estimated impact.
Sensitivity of receptor	The sensitivity of Manx shearwater is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.117 to 5.9.1.120). Manx shearwater is deemed to be of low vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of Manx shearwater is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.117 to 5.9.1.120). Manx shearwater is deemed to be of low vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of Manx shearwater is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.117 to 5.9.1.120). Manx shearwater is deemed to be of low vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Gannet

5.11.2.34 The estimated cumulative abundance of gannet from relevant projects is presented in Table 5.143. There are several projects for which there are no, or limited, data on the number of gannet predicted to be displaced, for some of the earlier developments these are discussed in Table 5.150.

Table 5.143: Gannet cumulative abundances for offshore wind projects for disturbance and displacement assessment during operations.

Note: Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Pre-breeding season cumulative abundance	Breeding season cumulative abundance	Post-breeding season cumulative abundance
Tier 1			
Awel y Môr	0	328	201
Burbo Bank	Unavailable – see Table 5.150		
Burbo Bank Extension	22	648	25
Erebus	100	224	334
Gwynt y Môr	Unavailable – see Table 5.150		
Mona Offshore Wind Project	28	251	58
Ormonde	Unavailable – see Table 5.150	199	Unavailable – see Table 5.150
Robin Rigg	Unavailable – see Table 5.150	14	Unavailable – see Table 5.150
Twinhub	Unavailable	244	153
Walney 1 & 2	Unavailable – see Table 5.150		
Walney 3 & 4	24	150	259
West of Duddon Sands	Unavailable – see Table 5.150	431	Unavailable – see Table 5.150
West of Orkney	140	852	1,368
White Cross	57	239	141
Tier 2			
Morecambe Offshore Wind Farm: Generation Assets	0	748	164
Morgan Generation Assets	35	154	65
Scenario Totals			
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	35	902	229

Project	Pre-breeding season cumulative abundance	Breeding season cumulative abundance	Post-breeding season cumulative abundance
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	406	4,482	2,769

5.11.2.35 The following displacement matrices provide the estimated cumulative mortality of gannet predicted to occur due to displacement during the operations and maintenance phase. Table 5.144 to Table 5.146 provide outputs for Scenario 2 with Table 5.147 to Table 5.149 providing outputs for Scenario 3. Within each matrix the range of displacement and mortality rates as defined following JNCC *et al.* (2022) guidance and recommendations from the EWG are highlighted using purple with the 1% threshold of baseline mortality for each associated seasonal regional population highlighted in blue. The approach used for the cumulative displacement assessment follows Volume 4, Annex 10.2: Offshore ornithology displacement assessment of the Environmental Statement.

5.11.2.36 In addition to impacts associated with offshore wind farms consideration in this section is also given to underwater collision impacts associated with tidal projects, specifically the Minesto and Morlais projects. Gannet was not considered vulnerable to disturbance at these projects.

5.11.2.37 In the breeding season, the total mortality of gannet associated with underwater collision risk impacts at the Morlais project, was predicted to be less than one bird in the breeding season. Gannet was not considered quantitatively as part of the underwater collision risk assessment undertaken for the Minesto project.

Table 5.144: Operations and maintenance phase cumulative gannet mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Gannet (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	0	0	0	1	1	1	2	2	2	3	3	4
	20	0	0	0	1	1	2	3	4	4	5	6	6	7
	30	0	0	1	1	2	3	4	5	6	7	8	9	11
	40	0	0	1	1	3	4	6	7	8	10	11	13	14
	50	0	0	1	2	4	5	7	9	11	12	14	16	18
	60	0	0	1	2	4	6	8	11	13	15	17	19	21
	70	0	0	1	2	5	7	10	12	15	17	20	22	25
	80	0	1	1	3	6	8	11	14	17	20	22	25	28
	90	0	1	2	3	6	9	13	16	19	22	25	28	32
	100	0	1	2	4	7	11	14	18	21	25	28	32	35

Table 5.145: Operations and maintenance phase cumulative gannet mortality following displacement from offshore wind farms in the breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Gannet (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	1	2	5	9	18	27	36	45	54	63	72	81	90
	20	2	4	9	18	36	54	72	90	108	126	144	162	180
	30	3	5	14	27	54	81	108	135	162	189	216	243	271
	40	4	7	18	36	72	108	144	180	216	253	289	325	361
	50	5	9	23	45	90	135	180	225	271	316	361	406	451
	60	5	11	27	54	108	162	216	271	325	379	433	487	541
	70	6	13	32	63	126	189	253	316	379	442	505	568	631
	80	7	14	36	72	144	216	289	361	433	505	577	649	721
	90	8	16	41	81	162	243	325	406	487	568	649	730	812
	100	9	18	45	90	180	271	361	451	541	631	721	812	902

Table 5.146: Operations and maintenance phase cumulative gannet mortality following displacement from offshore wind farms in the post-breeding season (Scenario 2) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Gannet (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	0	1	2	5	7	9	11	14	16	18	21	23
	20	0	1	2	5	9	14	18	23	27	32	37	41	46
	30	1	1	3	7	14	21	27	34	41	48	55	62	69
	40	1	2	5	9	18	27	37	46	55	64	73	82	92
	50	1	2	6	11	23	34	46	57	69	80	92	103	115
	60	1	3	7	14	27	41	55	69	82	96	110	124	137
	70	2	3	8	16	32	48	64	80	96	112	128	144	160
	80	2	4	9	18	37	55	73	92	110	128	147	165	183
	90	2	4	10	21	41	62	82	103	124	144	165	186	206
	100	2	5	11	23	46	69	92	115	137	160	183	206	229

Table 5.147: Operations and maintenance phase cumulative gannet mortality following displacement from offshore wind farms in the pre-breeding season (Scenario 3) (note the 1% baseline mortality threshold is not surpassed by any value in the matrix).

Gannet (pre-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	0	1	2	4	8	12	16	20	24	28	32	37	41
	20	1	2	4	8	16	24	32	41	49	57	65	73	81
	30	1	2	6	12	24	37	49	61	73	85	97	110	122
	40	2	3	8	16	32	49	65	81	97	114	130	146	162
	50	2	4	10	20	41	61	81	101	122	142	162	183	203
	60	2	5	12	24	49	73	97	122	146	170	195	219	243
	70	3	6	14	28	57	85	114	142	170	199	227	256	284
	80	3	6	16	32	65	97	130	162	195	227	260	292	324
	90	4	7	18	37	73	110	146	183	219	256	292	329	365
	100	4	8	20	41	81	122	162	203	243	284	324	365	406

Table 5.148: Operations and maintenance phase cumulative gannet mortality following displacement from offshore wind farms in the breeding season (Scenario 3).

Gannet (breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	4	9	22	45	90	134	179	224	269	314	359	403	448
	20	9	18	45	90	179	269	359	448	538	627	717	807	896
	30	13	27	67	134	269	403	538	672	807	941	1076	1210	1344
	40	18	36	90	179	359	538	717	896	1076	1255	1434	1613	1793
	50	22	45	112	224	448	672	896	1120	1344	1569	1793	2017	2241
	60	27	54	134	269	538	807	1076	1344	1613	1882	2151	2420	2689
	70	31	63	157	314	627	941	1255	1569	1882	2196	2510	2823	3137
	80	36	72	179	359	717	1076	1434	1793	2151	2510	2868	3227	3585
	90	40	81	202	403	807	1210	1613	2017	2420	2823	3227	3630	4033
	100	45	90	224	448	896	1344	1793	2241	2689	3137	3585	4033	4482

Table 5.149: Operations and maintenance phase cumulative gannet mortality following displacement from offshore wind farms in the post-breeding season (Scenario 3).

Gannet (post-breeding)		Mortality rate (%)												
		1	2	5	10	20	30	40	50	60	70	80	90	100
Displacement rate (%)	10	3	6	14	28	55	83	111	138	166	194	221	249	277
	20	6	11	28	55	111	166	221	277	332	388	443	498	554
	30	8	17	42	83	166	249	332	415	498	581	664	748	831
	40	11	22	55	111	221	332	443	554	664	775	886	997	1107
	50	14	28	69	138	277	415	554	692	831	969	1107	1246	1384
	60	17	33	83	166	332	498	664	831	997	1163	1329	1495	1661
	70	19	39	97	194	388	581	775	969	1163	1357	1550	1744	1938
	80	22	44	111	221	443	664	886	1107	1329	1550	1772	1993	2215
	90	25	50	125	249	498	748	997	1246	1495	1744	1993	2243	2492
	100	28	55	138	277	554	831	1107	1384	1661	1938	2215	2492	2769

Table 5.150: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of displacement impacts was not undertaken in project-specific documentation for gannet.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Burbo Bank (Seascape Energy Ltd., 2002)	Disturbance impacts considered qualitatively.	Surveys of the project comprised aerial and boat-based surveys both of which were undertaken during winter months (aerial undertaken during November to April and boat-based undertaken during December and February). Aerial surveys covered a large area encompassing the Liverpool Bay SPA with boat-based surveys covering the project area. The surveys were undertaken to provide abundance and distribution data for those species considered to be of most importance, namely common scoter and red-throated diver. Gannet was not recorded during boat-based surveys with relatively low numbers recorded during aerial surveys.	Gannet was not considered to be a species of International or National importance in the context of the assessments undertaken. Although gannet was not specifically assessed due to the species being considered of limited importance, low levels of disturbance were predicted for other species with conclusions of a negligible magnitude and very low significance reached.
Walney 1 & 2 (RPS, 2006a)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of gannet recorded in the project area plus 2 km buffer during aerial surveys was 52 birds. In boat-based surveys the equivalent population was 332 birds. The proportion of flying gannets recorded above 15 m was 21.5 % across all boat-based surveys within the boat-based survey area. Gannet was deemed to be a species of medium importance due to SPA connectivity (termed sensitivity in the Walney 1 & 2 assessments).	It was considered that the wind farm area did not represent a favoured foraging habitat and the magnitude of any impact was considered to be low. The species was considered to be of medium sensitivity. The overall significance of impacts associated with the project was considered to be low.
Robin Rigg (Natural Power, 2002)	Disturbance impacts considered qualitatively.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of gannet during boat-based surveys in the wind farm was 0.4 birds with a peak of 4 birds. Gannet was considered to be of local importance based on the populations recorded in the wind farm.	The magnitude of the effect was considered to be negligible with a very low significance.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
West of Duddon Sands (RPS, 2006b)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of gannet recorded in the project area plus 2 km buffer during aerial surveys was 57 birds. In boat-based surveys the equivalent population was 431 birds. Gannet was deemed to be a species of medium importance due to SPA connectivity (termed sensitivity in the West of Duddon Sands assessments).	The magnitude of impacts was considered to be low. Gannet was considered to be of medium importance (termed sensitivity in the assessments for the project). The significance of all impacts was considered to be low.
Gwynt y Môr (RWE Group and Npower Renewables, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys undertaken in support of the project included boat-based surveys undertaken between February 2003 and March 2005. Surveys between February 2003 and February 2004 covered a large area along the Welsh coast incorporating the project area with surveys between March 2004 and March 2005 more focussed on the project area. The assessment also used data from aerial surveys undertaken between 2000 and 2005 which were targeted at recording common scoter. Very few gannet were recorded during boat-based surveys between October and March. More birds were present in summer months with a large proportion on the sea surface.	It was considered that displacement (termed avoidance of turbines in the assessments conducted) would result in an impact of low significance for gannet due to the very extensive areas across which the species forages and the limited importance of the project area for the species.
Ormonde (Ecology Consulting, 2005)	Disturbance impacts considered qualitatively.	Site-specific surveys included boat-based surveys undertaken monthly between May 2004 and April 2005. In addition, three aerial surveys were conducted during the summer of 2004 with four further aerial surveys in the winter of 2004/5. The peak population of gannet recorded in the wind farm plus a 2 km buffer during boat-based surveys was 199 birds. During aerial surveys the equivalent population was 15 birds. The species was primarily recorded in summer months especially May and September. The species was considered to be regionally important in the context of the assessments conducted.	The magnitude of the effect for gannet was considered to be low with a low significance.

Table 5.151: Cumulative assessment for gannet in relation to cumulative disturbance and displacement impacts during the operations and maintenance phase.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets . The assessments for both the Morgan Generation Assets and Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets predicted negligible impact magnitudes. This was concluded for both projects based on the local spatial extents, short term durations, intermittency and high reversibility. The cumulative impact is predicted therefore to be of local spatial extent, short term duration, intermittent and high reversibility. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • The Morgan and Morecambe Offshore Wind Farms: Transmission Assets • Morecambe Offshore Windfarm Generation Assets. The displacement mortality associated with the range of displacement and mortality rates considered for gannet in all seasons and when all seasons are combined do not surpass the 1% threshold of relevant regional populations. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects.	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The displacement mortality associated with the range of displacement and mortality rates considered for gannet in all seasons and when all seasons are combined do not surpass the 1% threshold of relevant regional populations. The addition of impacts associated with the Morlais and Minesto tidal projects has a negligible effect on the cumulative impact which remains below the 1% threshold of baseline mortality. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is therefore predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. There are some projects for which abundance data are not available. For the majority of these projects the wind farm areas were not considered to be of importance for Manx shearwater. It is therefore considered that the inclusion of these projects would not alter the impact magnitude concluded.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
			The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects. In addition, no account is taken of the potential habituation by Manx shearwater which, due to the age of many of the projects considered cumulatively could affect the estimated impact.
Sensitivity of receptor	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.121 to 5.9.1.124). Gannet is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.121 to 5.9.1.124). Gannet is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.1.121 to 5.9.1.124). Gannet is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be medium.
Significance of effect	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.
Further mitigation and residual significance	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Decommissioning phase

5.11.2.38 During the decommissioning phase, cumulative disturbance and displacement of all species considered in the construction and operations and maintenance phases would only occur if these activities occur at the same time across wind farms. Disturbance effects during the decommissioning phase are anticipated to be similar to those predicted during the construction phase (section 5.1 onwards) if the decommissioning schedule of the Morgan Generation Assets overlaps with that for the other wind farms within the CEA. The magnitude of impact would be negligible for all receptors which is not significant in EIA terms.

5.11.3 Collision risk

Overview

5.11.3.1 There are no collision risk impacts associated with the Morgan and Morecambe Offshore Wind Farms: Transmission Assets and therefore only Scenarios 2 and 3, as described in paragraph 5.11.1.1 are relevant to the cumulative assessment of collision risk.

Operations and maintenance phase

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

5.11.3.3 The following species are considered in relation to cumulative collision risk impacts: kittiwake, lesser black-backed gull, herring gull, great black-backed gull and gannet. Manx shearwater is not considered for cumulative assessment as the total predicted impact from the Morgan Generation Assets was less than 0.001 collisions/annum and it is therefore considered that the Morgan Generation Assets will not materially contribute to any existing cumulative impact.

5.11.3.4 As stated, data used within the assessment of cumulative collision risk is based on published information produced by the respective project developers. As such, the input parameters (e.g. avoidance rates) and the collision risk model used (e.g. deterministic) may vary from those put forward in this Chapter which is based on the most up to date understanding of collision risk.

Magnitude of impact

Kittiwake

5.11.3.5 The expected mean seasonal and annual collision mortality for kittiwake has been compiled for relevant wind farms and is shown in Table 5.152. Totals for each scenario to be considered in the cumulative assessment are provided in Table 5.152. Projects considered to act cumulatively with the Morgan Generation Assets in the breeding season are those within the mean-maximum foraging range (+1SD) of kittiwake from colonies within the mean-maximum foraging range (+1SD) of kittiwake from the Morgan Generation Assets. In simple terms this therefore includes all projects within an area representing twice the foraging of kittiwake from the Morgan Generation Assets. In the non-breeding seasons, projects considered to act cumulatively with the Morgan Generation Assets are those within the relevant BDMPS area from Furness (2015). The seasonal extents used are consistent with those used in the assessment for the Morgan Generation Assets. All collision risk estimates are calculated using an avoidance rate of 99.79% (Ozsanlav-Harris *et al.,* 2023). Total collision risk estimates presented in brackets in Table 5.152 are calculated using an avoidance rate of 99.28%, as advocated by the EWG and, for the Morgan Generation Assets, represent collision risk estimates calculated using parameters as advocated by the EWG.

Table 5.152: Expected seasonal and annual collision mortality across relevant wind farms for the kittiwake.

Note: Values in brackets are calculated using an avoidance rate of 99.28%, as advocated by the EWG and, for the Morgan Generation Assets, represent collision risk estimates calculated using parameters as advocated by the EWG.

Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Breeding	Post-breeding	Pre-breeding	Total
Tier 1				
Awel y Môr	4.5	2.3	3.5	10.3
Burbo Bank	Unavailable – see Table 5.153			
Burbo Bank Extension	5.9	0.5	0.3	6.7
Erebus	0.4	7.0	3.6	11.0
Gwynt y Môr	Unavailable – see Table 5.153			
Mona Offshore Wind Project	2.8	2.5	4.5	9.8
Ormonde	0.3	0.3	0.1	0.6
Rampion	12.8	5.0	5.4	23.2
Rampion 2	0.4	2.9	5.2	8.5
Robin Rigg	Unavailable – see Table 5.153			
Twinhub	0.4	0.9	1.5	2.8
Walney 1 & 2	Unavailable – see Table 5.153			
Walney 3 & 4	6.0	16.9	12.9	35.8
West of Duddon Sands	Unavailable – see Table 5.153			
West of Orkney	8.1	5.3	0.8	14.2
White Cross	0.1	0.5	3.7	4.3
Tier 2				
Morecambe Offshore Wind Farm: Generation Assets	4.4	3.4	1.6	9.3
Morgan Generation Assets	1.9 (8.1)	4.3 (18.4)	3.2 (13.6)	9.4 (40.0)
Scenario Totals				
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets				**18.7 (72.0)**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects				**147.7 (514.2)**

5.11.3.6 There are a number of Tier 1 projects for which collision risk estimates are unavailable. This is due to various factors including species not being included in collision risk modelling or projects not having conducted collision risk modelling. To ensure these projects are considered in this assessment project-specific documents have been reviewed to provide a qualitative assessment of collision for each project. This process is summarised in Table 5.153.

Table 5.153: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of collision risk was not undertaken in project-specific documentation for kittiwake.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Burbo Bank (Seascape Energy Ltd., 2002)	Species not included in collision risk modelling.	The assessment of collision risk was undertaken on a qualitative basis by investigating flight heights of birds at the project site and was undertaken for species considered to be of International or National importance in the context of the assessments undertaken for the project. Kittiwake was not considered to be a species of International or National importance. Surveys of the project comprised aerial and boat-based surveys both of which were undertaken during winter months (aerial undertaken during November to April and boat-based undertaken during December and February). Aerial surveys covered a large area encompassing the Liverpool Bay SPA with boat-based surveys covering the project area. The surveys were undertaken to provide abundance and distribution data for those species considered to be of most importance, namely common scoter and red-throated diver. Low numbers of kittiwake were recorded during boat-based surveys with relatively low numbers also recorded during aerial surveys.	No assessment was conducted for kittiwake in relation to collision risk impacts however, kittiwake was not considered to be a species of International or National importance in the context of the assessments undertaken.
Walney 1 & 2 (RPS, 2006a)	Species not included in collision risk modelling.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. Kittiwake was not included in collision risk modelling and it was considered that, due to the very low numbers of birds recorded at rotor height, that the magnitude of collision was negligible.	Very low significance.
West of Duddon Sands (RSKENSR, 2006)	Species not included in collision risk modelling.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of kittiwake recorded in the project area plus 2 km buffer during aerial surveys was 14 birds. In boat-based surveys the equivalent	Very low significance.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
		population was 454 birds. The proportion of flying kittiwake recorded above 15 m was 15.5 % across all boat-based surveys within the boat-based survey area. Kittiwake was deemed to be a species of low importance (termed sensitivity in the West of Duddon Sands assessments).	
Gwynt y Môr (RWE Group and Npower Renewables, 2005)	Species not included in collision risk modelling.	Site-specific surveys undertaken in support of the project included boat-based surveys undertaken between February 2003 and March 2005. Surveys between February 2003 and February 2004 covered a large area along the Welsh coast incorporating the project area with surveys between March 2004 and March 2005 more focussed on the project area. The assessment also used data from aerial surveys undertaken between 2000 and 2005 which were targeted at recording common scoter. The highest populations of kittiwake were recorded between March and May. During boat-based surveys used to characterise the project undertaken between 2004 to 2005, covering an area considered by the project assessment to better represent the behaviour of birds than the area associated with boat-based surveys undertaken in 2003-04, 8,900 observations were obtained with only 22 flights recorded at a height of greater than 20 m. In 2004-05 surveys, 603 kittiwake were recorded in flight with only 0.2% of these flying above 20 m.	Low significance due to low proportion of flight heights recorded at collision height.
Robin Rigg (Natural Power, 2002)	Species not included in collision risk modelling.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of kittiwake during boat-based surveys in the wind farm was 4.5 birds with a peak of 46 birds. Kittiwake was considered to be of local importance based on the populations recorded in the wind farm. The proportion of kittiwake flying above 20 m during boat-based surveys across the entire study area was less than 1%. A qualitative assessment was undertaken for ‘other seabirds’ (a category that included gulls) and it was considered that collision rates would be low/negligible.	Low/Very low significance.

Table 5.154: Cumulative assessment for kittiwake in relation to cumulative collision risk impacts.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	Impact pathway is not applicable to the Morgan Transmission Assets.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets. This impact pathway is not applicable to the Morgan Transmission Assets The magnitude of the cumulative effect of these two projects may result in 18.7 collisions/annum (72.0 collisions/annum when applying assumptions advocated by the EWG). This represents a 0.01% increase in the baseline mortality of the largest BDMPS population (or a 0.05% increase when applying the avoidance rate advocated by the EWG for kittiwake). The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed).	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The magnitude of the cumulative effect of these projects may result in 147.7 (514.2) collisions/annum. This represents a 0.11% increase in the baseline mortality of the largest BDMPS population (or a 0.38% increase when applying the avoidance rate advocated by the EWG for kittiwake). The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed) • No consideration of changes to project designs between assessment and construction which will often lead to significant decreases in collision risk estimates. There are a number of projects for which collision risk has not been quantified. Based on the information

	Scenario 1 Morgan Generation Assets + Transmission Assets	**Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets**	**Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects**
			presented in Table 5.153 it is not considered that collision risk impacts at these projects would lead to a different conclusion in relation to the magnitude of this impact.
Sensitivity of receptor	Impact pathway is not applicable to the Morgan Transmission Assets.	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.34 to 5.9.4.37.). Kittiwake is deemed to be of high vulnerability, low recoverability and international conservation value. The sensitivity of the receptor is therefore, considered to be high.	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.34 to 5.9.4.37). Kittiwake is deemed to be of high vulnerability, low recoverability and international conservation value. The sensitivity of the receptor is therefore, considered to be high.
Significance of effect	Impact pathway is not applicable to the Morgan Transmission Assets.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.153 it is not considered that collision risk impacts at these projects would lead to different conclusions being reached in relation to the cumulative assessment undertaken for the Morgan Generation Assets.
Further mitigation and residual significance	Impact pathway is not applicable to the Morgan Transmission Assets.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Great black-backed gull

5.11.3.7 The expected mean seasonal and annual collision mortality for great black-backed gull has been compiled for relevant wind farms and is shown in Table 5.155. Totals for each scenario to be considered in the cumulative assessment are provided in Table 5.155. Projects considered to act cumulatively with the Morgan Generation Assets in the breeding season are those within the mean-maximum foraging range (+1SD) of great black-backed gull from colonies within the mean-maximum foraging range (+1SD) of great black-backed gull from the Morgan Generation Assets. In simple terms this therefore includes all projects within an area representing twice the foraging of great black-backed gull from the Morgan Generation Assets. In the non-breeding seasons, projects considered to act cumulatively with the Morgan Generation Assets are those within the relevant BDMPS area from Furness (2015). The seasonal extents used are consistent with those used in the assessment for the Morgan Generation Assets. All collision risk estimates are calculated using an avoidance rate of 99.91% (Ozsanlav-Harris *et al.* 2023). Total collision risk estimates presented in brackets in Table 5.155 are calculated using an avoidance rate of 99.39%, as advocated by the EWG and, for the Morgan Generation Assets, represent collision risk estimates calculated using parameters as advocated by the EWG.

Table 5.155: Expected seasonal and annual collision mortality across relevant wind farms for the great black-backed gull.

Note: Values in brackets are calculated using an avoidance rate of 99.39%, as advocated by the EWG and, for the Morgan Generation Assets, represent collision risk estimates calculated using parameters as advocated by the EWG.

Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Breeding	Non-breeding	Total
Tier 1			
Awel y Môr	0.8	0.1	0.9
Burbo Bank	Unavailable – see Table 5.156		
Burbo Bank Extension	Unavailable – see Table 5.156		
Erebus	0.0	0.1	0.1
Gwynt y Môr	Unavailable – see Table 5.156		
Mona Offshore Wind Project	0.3	0.5	0.7
Ormonde	0.0	0.0	0.0
Rampion	0.7	3.9	4.7
Rampion 2	0.9	2.0	3.0
Robin Rigg	Unavailable – see Table 5.156		
Twinhub	1.0	1.4	2.3
Walney 1 & 2	Unavailable – see Table 5.156		
Walney 3 & 4	0.7	4.4	5.1
West of Duddon Sands	Unavailable – see Table 5.156		
White Cross	0.1	0.0	0.1
Tier 2			
Morecambe Offshore Wind Farm: Generation Assets	0.1	0.1	0.1

Project	Breeding	Non-breeding	Total
Morgan Generation Assets	0.1 (1.1)	0.6 (4.6)	0.7 (5.7)
Scenario Totals			
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets			**0.9 (6.7)**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects			**17.8 (121.6)**

5.11.3.8 There are a number of projects for which collision risk estimates are unavailable. This is due to various factors including species not being included in collision risk modelling or projects not having conducted collision risk modelling. To ensure these projects are considered in this assessment project-specific documents have been reviewed to provide a qualitative assessment of collision for each project. This process is summarised in Table 5.156.

Table 5.156: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of collision risk was not undertaken in project-specific documentation for great black-backed gull.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Burbo Bank (Seascape Energy Ltd., 2002)	Species not included in collision risk modelling.	The assessment of collision risk was undertaken on a qualitative basis by investigating flight heights of birds at the project site and was undertaken for species considered to be of International or National importance in the context of the assessments undertaken for the project. Great black-backed gull was not considered to be a species of International or National importance. Surveys of the project comprised aerial and boat-based surveys both of which were undertaken during winter months (aerial undertaken during November to April and boat-based undertaken during December and February). Aerial surveys covered a large area encompassing the Liverpool Bay SPA with boat-based surveys covering the project area. The surveys were undertaken to provide abundance and distribution data for those species considered to be of most importance, namely common scoter and red-throated diver. Great black-backed gull was not recorded during boat-based surveys with relatively low numbers recorded during aerial surveys.	No assessment was conducted for great black-backed gull in relation to collision risk impacts however, for great black-backed gull was not considered to be a species of International or National importance in the context of the assessments undertaken.
Burbo Bank Extension (DONG Energy, 2013)	Species not included in collision risk modelling.	Collision risk modelling was undertaken however great black-backed gull was not included. Site-specific data consisted of six boat-based surveys undertaken between April and September 2011 and six aerial surveys undertaken between November 2010 and April 2011. The peak population of great black-backed gull recorded during boat-based surveys was 18 bids with an average of 8 birds. During aerial surveys, great black-backed gulls were recorded in all but one but in small numbers (peak population of 90 birds). The species was considered to be of regional/local importance in the context of the assessment for the project.	No assessment was conducted for great black-backed gull in relation to collision risk impacts.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Walney 1 & 2 (RPS, 2006b)	Species not included in collision risk modelling.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of great black-backed gull recorded in the project area plus 2 km buffer during aerial surveys was 43 birds. In boat-based surveys the equivalent population was 65 birds. The proportion of flying great black-backed gulls recorded above 15 m was 28.7 % across all boat-based surveys, although the total number of flying birds was low (108 records). Great black-backed gull was deemed to be a species of medium importance (termed sensitivity in the Walney 1 & 2 assessments). Great black-backed gull was not included in collision risk modelling, and it was considered that, due to the very low numbers of birds recorded at rotor height, that the magnitude of collision was negligible.	Very low significance.
West of Duddon Sands (RSKENSR, 2006)	Species not included in collision risk modelling.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of great black-backed gull recorded in the project area plus 2 km buffer during aerial surveys was 2 birds. In boat-based surveys the equivalent population was 661 birds. The proportion of flying great black-backed gulls recorded above 15 m was 28.7 % across all boat-based surveys, although the total number of flying birds was low (108 records). Great black-backed gull was deemed to be a species of medium importance (termed sensitivity in the West of Duddon Sands assessments).	Very low significance.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Gwynt y Môr (RWE Group and Npower Renewables, 2005)	Species not included in collision risk modelling.	Site-specific surveys undertaken in support of the project included boat-based surveys undertaken between February 2003 and March 2005. Surveys between February 2003 and February 2004 covered a large area along the Welsh coast incorporating the project area with surveys between March 2004 and March 2005 more focussed on the project area. The assessment also used data from aerial surveys undertaken between 2000 and 2005 which were targeted at recording common scoter. During boat-based surveys used to characterise the project undertaken between 2004 to 2005, covering an area considered by the project assessment to better represent the behaviour of birds than in 2003-04, 8,900 observations were obtained with only 22 flights recorded at a height of greater than 20 m. In 2004-05 surveys, 70 great black-backed gull were recorded in flight with only 2.9% of these flying above 20 m.	Low significance due to low proportion of flight heights recorded at collision height.
Robin Rigg (Natural Power, 2002)	Species not included in collision risk modelling.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of great black-backed gull during boat-based surveys in the wind farm was 0.1 birds with a peak of 1 bird. Great black-backed gull was not assigned an importance rating. The proportion of great black-backed gull flying above 20 m during boat-based surveys across the entire study area was 16%. A qualitative assessment was undertaken for ‘other seabirds’ (a category that included gulls) and it was considered that collision rates would be low/negligible.	Low/Very low significance.

Table 5.157: Cumulative assessment for great black-backed gull in relation to cumulative collision risk impacts.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	Impact pathway is not applicable to the Morgan Transmission Assets.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets. This impact pathway is not applicable to the Morgan Transmission Assets The magnitude of the cumulative effect of these two projects may result in 0.9 (6.7) collisions/annum. This represents a 0.02% increase in the baseline mortality of the largest BDMPS population (or a 0.16% increase when applying the avoidance rate advocated by the EWG). The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed).	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The magnitude of the cumulative effect of these projects may result in 17.8 (121.6) collisions/annum. This represents a 0.42% increase in the baseline mortality of the largest BDMPS population (or a 2.87% increase when applying the avoidance rate advocated by the EWG). The largest contributors to this total are the Rampion, Rampion 2, Twinhub and Walney Extension which contribute nearly 77% of the total impact. In contrast, the Morgan Generation Assets contribute less than 5%. Collision risk modelling for Walney Extension was based on a 207 x 3.6 MW turbine scenario whilst for Rampion modelling was based on a 175 x 4 MW turbine scenario. The as-built scenario at Walney Extension consists of 87 turbines with capacities of 7 and 8 MW whilst at Rampion the as-built scenario represents 116 x 3.45 MW turbines. Updated collision risk modelling for Walney Extension has shown significant reductions (53.02%) in the associated collision risk (Wheeldon *et al.*, 2023) with reductions also expected at Rampion. As discussed in Volume 4, Annex 5.3: Offshore Ornithology Collision Risk Modelling Technical Report, the flight speed values provided by

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
			Alerstam et al. (2007) are not considered appropriate for use in collision risk modelling. These flight speed values will have been used to calculate collision risk estimates for the majority of projects considered cumulatively. The likely decrease in collision risk estimates as a result of using more robust flight speed values could be approximately 20% (Ørsted, 2018). Similarly, Ozsanlav-Harris et al. (2023) presents avoidance rates for great black-backed gull that are species-specific and considered by Cook et al. (2021) to be supported by an appropriate amount of data to accurately reflect the flight behaviour of great black-backed gull. There is a large difference between the species-specific avoidance rate estimated for great black-backed gull and those estimated for other large gull species by Ozsanlav-Harris *et al.* (2023) which suggests a difference in avoidance behaviour. Although great black-backed gulls are a large gull they are larger than other species included in the grouped avoidance rate and this may therefore influence the avoidance rate obtained for this group in Ozsanlav-Harris et al. (2023). It is therefore anticipated that the cumulative collision risk total is therefore significantly lower than estimated here and it is considered that the actual collision risk total would be below the 1% increase in baseline mortality. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
			predicted that the impact will affect the receptor directly. As a result of the information presented here and elements of significant precaution incorporated into the assessment (see below) the impact magnitude is therefore, considered to be low. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed) • No consideration of changes to project designs between assessment and construction which will often lead to significant decreases in collision risk estimates. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.156 it is not considered that collision risk impacts at these projects would lead to a different conclusion in relation to the magnitude of this impact.
Sensitivity of receptor	Impact pathway is not applicable to the Morgan Transmission Assets.	The sensitivity of great black-backed gull is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.38 to 5.9.4.41).	The sensitivity of great black-backed gull is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.38 to 5.9.4.41).

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		Great black-backed gull is deemed to be of very high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.	Great black-backed gull is deemed to be of very high vulnerability, medium recoverability and regional value. The sensitivity of the receptor is therefore, considered to be medium.
Significance of effect	Impact pathway is not applicable to the Morgan Transmission Assets.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **negligible adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance due to the elements of precaution built into the assessment, which is not significant in EIA terms. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.153 it is not considered that collision risk impacts at these projects would lead to different conclusions being reached in relation to the cumulative assessment undertaken for the Morgan Generation Assets.
Further mitigation and residual significance	Impact pathway is not applicable to the Morgan Transmission Assets.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Herring gull

5.11.3.9 The expected mean seasonal and annual collision mortality for herring gull has been compiled for relevant wind farms and is shown in Table 5.158. Totals for each scenario to be considered in the cumulative assessment are provided in Table 5.158. Projects considered to act cumulatively with the Morgan Generation Assets in the breeding season are those within the mean-maximum foraging range (+1SD) of herring gull from colonies within the mean-maximum foraging range (+1SD) of herring gull from the Morgan Generation Assets. In simple terms this therefore includes all projects within an area representing twice the foraging range of herring gull from the Morgan Generation Assets. In the non-breeding seasons, projects considered to act cumulatively with the Morgan Generation Assets are those within the relevant BDMPS area from Furness (2015). The seasonal extents used are consistent with those used in the assessment for the Morgan Generation Assets. All collision risk estimates are calculated using an avoidance rate of 99.52% (Ozsanlav-Harris *et al.* 2023). Total collision risk estimates presented in brackets in Table 5.158 are calculated using an avoidance rate of 99.39%, as advocated by the EWG and, for the Morgan Generation Assets, represent collision risk estimates calculated using parameters as advocated by the EWG.

Table 5.158: Expected seasonal and annual collision mortality across relevant wind farms for the herring gull.

Note: Values in brackets are calculated using an avoidance rate of 99.39%, as advocated by the EWG and, for the Morgan Generation Assets, represent collision risk estimates calculated using parameters as advocated by the EWG.

Cells that are grey have no connectivity with the cumulative seasonal study area defined for the species

Project	Breeding	Non-breeding	Total
Tier 1			
Awel y Môr	0.8	0.6	1.4
Burbo Bank	Unavailable – see Table 5.159		
Burbo Bank Extension	12.9	9.9	22.8
Erebus	2.2	1.4	3.6
Gwynt y Môr	Unavailable – see Table 5.159		
Mona Offshore Wind Project	0.0	1.2	1.2
Ormonde	0.0	0.3	0.3
Robin Rigg	Unavailable – see Table 5.159		
Twinhub	15.2	11.2	26.4
Walney 1 & 2	Unavailable – see Table 5.159		
Walney 3 & 4	32.5	19.9	52.3
West of Duddon Sands	Unavailable – see Table 5.159		
West of Orkney	Unavailable – see Table 5.159		
White Cross	0.0	0.2	0.2
Tier 2			
Morecambe Offshore Wind Farm: Generation Assets.	1.6	1.1	2.7
Morgan Generation Assets	1.4 (2.1)	5.4 (8.0)	6.8 (10.1)

Project	Breeding	Non-breeding	Total
Scenario Totals			
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets			**9.5 (13.5)**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects			**117.9 (151.2)**

5.11.3.10 There are a number of projects for which collision risk estimates are unavailable. This is due to various factors including species not being included in collision risk modelling or projects not having conducted collision risk modelling. To ensure these projects are considered in this assessment project-specific documents have been reviewed to provide a qualitative assessment of collision for each project. This process is summarised in Table 5.159. Information is also unavailable for some Tier 2 projects, but this is due to the planning stage of the project and not because data is not presented in relevant documents.

Table 5.159: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of collision risk was not undertaken in project-specific documentation for herring gull.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Burbo Bank (Seascape Energy Ltd., 2002)	Species not included in collision risk modelling.	The assessment of collision risk was undertaken on a qualitative basis by investigating flight heights of birds at the project site and was undertaken for species considered to be of International or National importance in the context of the assessments undertaken for the project. Herring gull was not considered to be a species of International or National importance. Surveys of the project comprised aerial and boat-based surveys both of which were undertaken during winter months (aerial undertaken during November to April and boat-based undertaken during December and February). Aerial surveys covered a large area encompassing the Liverpool Bay SPA with boat-based surveys covering the project area. The surveys were undertaken to provide abundance and distribution data for those species considered to be of most importance, namely common scoter and red-throated diver. Herring gull was not recorded during boat-based surveys with relatively low numbers recorded during aerial surveys.	No assessment was conducted for herring gull in relation to collision risk impacts however, for herring gull was not considered to be a species of International or National importance in the context of the assessments undertaken.
Walney 1 & 2 (RPS, 2006a)	Species not included in collision risk modelling.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of herring gull recorded in the project area plus 2 km buffer during aerial surveys was 47 birds. In boat-based surveys the equivalent population was 78 birds. The proportion of flying herring gulls recorded above 15 m was 21.1 % across all boat-based surveys, although the total number of flying birds was low (90 records). Herring gull was deemed to be a species of very high importance due to SPA connectivity (termed sensitivity in the Walney 1 & 2 assessments).	Low significance.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
		Herring gull was not included in collision risk modelling, and it was considered that, due to the very low numbers of birds recorded at rotor height, that the magnitude of collision was negligible.	
West of Duddon Sands (RSKENSR, 2006)	Species not included in collision risk modelling.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of herring gull recorded in the project area plus 2 km buffer during aerial surveys was 6 birds. In boat-based surveys the equivalent population was 1,562 birds. The proportion of flying herring gulls recorded above 15 m was 21.1 % across all boat-based surveys, although the total number of flying birds was low (90 records). Herring gull was deemed to be a species of very high importance due to SPA connectivity (termed sensitivity in the West of Duddon Sands assessments). Herring gull was not included in collision risk modelling, and it was considered that, due to the very low numbers of birds recorded at rotor height, that the magnitude of collision was negligible.	Low significance.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Gwynt y Môr (RWE Group and Npower Renewables, 2005)	Species not included in collision risk modelling.	Site-specific surveys undertaken in support of the project included boat-based surveys undertaken between February 2003 and March 2005. Surveys between February 2003 and February 2004 covered a large area along the Welsh coast incorporating the project area with surveys between March 2004 and March 2005 more focussed on the project area. The assessment also used data from aerial surveys undertaken between 2000 and 2005 which were targeted at recording common scoter. During boat-based surveys used to characterise the project undertaken between 2004-05, covering an area considered by the project assessment to better represent the behaviour of birds than in 2003-04, 8,900 observations were obtained with only 22 flights recorded at a height of greater than 20 m. In 2004-05 surveys, 225 herring gulls were recorded in flight with only 1.3% of these flying above 20 m.	Low significance due to low proportion of flight heights recorded at collision height.
Robin Rigg (Natural Power, 2002)	Species not included in collision risk modelling.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of herring gull during boat-based surveys in the wind farm was 0.9 birds with a peak of 3 birds. Herring gull was considered to be of local importance based on the populations recorded in the wind farm. The proportion of herring gull flying above 20 m during boat-based surveys across the entire study area was 8%. A qualitative assessment was undertaken for ‘other seabirds’ (a category that included gulls) and it was considered that collision rates would be low/negligible.	Low/Very low significance.
West of Orkney (Xodus, 2023)	Species not included in collision risk modelling.	Herring gull were recorded in only four of the site-specific surveys undertaken to characterise the baseline. When recorded the species was present in very low numbers generally during the non-breeding season, being largely absent during the breeding season.	Species not included in collision risk assessments however, given the low abundance of the species, collision risk estimates will be negligible.

Table 5.160: Cumulative assessment for herring gull in relation to cumulative collision risk impacts.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	Impact pathway is not applicable to the Morgan Transmission Assets.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets. This impact pathway is not applicable to the Morgan Transmission Assets The magnitude of the cumulative effect of these two projects may result in 9.5 (13.5) collisions/annum. This represents a 0.03% increase in the baseline mortality of the largest BDMPS population (or a 0.04% increase if applying the avoidance rate advocated by the EWG). The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed).	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The magnitude of the cumulative effect of these projects may result in 117.9 (151.2) collisions/annum. This represents a 0.32% increase in the baseline mortality of the largest BDMPS population (or a 0.41% increase if applying the avoidance rate advocated by the EWG). The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed) • No consideration of changes to project designs between assessment and construction which will often lead to significant decreases in collision risk estimates. There are a number of projects for which collision risk has not been quantified. Based on the information

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
			presented in Table 5.159 it is not considered that collision risk impacts at these projects would lead to a different conclusion in relation to the magnitude of this impact.
Sensitivity of receptor	Impact pathway is not applicable to the Morgan Transmission Assets.	The sensitivity of herring gull is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.42 to 5.9.4.45). Herring gull is deemed to be of very high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be high**.**	The sensitivity of herring gull is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.42 to 5.9.4.45). Herring gull is deemed to be of very high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.
Significance of effect	Impact pathway is not applicable to the Morgan Transmission Assets.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.159 it is not considered that collision risk impacts at these projects would lead to different conclusions being reached in relation to the cumulative assessment undertaken for the Morgan Generation Assets.
Further mitigation and residual significance	Impact pathway is not applicable to the Morgan Transmission Assets.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Lesser black-backed gull

5.11.3.11 The expected mean seasonal and annual collision mortality for lesser black-backed gull has been compiled for relevant wind farms and is shown in Table 5.161. Totals for each scenario to be considered in the cumulative assessment are provided in Table 5.161. Projects considered to act cumulatively with the Morgan Generation Assets in the breeding season are those within the mean-maximum foraging range (+1SD) of lesser black-backed gull from colonies within the mean-maximum foraging range (+1SD) of lesser black-backed gull from the Morgan Generation Assets. In simple terms this therefore includes all projects within an area representing twice the foraging of lesser black-backed gull from the Morgan Generation Assets. In the non-breeding seasons, projects considered to act cumulatively with the Morgan Generation Assets are those within the relevant BDMPS area from Furness (2015). The seasonal extents used are consistent with those used in the assessment for the Morgan Generation Assets. All collision risk estimates are calculated using an avoidance rate of 99.54% (Ozsanlav-Harris *et al.* 2023). Total collision risk estimates presented in brackets in Table 5.161 are calculated using an avoidance rate of 99.39%, as advocated by the EWG and, for the Morgan Generation Assets, represent collision risk estimates calculated using parameters as advocated by the EWG.

Table 5.161: Expected seasonal and annual collision mortality across relevant wind farms for the lesser black-backed gull.

Note: Values in brackets are calculated using an avoidance rate of 99.39%, as advocated by the EWG and, for the Morgan Generation Assets, represent collision risk estimates calculated using parameters as advocated by the EWG.

Project	Breeding	Post-breeding	Non-breeding	Pre-breeding	Total
Tier 1					
Awel y Môr	Unavailable – see Table 5.162				
Burbo Bank	0.8	0.3	0.6	0.2	1.8
Burbo Bank Extension	33.7	5.9	0.4	0.5	40.5
Erebus	6.2	0.0	0.0	0.0	6.2
Gwynt y Môr	1.9	0.8	1.5	0.4	4.6
Mona Offshore Wind Project	0.3	0.0	0.6	0.6	1.5
Ormonde	14.2	5.0	0.8	0.1	20.2
Robin Rigg	Unavailable – see Table 5.162				
Twinhub	2.7	2.1	1.1	0.4	6.3
Walney 1 & 2	26.9	8.8	13.5	3.4	52.6
Walney 3 & 4	6.1	4.2	9.8	5.9	26.0
West of Duddon Sands	24.7	8.0	12.4	3.1	48.2
West of Orkney	Unavailable – see Table 5.162				
White Cross	0.3	0.0	0.0	0.0	0.3

Project	Breeding	Post-breeding	Non-breeding	Pre-breeding	Total
Tier 2					
Morecambe Offshore Wind Farm: Generation Assets.	1.5	1.6	0.3	0.0	3.3
Morgan Generation Assets	0.2 (0.3)	0.2 (0.4)	0.2 (0.3)	0.2 (0.3)	0.8 (1.2)
Scenario Totals					
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets					**4.1 (5.7)**
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects					**212.3 (281.7)**

5.11.3.12 There are a number of projects for which collision risk estimates are unavailable. This is due to various factors including species not being included in collision risk modelling or projects not having conducted collision risk modelling. To ensure these projects are considered in this assessment project-specific documents have been reviewed to provide a qualitative assessment of collision for each project. This process is summarised in Table 5.162. Information is also unavailable for some Tier 2 projects but this is due to the planning stage of the project and not because data is not presented in relevant documents.

Table 5.162: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of collision risk was not undertaken in project-specific documentation for lesser black-backed gull.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Robin Rigg (Natural Power, 2002)	Species not included in collision risk modelling.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of lesser black-backed gull during boat-based surveys in the wind farm was 0.2 birds with a peak of 3 birds. Lesser black-backed gull was considered to be of local importance based on the populations recorded in the wind farm. The proportion of lesser black-backed gull flying above 20 m during boat-based surveys across the entire study area was 24% A qualitative assessment was undertaken for 'other seabirds' (a category that included gulls) and it was considered that collision rates would be low/negligible.	Low/very low significance.
Awel-y-Môr (RWE Renewables UK, 2022)	Species not included in collision risk modelling.	Project -specific surveys comprised 24 months of digital aerial surveys undertaken between March 2019 and February 2021. Lesser black-backed gulls were recorded in only one of the baseline aerial surveys. Eight birds were recorded in July 2020.	Project concluded: *'Recorded in negligible numbers, therefore the level of potential impact would be indistinguishable from natural fluctuations in* [BDMPS] *baseline mortality'.*
West of Orkney (Xodus, 2023)	Species not included in collision risk modelling.	The species was recorded in only two of the site-specific surveys undertaken to characterise the baseline. One bird was recorded sitting on the sea in August 2020 and August 2021.	Species not included in collision risk assessments however, given the low abundance of the species, collision risk estimates will be negligible.

Table 5.163: Cumulative assessment for lesser black-backed gull in relation to cumulative collision risk impacts.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	Impact pathway is not applicable to the Morgan Transmission Assets.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets. This impact pathway is not applicable to the Morgan Transmission Assets The magnitude of the cumulative effect of these two projects may result in 4.1 (5.7) collisions/annum. This represents a 0.01% increase in the baseline mortality of the largest BDMPS population (or a 0.02% increase if applying the avoidance rate advocated by the EWG). The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed).	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The magnitude of the cumulative effect of these projects may result in 212.3 (281.7) collisions/annum. This represents a 0.73% increase in the baseline mortality of the largest BDMPS population or a 0.97% increase when applying the avoidance rate advocated by the EWG. The contribution of the Morgan Generation Assets to the cumulative total is 0.38% with the majority of collisions being contributed by projects located much closer to the coast including Walney 1 & 2 (25%), Walney Extension (12%), West of Duddon Sands (23%) and Burbo Bank Extension (19%) which provide nearly 90% of the total cumulative impact. Collision risk modelling for Walney Extension was based on a 207 x 3.6 MW turbine scenario. The as-built scenario at Walney Extension consists of 87 turbines with capacities of 7 and 8 MW. Updated collision risk modelling for Walney Extension has shown significant reductions (52.59%) in the associated collision risk (Wheeldon *et al.*, 2023). For Walney 1 & 2, collision risk estimates represent a 600 MW turbine scenario. The as-built project has a total capacity of 367 MW. The assessed turbine scenario for West of Duddon Sands was 139 x 3.6 MW with the as-built scenario representing 108 x 3.6 MW turbines, a 21% reduction.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
			For Burbo Bank Extension modelling was based on a 69 x 3.6 MW turbine scenario. The as-built scenario represents 32 x 8 MW turbines. It is therefore anticipated that the cumulative collision risk total is therefore significantly lower than estimated here and it is considered that the actual collision risk total would be below the 1% increase in baseline mortality. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed) • No consideration of changes to project designs between assessment and construction which will often lead to significant decreases in collision risk estimates. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.162 it is not considered that collision risk impacts at these projects would lead to a different conclusion in relation to the magnitude of this impact.
Sensitivity of receptor	Impact pathway is not applicable to the Morgan Transmission Assets.	The sensitivity of lesser black-backed gull is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.46 to 5.9.4.49). Lesser black-backed gull is deemed to be of very high vulnerability, medium recoverability	The sensitivity of lesser black-backed gull is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.46 to 5.9.4.49). Lesser black-backed gull is deemed to be of very high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be high.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		and international value. The sensitivity of the receptor is therefore, considered to be high.	
Significance of effect	Impact pathway is not applicable to the Morgan Transmission Assets.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.162 it is not considered that collision risk impacts at these projects would lead to different conclusions being reached in relation to the cumulative assessment undertaken for the Morgan Generation Assets.
Further mitigation and residual significance	Impact pathway is not applicable to the Morgan Transmission Assets.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Gannet

5.11.3.13 The expected mean seasonal and annual collision mortality for gannet has been compiled for relevant wind farms and is shown in Table 5.164. Totals for each scenario to be considered in the cumulative assessment are provided in Table 5.164. Projects considered to act cumulatively with the Morgan Generation Assets in the breeding season are those within the mean-maximum foraging range (+1SD) of gannet from colonies within the mean-maximum foraging range (+1SD) of gannet from the Morgan Generation Assets. In simple terms this therefore includes all projects within an area representing twice the foraging of gannet from the Morgan Generation Assets. In the non-breeding seasons, projects considered to act cumulatively with the Morgan Generation Assets are those within the relevant BDMPS area from Furness (2015). The seasonal extents used are consistent with those used in the assessment for the Morgan Generation Assets. All collision risk estimates are calculated using an avoidance rate of 99.28% (Ozsanlav-Harris *et al.* 2023). Total collision risk estimates presented in brackets in Table 5.161 are calculated using collision risk estimates for the Morgan Generation Assets, calculated using parameters as advocated by the EWG.

Table 5.164: Expected seasonal and annual collision mortality across relevant wind farms for gannet.

Note: Values in brackets are calculated using an avoidance rate of 99.28%, as advocated by the EWG and, for the Morgan Generation Assets, represent collision risk estimates calculated using parameters as advocated by the EWG.

Project	Breeding	Post-breeding	Pre-breeding	Total
Tier 1				
Awel y Môr	10.9	2.5	0.0	13.4
Burbo Bank	Unavailable – see Table 5.165			
Burbo Bank Extension	11.9	0.2	0.1	12.2
Erebus	4.1	0.2	0.3	4.6
Gwynt y Môr	Unavailable – see Table 5.165			
Mona Offshore Wind Project	1.2	0.1	0.1	1.5
Ormonde	6.7	0.1	0.1	6.9
Robin Rigg	Unavailable – see Table 5.165			
Twinhub	15.0	4.4	6.8	26.1
Walney 1 & 2	Unavailable – see Table 5.165			
Walney 3 & 4	11.3	12.4	0.8	24.5
West of Duddon Sands	Unavailable – see Table 5.165			
West of Orkney	39.8	7.9	1.2	48.8
White Cross	1.0	0.4	0.0	1.4
Tier 2				
Morecambe Offshore Wind Farm: Generation Assets	1.9	0.0	0.0	1.9
Morgan Generation Assets	1.2 (1.2)	0.1 (0.2)	0.0 (0.0)	1.4 (1.5)

Project	Breeding	Post-breeding	Pre-breeding	Total
Scenario Totals				
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets				3.2 (.32)
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects				142.7 (142.7)

5.11.3.14 There are a number of projects for which collision risk estimates are unavailable. This is due to various factors including species not being included in collision risk modelling or projects not having conducted collision risk modelling. To ensure these projects are considered in this assessment project-specific documents have been reviewed to provide a qualitative assessment of collision for each project. This process is summarised in Table 5.165. Information is also unavailable for some Tier 2 projects but this is due to the planning stage of the project and not because data is not presented in relevant documents.

Table 5.165: Qualitative assessment of projects considered cumulatively with the Morgan Generation Assets for which quantitative consideration of collision risk was not undertaken in project-specific documentation for gannet.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
Tier 1			
Burbo Bank (Seascape Energy Ltd., 2002)	Species not included in collision risk modelling.	The assessment of collision risk was undertaken on a qualitative basis by investigating flight heights of birds at the project site and was undertaken for species considered to be of International or National importance in the context of the assessments undertaken for the project. Gannet was not considered to be a species of International or National importance. Surveys of the project comprised aerial and boat-based surveys both of which were undertaken during winter months (aerial undertaken during November to April and boat-based undertaken during December and February). Aerial surveys covered a large area encompassing the Liverpool Bay SPA with boat-based surveys covering the project area. The surveys were undertaken to provide abundance and distribution data for those species considered to be of most importance, namely common scoter and red-throated diver. Gannet was not recorded during boat-based surveys with relatively low numbers recorded during aerial surveys.	No assessment was conducted for gannet in relation to collision risk impacts however, for gannet was not considered to be a species of International or National importance in the context of the assessments undertaken.
Walney 1 & 2 (RPS, 2006b)	Species not included in collision risk modelling.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of gannet recorded in the project area plus 2 km buffer during aerial surveys was 52 birds. In boat-based surveys the equivalent population was 332 birds. The proportion of flying gannets recorded above 15 m was 21.5 % across all boat-based surveys within the boat-based survey area. Gannet was deemed to be a species of medium importance due to SPA connectivity (termed sensitivity in the Walney 1 & 2 assessments). Gannet was not included in collision risk modelling and it was considered that many gannet would avoid the wind farm area due to	Low significance.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
		alternative foraging habitats being available to this species. It was concluded that there was a low magnitude impact for this species associated with collision.	
West of Duddon Sands (RSKENSR, 2006)	Species not included in collision risk modelling.	Site-specific surveys included boat-based surveys undertaken across an area of 512 km^2 in the vicinity of the project between May 2004 and September 2005. The project also utilised survey data collected by regional aerial surveys, undertaken across the NW3 aerial survey area between 2002 and 2006 and radar survey data collected between 01 October and 29 October 2005. The peak population of gannet recorded in the project area plus 2 km buffer during aerial surveys was 57 birds. In boat-based surveys the equivalent population was 431 birds. The proportion of flying gannets recorded above 15 m was 21.5 % across all boat-based surveys within the boat-based survey area. Gannet was deemed to be a species of medium importance due to SPA connectivity (termed sensitivity in the West of Duddon Sands assessments). Gannet was not included in collision risk modelling and it was considered that many gannet would avoid the wind farm area due to alternative foraging habitats being available to this species. It was concluded that there was a low magnitude impact for this species associated with collision.	Low significance.
Gwynt y Môr (RWE Group and Npower Renewables, 2005)	Species not included in collision risk modelling.	Site-specific surveys undertaken in support of the project included boat-based surveys undertaken between February 2003 and March 2005. Surveys between February 2003 and February 2004 covered a large area along the Welsh coast incorporating the project area with surveys between March 2004 and March 2005 more focussed on the project area. The assessment also used data from aerial surveys undertaken between 2000 and 2005 which were targeted at recording common scoter. Very few gannet were recorded during boat-based surveys between October and March. More birds were present in summer months with a large proportion on the sea surface. During boat-based surveys used to characterise the project undertaken between 2004-05, covering an area considered by the project	Low significance due to low proportion of flight heights recorded at collision height.

Project	Reason for estimates being unavailable	Qualitative assessment	Final conclusion
		assessment to better represent the behaviour of birds than in 2003-04, 8,900 observations were obtained with only 22 flights recorded at a height of greater than 20 m. In 2004-05 surveys, 583 gannets were recorded in flight with only 0.7% of these flying above 20 m.	
Robin Rigg (Natural Power, 2002)	Species not included in collision risk modelling.	The project utilised site-specific boat-based surveys to characterise the baseline environment. Two surveys were completed in each month from May 2001 for one year. In addition, aerial surveys were undertaken from November 2001 on a monthly basis through winter and spring to verify the distribution and abundance of seaduck. The mean count of gannet during boat-based surveys in the wind farm was 0.4 birds with a peak of 4 birds. Gannet was considered to be of local importance based on the populations recorded in the wind farm. The proportion of gannet flying above 20 m during boat-based surveys across the entire study area was 3% of birds recorded in flight. Gannet was not considered to be an 'other seabird' species that would occur in sufficient numbers to be at risk of collision impacts.	Low/Very low significance.

Table 5.166: Cumulative assessment for gannet in relation to cumulative collision risk impacts.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	Impact pathway is not applicable to the Morgan Transmission Assets.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets. This impact pathway is not applicable to the Morgan Transmission Assets The magnitude of the cumulative effect of these two projects may result in 3.2 collisions/annum. This represents less than a 0.01% increase in the baseline mortality of the largest BDMPS population when using either collision risk estimates for the Morgan Generation Assets. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The magnitude of the cumulative effect of these projects may result in 142.7 collisions/annum. This represents a 0.14% increase in the baseline mortality of the largest BDMPS population when using either collision risk estimates for the Morgan Generation Assets. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed) • No consideration of changes to project designs between assessment and construction which will often lead to significant decreases in collision risk estimates. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.165 it is not considered that collision risk impacts at these projects would lead to a different conclusion in relation to the magnitude of this impact.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		over-estimate collision risk (e.g. flight speed).	
Sensitivity of receptor	Impact pathway is not applicable to the Morgan Transmission Assets.	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.54 to 5.9.4.57). Gannet is deemed to be of high vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore considered, on a precautionary basis to be high.	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.54 to 5.9.4.57). Gannet is deemed to be of high vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore considered, on a precautionary basis to be high.
Significance of effect	Impact pathway is not applicable to the Morgan Transmission Assets.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.165 it is not considered that collision risk impacts at these projects would lead to different conclusions being reached in relation to the cumulative assessment undertaken for the Morgan Generation Assets.
Further mitigation and residual significance	Impact pathway is not applicable to the Morgan Transmission Assets.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Migratory waterbirds

5.11.3.15 Collision risk impacts for migratory waterbirds and seabirds is not quantified for the majority of Tier 1 projects identified in Table 5.64. Collision risk estimates for those migratory waterbird species that may be impacted by the Morgan Generation Assets (as assessed in section 5.9.4) at those projects for which collision risk estimates are available are presented in Table 5.167.

Table 5.167: Cumulative collision risk estimates for migratory waterbirds (99% avoidance rate).

Species	Morgan	Burbo Bank Extension	Walney Extension	Awel y Mor	Morecambe	Mona	Total	% increase in baseline mortality
Light-bellied brent goose	<0.1	-	-	-	-	<0.1	<0.1	0.02
Greenland white-fronted goose	0.3	-	-	-	-	0.1	0.4	0.01
Bewick's swan	<0.1	-	-	-	<0.1	<0.1	0.1	0.08
Whooper swan	0.9	-	1.9	-	<0.1	0.2	3.0	0.08
Shelduck	0.2	<0.1	0.5	-	<0.1	0.1	1.8	0.11
Shoveler	<0.1	-	-	-	<0.1	<0.1	0.1	0.01
Gadwall	<0.1	-	-	-	-	0.1	0.1	0.05
Wigeon	1.1	-	1.0	-	<0.1	0.9	5.0	0.01
Mallard	0.5	-	-	-	-	1.4	2.0	0.01
Pintail	0.2	<0.1	<0.1	-	<0.1	<0.1	0.3	<0.01
Teal	5.2	<0.1	0.5	-	<0.1	0.8	7.5	<0.01
Pochard	0.5	-	-	-	-	0.1	0.6	<0.01
Tufted duck	1.9	-	-	-	-	0.3	2.2	<0.01
Scaup	0.1	-	-	-	<0.1	<0.1	0.1	0.01
Common scoter	0.1	-	-	-	<0.1	<0.1	0.1	<0.01
Long-tailed duck	<0.1	-	-	-	-	<0.1	0.1	<0.01
Goldeneye	0.2	-	-	-	<0.1	<0.1	0.3	0.01
Red-breasted merganser	0.1	-	-	-	<0.1	<0.1	0.1	0.01
Corncrake	0.1	-	-	-	-	<0.1	0.1	0.01
Great crested grebe	0.1	-	-	-	<0.1	<0.1	0.1	0.01
Slavonian grebe	<0.1	-	-	-	-	<0.1	<0.1	<0.01

Species	Morgan	Burbo Bank Extension	Walney Extension	Awel y Mor	Morecambe	Mona	Total	% increase in baseline mortality
Oystercatcher (breeding)	3.2	<0.1	2.0	0.6	<0.1	0.3	10.0	0.04
Oystercatcher (non-breeding)	5.1	<0.1	2.0	0.6	<0.1	0.9	12.5	0.03
Lapwing	4.7	-	-	-	<0.1	1.7	6.4	0.01
Golden plover (breeding)	1.5	<0.1	<0.1	0.4	<0.1	0.1	2.1	0.01
Golden plover (non-breeding)	6.3	<0.1	<0.1	-	<0.1	1.1	7.4	0.01
Grey plover	0.1	<0.1	<0.1	-	<0.1	0.1	0.2	0.03
Ringed plover (breeding)	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.01
Ringed plover (non-breeding)	0.6	<0.1	<0.1	0.1	<0.1	0.1	0.8	0.01
Dotterel	<0.1	-	-	-	-	<0.1	<0.1	0.01
Whimbrel	0.1	-	-	-	-	<0.1	0.1	0.01
Curlew (breeding)	2.0	<0.1	1.0	0.2	<0.1	0.6	5.8	0.05
Curlew (non-breeding)	1.3	<0.1	1.0	0.2	<0.1	0.3	4.8	0.09
Bar-tailed godwit	0.4	<0.1	0.5	-	<0.1	0.2	2.1	0.05
Black-tailed godwit (Icelandic race)	0.6	<0.1	<0.1	0.1	<0.1	0.1	0.9	0.04
Turnstone	0.6	-	<0.1	0.1	<0.1	0.1	0.7	0.01
Knot	3.8	<0.1	2.0	0.3	<0.1	0.8	10.9	0.03
Ruff	<0.1	-	-	-	-	<0.1	<0.1	<0.01
Sanderling	0.3	-	<0.1	0.1	<0.1	0.1	0.4	0.01
Dunlin (sub-species schinzii and arctica)	14.2	<0.1	4.0	<0.1	<0.1	0.9	27.1	0.01
Dunlin (sub-species alpina)	2.4	<0.1	4.0	-	<0.1	0.1	14.5	0.06
Purple sandpiper	0.2	-	-	-	-	<0.1	0.2	0.01
Snipe	15.9	-	-	-	-	3.1	19.0	<0.01

Species	Morgan	Burbo Bank Extension	Walney Extension	Awel y Mor	Morecambe	Mona	Total	% increase in baseline mortality
Red-necked phalarope	<0.1	-	-	-	-	-	<0.1	0.01
Redshank (breeding)	0.7	<0.1	1.0	0.1	<0.1	0.2	3.9	0.03
Redshank (Icelandic race - non-breeding)	6.2	<0.1	1.0	0.8	<0.1	1.6	11.6	0.01
Wood sandpiper	<0.1	-	-	-	-	<0.1	<0.1	<0.01
Greenshank	<0.1	-	-	<0.1	-	<0.1	<0.1	0.01
Bittern	<0.1	-	-	-	-	<0.1	<0.1	0.01
Osprey	<0.1	-	-	-	-	<0.1	<0.1	0.01
Hen harrier	<0.1	-	-	-	<0.1	<0.1	<0.1	0.01
Short-eared owl	0.2	-	-	-	<0.1	<0.1	0.2	0.01
Merlin	0.1	-	-	-	<0.1	<0.1	0.1	<0.01

5.11.3.16 The increase in baseline mortality for all migratory waterbird species is well below the 1% threshold of baseline mortality.

5.11.3.17 As mentioned in paragraph 5.11.3.15, collision risk to migratory waterbirds has not been quantified for many Tier 1 projects. The main waterbird species of concern for projects in the Irish Sea, especially those located close to Morecambe Bay (Walney 1 and 2, Walney 3 and 4, West of Duddon Sands, and Ormonde) have been pink-footed goose and whooper swan. Based on the SOSSMAT there is no connectivity between migratory flights of pink-footed goose and the Morgan Generation Assets and this species is therefore not considered further. There is however connectivity with migratory flights of whooper swan. The assessment undertaken for Walney 3 and 4 conducted a bespoke theoretical modelling approach for this species predicting a cumulative collision risk of 3.9 collisions/annum (an additional two collisions for the species as estimated in Table 5.167). This would only represent an increase in the baseline mortality of the biogeographic population to 0.13%, still well below the 1% threshold. In addition, post-construction monitoring undertaken for many of the offshore wind farms previously mentioned have found no impact of the operation of the wind farm on the population of whooper swan at Martin Mere, the nearest site of importance for the species in terms of both population size and autumn arrival time (NIRAS, 2015).

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

5.11.3.19 The sensitivity of migratory waterbirds is considered to be as discussed in paragraphs 5.9.4.58 to 5.9.4.60 for the assessment of the Morgan Generation Assets alone. On a precautionary basis and for the purposes of this assessment migratory waterbirds species are therefore assumed to have **medium** sensitivity to collision.

5.11.3.20 The significance of effect for all migratory waterbird species in relation to all cumulative assessment scenarios is therefore considered to be **negligible**.

Migratory seabirds

5.11.3.21 As discussed for migratory waterbirds, collision risk for migratory seabirds has not been quantified for many Tier 1 projects considered in this cumulative assessment in Table 5.64. Collision risk estimates for those migratory seabird species that may be impacted by the Morgan Generation Assets (as assessed in section 5.9.4) at those projects for which collision risk estimates are available are presented in Table 5.168.

Table 5.168: Cumulative collision risk estimates for migratory seabirds (99% avoidance rate).

Species	Morgan	Burbo Bank Extension	Morecambe	Mona	Total	% increase in baseline mortality
Great skua	0.0	0.0	0.0	0.1	0.1	<0.01
European storm petrel	0.7	Not considered	0.0	0.2	0.8	<0.01
Leach’s petrel	1.6	Not considered	0.0	0.4	1.9	<0.01

5.11.3.22 The increase in baseline mortality for all migratory seabird species is well below the 1% threshold of baseline mortality. Although collision risk estimates are unavailable for many projects that may act cumulatively with the Morgan Generation Assets it is not considered that, if the impacts associated with these projects were to be quantified that the total collision risk estimate would increase to levels commensurate with a significant effect. The Morgan Generation Assets and Mona Offshore Wind Project are the largest projects in the Irish Sea and, due to the way in which the collision risk modelling approach for migrator seabirds works, all other projects in the Irish Sea that may act cumulatively would have lower collision risk estimates.

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

5.11.3.24 The sensitivity of migratory seabirds is considered to be as discussed in paragraphs 5.9.4.61 to 5.9.4.66 for the assessment of the Morgan Generation Assets alone. Great skua is deemed to be of high vulnerability, medium recoverability and international value. The sensitivity of the receptor is therefore, considered to be **high**. European storm petrel and Leach’s petrel are deemed to be of low vulnerability, medium recoverability and National value. The sensitivity of the receptor is therefore, considered to be **medium**.

5.11.3.25 The significance of effect for great skua in relation to all cumulative assessment scenarios is therefore considered to be **minor**. The significance of effect for European storm petrel and Leach’s petrel in relation to all cumulative assessment scenarios is therefore considered to be **negligible**.

5.11.4 Combined displacement and collision risk

Operations and maintenance phase

Magnitude of impact

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

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

5.11.4.3 Outputs from the combined impact from displacement and collision from the Morgan Generation Assets, together with other offshore wind farms in the Irish Sea are tabulated and presented in Table 5.169.

Table 5.169: Kittiwake and gannet combined displacement and collision cumulative impacts.

Species	Annual displacement mortality	Annual collision mortality	Total combined annual impact	% increase in baseline mortality
Kittiwake				
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	41	11.7 (47.9)	52.8 (88.9)	0.04 (0.06)
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	116	158.9 (545.6)	274.8 (661.5)	0.19 (0.46)
Gannet				
Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	8	2.1	10.3	0.01
Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects	54	141.6	195.2	0.19

Table 5.170: Cumulative assessment for kittiwake in relation to cumulative collision risk and displacement impacts.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	Collision risk impacts are not applicable to the Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets and therefore the conclusions in relation to Scenario 1 remain as assessed in section 5.11.2.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets. This impact pathway is not applicable to the Morgan Transmission Assets The magnitude of the cumulative effect when combining collision and displacement impacts does not surpass the 1% threshold of the regional population. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed) • The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The magnitude of the cumulative effect surpasses the 1% threshold of baseline mortality for the regional population when considering the upper range of the values under consideration. However, as discussed in Table 5.115 the use of displacement rates towards the upper range of rates considered is not considered appropriate and therefore it is considered that the impact magnitude associated with combined collision and displacement impacts will not surpass the 1% threshold of baseline mortality. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		seasonal totals for individual projects and between projects.	considered cumulatively that will over-estimate collision risk (e.g. flight speed) • No consideration of changes to project designs between assessment and construction which will often lead to significant decreases in collision risk estimates • The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.153 it is not considered that collision risk impacts at these projects would lead to a different conclusion in relation to the magnitude of this impact.
Sensitivity of receptor	Collision risk impacts are not applicable to the Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets and therefore the conclusions in relation to Scenario 1 remain as assessed in section 5.11.2.	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.34 to 5.9.4.37 and paragraphs 5.9.1.101 to 5.9.1.104). Kittiwake is deemed to be of low or high vulnerability, low recoverability and international conservation value. The sensitivity of the receptor is therefore, considered to be high	The sensitivity of kittiwake is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.34 to 5.9.4.37 and paragraphs 5.9.1.101 to 5.9.1.104). Kittiwake is deemed to be of low or high vulnerability, low recoverability and international conservation value. The sensitivity of the receptor is therefore, considered to be high
Significance of effect	Collision risk impacts are not applicable to the Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets and	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **minor**	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **minor**

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
	therefore the conclusions in relation to Scenario 1 remain as assessed in section 5.11.2.	**adverse** significance, which is not significant in EIA terms.	**adverse** significance, which is not significant in EIA terms. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.153 it is not considered that collision risk impacts at these projects would lead to different conclusions being reached in relation to the cumulative assessment undertaken for the Morgan Generation Assets.
Further mitigation and residual significance	Collision risk impacts are not applicable to the Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets and therefore the conclusions in relation to Scenario 1 remain as assessed in section 5.11.2.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

Table 5.171: Cumulative assessment for gannet in relation to cumulative collision risk and displacement impacts.

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
Operations and maintenance			
Magnitude of impact	Collision risk impacts are not applicable to the Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets and therefore the conclusions in relation to Scenario 1 remain as assessed in section 5.11.2.	The cumulative effects assessment for Scenario 2 considers the following: • The Morgan Generation Assets • Morecambe Offshore Windfarm Generation Assets. This impact pathway is not applicable to the Morgan Transmission Assets The magnitude of the cumulative effect of combining collision and displacement impacts does not surpass the 1% threshold of baseline mortality of the regional population. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed) • The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the	The cumulative effects assessment for Scenario 3 considers the following: • The Morgan Generation Assets • All other projects. The magnitude of the cumulative effect of combining collision and displacement impacts does not surpass the 1% threshold of baseline mortality of the regional population. The cumulative impact is predicted to be of local spatial extent, medium to long term duration, continuous and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be negligible. It should be noted that this assessment of impact magnitude is considered to be precautionary for a number of reasons including: • The use of collision risk modelling parameters in modelling undertaken for projects considered cumulatively that will over-estimate collision risk (e.g. flight speed) • No consideration of changes to project designs between assessment and construction which will often lead to significant decreases in collision risk estimates

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
		seasonal totals for individual projects and between projects.	• The predicted cumulative impacts are considered to be precautionary as impacts may be double counted both within the seasonal totals for individual projects and between projects. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.165 it is not considered that collision risk impacts at these projects would lead to a different conclusion in relation to the magnitude of this impact.
Sensitivity of receptor	Collision risk impacts are not applicable to the Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets and therefore the conclusions in relation to Scenario 1 remain as assessed in section 5.11.2.	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.54 to 5.9.4.57 and 5.9.1.121 to 5.9.1.124). Gannet is deemed to be of high vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore considered, on a precautionary basis to be high.	The sensitivity of gannet is considered to be as described for the assessment of the Morgan Generation Assets alone (see paragraphs 5.9.4.54 to 5.9.4.57 and 5.9.1.121 to 5.9.1.124). Gannet is deemed to be of high vulnerability, high recoverability and international value. The sensitivity of the receptor is therefore considered, on a precautionary basis to be high.
Significance of effect	Collision risk impacts are not applicable to the Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets and therefore the conclusions in relation to Scenario 1 remain as assessed in section 5.11.2.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be high. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms.	Overall, the magnitude of the cumulative impact is deemed to be negligible and the sensitivity of the receptor is considered to be medium. The cumulative effect will, therefore, be of **minor adverse** significance, which is not significant in EIA terms. There are a number of projects for which collision risk has not been quantified. Based on the information presented in Table 5.165 it is not considered that collision risk impacts at these projects would lead to different

	Scenario 1 Morgan Generation Assets + Transmission Assets	Scenario 2: Morgan Generation Assets + Morecambe Offshore Windfarm Generation Assets + Transmission Assets	Scenario 3: Morgan Generation Assets + Transmission Assets + Tier 1, Tier 2, Tier 3 projects
			conclusions being reached in relation to the cumulative assessment undertaken for the Morgan Generation Assets.
Further mitigation and residual significance	Collision risk impacts are not applicable to the Morgan and Morecambe Offshore Wind Farms: Transmission Assets Morgan and Morecambe Offshore Wind Farms: Transmission Assets and therefore the conclusions in relation to Scenario 1 remain as assessed in section 5.11.2.	As per section 5.7.1.2 above.	As per section 5.7.1.2 above.

5.11.5 Future monitoring

5.11.5.1 Based on the predicted impacts it is considered that no future monitoring is required given the level of certainty around the potential effects. The project will continue to engage through the Evidence Plan process to explain the context of this approach.

5.12 Transboundary effects

5.12.1.1 A screening of transboundary impacts has been carried out and any potential for significant transboundary effects with regard to offshore ornithology from the Morgan Generation Assets upon the interests of other states has been assessed as part of the EIA. The potential transboundary impacts assessed within sections 5.10 and 5.11 are summarised below:

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

5.13 Inter-related effects

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

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

5.13.1.2 A description of the likely interactive effects arising from the Morgan Generation Assets on offshore ornithology is provided in Volume 2, Chapter 15: Inter-related effects of the Environmental Statement.

5.14 Summary of impacts, mitigation measures and monitoring

5.14.1.1 Information on offshore ornithology within the Offshore Ornithology study areas as defined in section 5.4.4 was collected through review of available literature, other offshore wind farm assessments, UK statutory guidance, detailed analysis of the data collected during the site-specific aerial surveys, and consultation with relevant stakeholders.

- Table 5.172 presents a summary of the potential impacts, measures adopted as part of the project and residual effects in respect to offshore ornithology. The impacts assessed include: disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure, indirect impacts from underwater sound affecting prey species, temporary habitat loss/ disturbance and increased SSCs, collision risk and barrier to movement.
- Overall it is concluded that there will be no significant effects arising from the Morgan Generation Assets during the construction, operations and maintenance or decommissioning phases.
- Table 5.173 presents a summary of the potential cumulative impacts, mitigation measures and residual effects. The cumulative impacts assessed include: disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure and collision risk. Overall it is concluded that there are no significant cumulative effects to any species from the Morgan Generation Assets alongside other projects/plans. It is concluded that no mitigation or monitoring is required.

5.14.1.2 Potential transboundary impacts have been identified in relation to offshore ornithology. Overall, it is concluded that there will be no significant transboundary effects arising from the Morgan Generation Assets.

Table 5.172: Summary of potential environmental effects, mitigation and monitoring.

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

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure.	✓	✓	✓	Offshore EMP which will include measures to minimise disturbance to rafting birds from transiting vessels	Kittiwake C: Negligible O: Negligible D: Negligible Guillemot C: Negligible O: Negligible D: Negligible Razorbill C: Negligible O: Negligible D: Negligible Fulmar C: Negligible O: Negligible D: Negligible Manx shearwater C: Negligible O: Negligible D: Negligible Gannet C: Negligible O: Negligible	Kittiwake C: Medium O: Medium D: Medium Guillemot C: Medium O: Medium D: Medium Razorbill C: Medium O: Medium D: Medium Fulmar C: Medium O: Medium D: Medium Manx shearwater C: Medium O: Medium D: Medium Gannet C: Medium	Kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Guillemot C: Negligible adverse O: Negligible adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Fulmar C: Negligible adverse O: Negligible adverse D: Negligible adverse Manx shearwater C: Negligible adverse O: Negligible adverse D: Negligible adverse Gannet C: Negligible adverse O: Negligible adverse	None	Kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Guillemot C: Negligible adverse O: Negligible adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Fulmar C: Negligible adverse O: Negligible adverse D: Negligible adverse Manx shearwater C: Negligible adverse O: Negligible adverse D: Negligible adverse Gannet C: Negligible adverse O: Negligible adverse	None

Description of impact	Phase[a]			Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
					D: Negligible	O: Medium D: Medium	D: Negligible adverse		D: Negligible adverse	
Indirect impacts from underwater sound affecting prey species.	✓	×	✓	None	Auk species C: Negligible D: Negligible	Auk species C: Low D: Low	Auk species C: Negligible adverse D: Negligible adverse	None	Auk species C: Negligible adverse D: Negligible adverse	None
Temporary habitat loss/disturbance and increased suspended sediment concentrations (SSCs).	✓	✓	✓	None	Auk species C: Negligible O: Negligible D: Negligible	Auk species C: Low O: Low D: Low	Auk species C: Negligible adverse O: Negligible adverse D: Negligible adverse	None	Auk species C: Negligible adverse O: Negligible adverse D: Negligible adverse	None
Collision risk	×	✓	×	Increasing air draught to reduce bird collision.	Kittiwake O: Negligible Great black-backed gull O: Low Herring gull O: Negligible Lesser black-backed gull O: Negligible Great skua O: Negligible	Kittiwake O: High Great black-backed gull O: Medium Herring gull O: High Lesser black-backed gull O: High Manx shearwater	Kittiwake O: Minor adverse Great black-backed gull O: Minor adverse Herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Great skua O: Minor adverse European storm petrel	None	Kittiwake O: Minor adverse Great black-backed gull O: Minor adverse Herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Great skua O: Minor adverse	None

Description of impact	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					European storm petrel O: Negligible Leach's petrel O: Negligible Fulmar O: Negligible Manx shearwater O: Negligible Gannet O: Negligible Migratory waterbirds O: Negligible	O: High Great skua O: High European storm petrel O: Medium Leach's petrel O: Medium Fulmar O: Medium Manx shearwater O: Medium Gannet O: High Migratory waterbirds O: Medium	O: Negligible adverse Leach's petrel O: Negligible adverse Fulmar O: Negligible adverse Manx shearwater O: Negligible adverse Gannet O: Negligible adverse Migratory waterbirds O: Negligible adverse		European storm petrel O: Negligible adverse Leach's petrel O: Negligible adverse Fulmar O: Negligible adverse Manx shearwater O: Negligible adverse Gannet O: Negligible adverse Migratory waterbirds O: Negligible adverse	
Combined displacement and collision risk	×	✓	×	Increasing air draught to reduce bird collision.	Kittiwake O: Negligible Gannet O: Negligible	Kittiwake O: High Gannet O: High	Kittiwake O: Minor adverse Gannet O: Minor adverse	None	Kittiwake O: Minor adverse Gannet O: Minor adverse	None
Barrier to movement	×	✓	×	Offshore EMP which will include measures to	All receptors O: Negligible	All receptors O: Medium	All receptors O: Negligible adverse	None	All receptors O: Negligible adverse	None

Description of impact	Phase[a]			Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
	C	O	D							
				minimise disturbance to rafting birds from transiting vessels.						

Table 5.173: Summary of potential cumulative environmental effects, mitigation and monitoring.

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

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Scenario 1										
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure.	✓	✓	✓	Offshore EMP which will include measures to minimise disturbance to rafting birds from transiting vessels.	Kittiwake C: Negligible O: Negligible D: Negligible Guillemot C: Negligible O: Negligible D: Negligible Razorbill C: Negligible O: Negligible D: Negligible Manx shearwater C: Negligible O: Negligible D: Negligible Gannet C: Negligible O: Negligible D: Negligible	Kittiwake C: Medium O: Medium D: Medium Guillemot C: Medium O: Medium D: Medium Razorbill C: Medium O: Medium D: Medium Manx shearwater C: Medium O: Medium D: Medium Gannet C: Medium O: Medium D: Medium	Kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Guillemot C: Negligible adverse O: Negligible adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse	None	Kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Guillemot C: Negligible adverse O: Minor adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse	None

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
Collision Risk	×	✓	×	Impact pathway is not applicable to the Morgan Transmission Assets						
Combined collision risk and disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure.	×	✓	×	Impact pathway is not applicable to the Morgan Transmission Assets						
Scenario 2										
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure.	✓	✓	✓	Offshore EMP which will include measures to minimise disturbance to rafting birds from transiting vessels.	Kittiwake C: Negligible O: Negligible D: Negligible Guillemot C: Negligible O: Negligible D: Negligible Razorbill C: Negligible O: Negligible D: Negligible Manx shearwater C: Negligible O: Negligible D: Negligible	Kittiwake C: Medium O: Medium D: Medium Guillemot C: Medium O: Medium D: Medium Razorbill C: Medium O: Medium D: Medium Manx shearwater C: Medium O: Medium D: Medium	Kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Guillemot C: Negligible adverse O: Negligible adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse	None	Kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Guillemot C: Negligible adverse O: Minor adverse D: Negligible adverse Razorbill C: Negligible adverse O: Negligible adverse	None

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					Gannet C: Negligible O: Negligible D: Negligible	Gannet C: Medium O: Medium D: Medium	D: Negligible adverse Gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse		D: Negligible adverse Gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse	
Collision Risk	×	✓	×	Increasing air draught to reduce bird collision.	Kittiwake O: Negligible Great black-backed gull O: Negligible Herring gull O: Negligible Lesser black-backed gull O: Negligible Great skua O: Negligible European storm petrel O: Negligible Leach's petrel O: Negligible Gannet O: Negligible	Kittiwake O: High Great black-backed gull O: Medium Herring gull O: High Lesser black-backed gull O: High Great skua O: High European storm petrel O: Medium Leach's petrel O: Medium Gannet O: High	Kittiwake O: Negligible adverse Great black-backed gull O: Minor adverse Herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Great skua O: Minor adverse European storm petrel O: Negligible adverse Leach's petrel	None	Kittiwake O: Negligible adverse Great black-backed gull O: Minor adverse Herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Great skua O: Minor adverse European storm petrel O: Negligible adverse Leach's petrel	None

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					Migratory waterbirds: O: Negligible	Migratory waterbirds O: Medium	O: Negligible adverse Gannet O: Minor adverse Migratory waterbirds: O: Negligible adverse		O: Negligible adverse Gannet O: Minor adverse Migratory waterbirds: O: Negligible adverse	
Combined collision risk and disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure.	×	✓	×	Increasing air draught to reduce bird collision.	Kittiwake O: Negligible Gannet O: Negligible	Kittiwake O: High Gannet O: High	Kittiwake O: Minor adverse Gannet O: Minor adverse	None	Kittiwake O: Minor adverse Gannet O: Minor adverse	None
Scenario 3										
Disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure.	✓	✓	✓	Offshore EMP which will include measures to minimise disturbance to rafting birds from transiting vessels.	Kittiwake C: Negligible O: Negligible D: Negligible Guillemot C: Negligible O: Negligible D: Negligible Razorbill C: Negligible O: Negligible	Kittiwake C: Medium O: Medium D: Medium Guillemot C: Medium O: Medium D: Medium Razorbill C: Medium O: Medium	Kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Guillemot C: Negligible adverse O: Negligible adverse D: Negligible adverse	None	Kittiwake C: Negligible adverse O: Negligible adverse D: Negligible adverse Guillemot C: Negligible adverse O: Minor adverse D: Negligible adverse	None

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					D: Negligible Manx shearwater C: Negligible O: Negligible D: Negligible Gannet C: Negligible O: Negligible D: Negligible	D: Medium Manx shearwater C: Medium O: Medium D: Medium Gannet C: Medium O: Medium D: Medium	Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse		Razorbill C: Negligible adverse O: Negligible adverse D: Negligible adverse Gannet C: Negligible adverse O: Negligible adverse D: Negligible adverse	
Collision Risk	×	✓	×	Increasing air draught to reduce bird collision.	Kittiwake O: Negligible Great black-backed gull O: Low Herring gull O: Negligible Lesser black-backed gull O: Negligible Great skua: O: Negligible European storm petrel	Kittiwake O: High Great black-backed gull O: Medium Herring gull O: High Lesser black-backed gull O: High Great skua O: High European storm petrel	Kittiwake O: Minor adverse Great black-backed gull O: Minor adverse Herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Great skua O: Minor adverse European storm petrel	None	Kittiwake O: Minor adverse Great black-backed gull O: Minor adverse Herring gull O: Minor adverse Lesser black-backed gull O: Minor adverse Great skua O: Minor adverse European storm petrel	None

Description of effect	Phase[a] C	O	D	Measures adopted as part of the project	Magnitude of impact	Sensitivity of the receptor	Significance of effect	Further mitigation	Residual effect	Proposed monitoring
					O: Negligible Leach's petrel O: Negligible Gannet O: Negligible Migratory waterbirds O: Negligible	O: Medium Leach's petrel O: Medium Gannet O: High Migratory waterbirds O: Medium	O: Negligible adverse Leach's petrel O: Negligible adverse Gannet O: Minor adverse Migratory waterbirds O: Negligible adverse		O: Negligible adverse Leach's petrel O: Negligible adverse Gannet O: Minor adverse Migratory waterbirds O: Negligible adverse	
Combined collision risk and disturbance and displacement from airborne noise, underwater sound, and presence of vessels and infrastructure.	×	✓	×	Increasing air draught to reduce bird collision.	Kittiwake O: Negligible Gannet O: Negligible	Kittiwake O: High Gannet O: High	Kittiwake O: Minor adverse Gannet O: Minor adverse	None	Kittiwake O: Minor adverse Gannet O: Minor adverse	None

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