MachairWind Offshore Windfarm

Chapter 22 Inter-related Effects and Ecosystem Assessment

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GLOSSARY OF ACRONYMS

Term	Definition
ADSFB	Argyll District Salmon Fishery Board
ALARP	As low as reasonably practicable
CCR	Climate Change Risk
ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Electromagnetic fields
FMS	Fisheries Management Scotland
GHG	Greenhouse Gas
HPAI	Highly Pathogenic Avian Influenza
ICES	The International Council for the Exploration of the Seas
IEMA	Institute of Environmental Management and Assessment
INNS	Invasive Non-Native Species
INNSMP	Invasive Non-Native Species Management Plan
JNCC	Joint Nature Conservation Committee
LSE	Likely significant effects
MD-LOT	Marine Directorate Licensing and Operations Team
MoD	Ministry of Defence
O&M	Operation and Maintenance
OnTDA	Onshore Transmission development Area
OSP	Offshore Substation Platforms
OWEKH	Offshore Wind Evidence and Knowledge Hub
PMF	Priority Marine Features
PSR	Primary Surveillance Radar
RSPB	Royal Society for the Protection of Birds
SAR	Search and Rescue
SLVIA	Seascape, Landscape and Visual Impact Assessment
SSC	Suspended sediment concentrations
UWN	Underwater Noise
UXO	Unexploded Ordnance
WDA	Windfarm Development Area
WTG	Wind Turbine Generator

GLOSSARY OF TERMS

Term	Definition
Allision	The act of striking or collision of a moving vessel against a stationary object.
Bedload	Sediment particles that travel near or on the seabed.
Breeding season	Furness (2015) defines breeding season as the period from modal return to the colony through to modal departure from the colony at the end of breeding, for birds at UK colonies.
Cable protection	Protective measure to minimise the effects of scour and hazards along the offshore cables (e.g. to prevent cable exposure or snagging of vessel anchors or fishing gear), as well as for protecting these cables at infrastructure crossing points.
Collision	The act or process of two moving objects colliding.
Combined Assessment	A whole-Project assessment considering interactions between the Windfarm Development Area, Offshore Export Cable Corridor and Onshore Transmission Development Area (i.e. considering impact interactions and additive effects to determine if any effects would be materially elevated from those assessed for the Windfarm Development Area-alone assessment). Due to long delays in securing confirmation of the Project's grid connection location, the level of detail available for the Offshore Export Cable Corridor and Onshore Transmission Development Area is limited and therefore the assessment is commensurate with the level of detail available at the time of carrying out the assessment. When it is time to progress the Offshore Export Cable Corridor and Onshore Transmission Development Area consent applications, their respective scoping and Environmental Impact Assessment Report / Environmental Report will take account of all likely effects predicted within the WDA EIA and present updated combined assessments using the latest available information covering all aspects of the Project.
Demersal	Living on or near the seabed.
Development Area	Application boundary for consenting purposes which, for the Project, consists of a Windfarm Development Area, Offshore Export Cable Corridor, and Onshore Transmission Development Area. Separate consent and marine licence applications will be submitted for each Development Area where applicable.
Embedded mitigation measure	Mitigation measures, including industry good practice measures, that are directly incorporated into the design for the MachairWind Windfarm Development Area to avoid or reduce environmental effects.
Environmental Impact Assessment (EIA)	The process of evaluating the likely significant environmental effects of a proposed development over and above the existing circumstances (or 'baseline').
Environmental Impact Assessment (EIA) Regulations	A collective term referring to The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 and The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017.
Fleet	A physical group of vessels sharing similar characteristics (e.g., nationality).
Greenhouse gas	A gas in the Earth's atmosphere that traps heat by absorbing and emitting infrared radiation, a process known as the greenhouse effect. Also known by the collective shorthand "carbon".
Holistic Network Design (HND) process	An integrated approach for connecting 23 GW of offshore wind (including from ScotWind projects) to Great Britain providing a recommended offshore and onshore design for a 2030 electricity network, that facilitates the Government's ambition for 50 GW of offshore wind by 2030. The recommended design in the HND has equally considered four objectives to make sure the most appropriate approach is taken forwards, including: cost to consumer, deliverability and operability, impact on environment; and impact on local communities.

Term	Definition
International Council for the Exploration of the Seas (ICES) statistical rectangles	ICES standardise the division of sea areas to enable statistical analysis of data. Each ICES statistical rectangle is 30 min latitude by 1 degree longitude in size (approximately 30 x 30 nautical miles). A number of rectangles are amalgamated to create ICES statistical areas.
Landfall	The area from Mean Low Water Springs to a transition bay(s), where the offshore export cable(s) come ashore.
MachairWind Offshore Windfarm	An offshore windfarm capable of exporting around 2 GW of renewable energy to the National Electricity Transmission System. MachairWind Offshore Windfarm comprises three Development Areas: • The WDA – located on the west coast of Scotland to the northwest of Islay and west of Colonsay; • The Offshore Export Cable Corridor – a preliminary boundary extending from the WDA to mean high water springs at a landfall location near Girvan, South Ayrshire; and • The Onshore Transmission Development Area – a preliminary boundary which extends landward from mean low water springs and includes the land required for the landfall of the offshore export cables and their route up to but not including the proposed high voltage direct current switching station which will be developed and constructed by Transmission Owner, ScottishPower Transmission. Separate consent and licence applications will be submitted for each Development Area.
Non-breeding season	Furness (2015) defines non-breeding season as the remaining part of the year that is not a part of breeding season.
Offshore ECC infrastructure	The offshore transmission infrastructure located within the boundary of the Offshore Export Cable Corridor, namely the offshore export cable(s).
Offshore export cable	Armoured cable containing electrical cores between the offshore substation platform(s) and landfall. Offshore export cables will include bundled fibre optic cables. The offshore export cables are subject to Marine Licence applications under the Marine (Scotland) Act 2010. The portion of the offshore export cable(s) located within the WDA is assessed as part of this MachairWind WDA EIA and a marine licence application to construct, alter or improve this portion has been submitted alongside the WDA application. A separate marine licence application will be submitted for the portion of the offshore export cable(s) from the WDA boundary to mean high water Mean High Water Springs.
Offshore Export Cable Corridor (ECC)	The preliminary boundary extending from the WDA to mean high water springs near Girvan, South Ayrshire and within which the offshore export cable(s) will be located. A separate marine licence application will be submitted for the offshore export cable(s) located within the Offshore ECC.
Offshore Substation Platform (OSP)	An offshore platform with a fixed foundation located within the WDA which houses electrical equipment such as transformers, switchgear, protection and control systems, and enables the windfarm's renewable electricity to be collected via inter-array cables and exported to the National Electricity Transmission System via offshore export cables.
Offshore Substation Platform (OSP) link cables	Electrical cables which link OSPs (if more than one OSP is required). These cables will include fibre optic cores or bundled fibre optic cables. OSP link cables will be wholly located within the WDA.
Onshore Transmission Development Area (OnTDA)	The preliminary boundary which extends landward from mean low water springs and includes the land required for the landfall of the offshore export cables and their route up to but not including the proposed high voltage direct current switching station which will be developed and constructed by Transmission Owner, ScottishPower Transmission. This Transmission Owner is responsible for consenting the high voltage direct current switching station. Onward connections to the National Electricity Transmission System will be consented by National

Term	Definition
	Grid Electricity Transmission and ScottishPower Transmission. Where relevant, these are considered as part of cumulative effects assessment in the EIA.
OSPAR	OSPAR started in 1972 with the Oslo Convention against dumping and was broadened to cover land-based sources of marine pollution and the offshore industry by the Paris Convention of 1974. These two conventions were unified, updated and extended by the 1992 OSPAR Convention. OSPAR is so named because of the original Oslo and Paris Conventions ("OS" for Oslo and "PAR" for Paris).
Pelagic	Of or relating to the open sea.
Pre-construction works	Pre-construction works are activities undertaken prior to formal commencement of construction. Examples include survey works such as geotechnical and geophysical surveys and seabed preparation activities.
Receptor-led effects	Assessment of multiple effects which interact to create inter-related effects on a receptor. As an example, multiple effects on a given receptor such as benthic habitats (e.g. direct habitat loss or disturbance, sediment plumes, scour, jack-up vessel use etc.) may interact to produce a different or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects might be short-term, temporary or transient effects, or incorporate longer term effects.
Safety zones	An area of water around or adjacent to a wind turbine generator or Offshore Substation Platform and associated substructure which is to be constructed, extended, operated or decommissioned, from which certain or all classes of vessels are excluded and within which activities can be regulated for the purpose of securing safety of the wind turbine generator, substructure or vessels in that vicinity, and individuals on both the wind turbine generator, substructure or vessel, in line with Section 95 of the Energy Act 2004.
Scour protection	Protective measures to avoid sediment being eroded away from the base of the wind turbine generator foundations as a result of the flow of water.
The Applicant	The legal entity submitting consent applications for the MachairWind Offshore Windfarm, namely Machairwind Limited.
The Project	MachairWind Offshore Windfarm including all its Development Areas and associated infrastructure.
WDA infrastructure	The offshore generation and transmission infrastructure located within the WDA including but not limited to: WTGs, WTG fixed foundations (and associated scour protection), OSP(s), OSP fixed foundations (and associated scour protection), IACs, OSP link and offshore export cable(s) and their associated external cable protection (insofar as these are located within the WDA) and fibre optic cables.
WDA lifetime effects	Assessment of effects that may occur throughout more than one phase of the Windfarm Development Area (WDA), (construction, operation and maintenance and decommissioning) which interact to potentially create a more significant effect on a receptor than if just assessed in isolation in each of the three key phases of the WDA (e.g. underwater sound effects from construction piling, operational wind turbine generators, vessels and decommissioning activities).
Wind Turbine Generator (WTG)	A wind turbine generator which converts wind energy into electrical energy. Each wind turbine generator is a complex system composed of a high number of components. Typically, the main components include the rotor assembly (composed of three blades and a hub); the nacelle (containing a generator, shaft and gearbox, power electronic converter and transformer); and the tower (containing lifting equipment and the switchgear).

Term	Definition
Windfarm Development Area (WDA)	The application boundary within the OAA where consent will be sought for the proposed WDA infrastructure. The WDA infrastructure is subject to Section 36 consent and marine licence applications (generation and transmission) which are being applied for separately from the Offshore ECC infrastructure and OnTDA infrastructure.

22 INTER-RELATED EFFECTS AND ECOSYSTEM ASSESSMENT

22.1 INTRODUCTION

1. This chapter presents an assessment of potential effects and likely significant effects (LSE) on the environment in relation to inter-related effects that may arise from the construction, operation and maintenance (O&M), and decommissioning of the MachairWind Windfarm Development Area (WDA) infrastructure.

2. The grid connection location for the Project was only confirmed in August 2025 following lengthy delays stemming from the National Electricity System Operator's 2022 Holistic Network Design (HND) process (see **Chapter 1 Introduction** for further information). Consequently, this topic chapter considers the WDA Study Area and existing environment only. A combined assessment of the construction, O&M and decommissioning of the WDA activities, Offshore Export Cable Corridor (ECC) and Onshore Transmission Development Area (OnTDA) activities (commensurate with the level of detail that is available at the time of carrying out that assessment) is also provided. This approach will ensure a holistic assessment is undertaken of the whole Project in a manner that is meaningful and proportionate. To inform the combined assessment, a set of assumptions were developed which includes a preliminary boundary for the Offshore ECC and OnTDA, anticipated project components and associated construction methods and timelines. These are set out in **Chapter 3 Project Description**, Sections 3.7 and 3.8. As noted in **Chapter 1 Introduction**, the assessment of potential effects on all receptors associated with the Offshore ECC and OnTDA will be presented in individual Environmental Impact Assessment (EIA) Report (EIAR), which will be submitted separately in accordance with the relevant EIA Regulations. These will take account of all likely effects predicted within the WDA EIA and present updated combined assessments using the latest available information covering all aspects of the Project.

3. This chapter has been prepared to provide the Marine Directorate Licensing and Operations Team (MD-LOT) (administering on behalf of the Scottish Ministers) and stakeholders with sufficient information to determine the likely significant effect(s) of the Project on the receiving environment.

4. The purpose of this Inter-related Effects and Ecosystem Assessment WDA EIAR chapter is to describe:

- The receptor groups considered within the Inter-related Effects and Ecosystem Assessment;
- The potential for effects on receptor groups across the three key phases of the WDA (construction, O&M and decommissioning);
- The potential for multiple effects on a receptor group, as presented within the topic-specific chapters, to interact to create inter-related effects; and
- The inter-related effects across different trophic levels of the ecosystem, affecting the environment.

5. For the purposes of this assessment, the following definitions have been provided:

- **Inter-related Effect** – An effect arising where a single receptor is exposed to multiple project-related impacts, either through repeated exposure to the same type of impact over different WDA phases or through different types of impacts (e.g. underwater noise (UWN) and habitat loss) acting together to create a combined or compounded effect.
    - **WDA Lifetime Effect** - effects that occur across more than one phase of the WDA construction, O&M, and decommissioning, where repeated or sequential exposure to the same type of impact (such as UWN, seabed disturbance or vessel activity) may combine to influence a receptor differently than when each phase is considered in isolation.
    - **Receptor-led Effect** – effects that occur when multiple different types of impacts act upon the same receptor or receptor group, either concurrently or in close succession, creating the

potential for a combined or compounded effect (for example, where a species could experience temporary disturbance, habitat alteration and prey-related changes within the same timeframe).

6. This chapter should be read in conjunction with the following related EIAR chapters:

- **Chapter 7 Marine Physical Environment**
- **Chapter 8 Benthic Ecology**
- **Chapter 9 Fish (including Basking Shark) and Shellfish**
- **Chapter 10 Marine Mammals and Leatherback Turtle**
- **Chapter 11 Offshore Ornithology**
- **Chapter 12 Commercial Fisheries**
- **Chapter 13 Shipping and Navigation**
- **Chapter 14 Offshore Archaeology and Cultural Heritage**
- **Chapter 15 Military and Civil Aviation**
- **Chapter 16 Seascape Landscape and Visual Impacts**
- **Chapter 17 Infrastructure and Other Marine Users**
- **Chapter 18 Socio-economics**
- **Chapter 19 Greenhouse Gas Assessment**
- **Chapter 20 Climate Change Risk Assessment**
- **Chapter 21 Major Accidents and Disasters.**

7. Key inter-relationships between this chapter and those listed above will be considered where relevant and presented in this chapter.

22.2 LEGISLATION, POLICY AND GUIDANCE

8. The overarching policy and legislation relevant to the EIA is described in **Chapter 2 Policy and Legislative Context**. The following (**Table 22.1**) relevant legislation, policy and guidance for Inter-related Effects and Ecosystem Assessment chapter, has been identified.

Table 22.1 Relevant legislation and guidance for the Inter-related Effects and Ecosystem Assessment

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
Legislation	
The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 - Regulation 4(2)	Regulation 4(2) requires assessment of the likely significant effects arising from electricity works, including direct, indirect and cumulative effects, which underpin consideration of inter-related effects where impacts from different environmental topics interact or combine.
The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 - Regulation 5(2)	Regulation 5(2) requires consideration of the effects of marine works on the environment, including indirect and cumulative effects. This supports the identification and assessment of inter-related effects associated with offshore activities affecting multiple environmental receptors.
Wildlife and Natural Environment (Scotland) Act 2011	The Wildlife and Natural Environment (Scotland) Act promotes an ecosystem approach to environmental management, supporting the need to consider interactions between habitats, species and environmental processes, which is relevant when assessing inter-related ecological effects.

Relevant Legislation, Policy or Guidance	Relevance to the Assessment
Marine (Scotland) Act 2010	The Marine (Scotland) Act provides a framework for integrated marine management, recognising that marine activities can affect multiple receptors and processes simultaneously. It supports consideration of combined and interacting environmental effects in the marine environment.
Directive 2008/56/EC - Marine Strategy Framework Directive	The Marine Strategy Framework Directive requires Member States to achieve Good Environmental Status through consideration of cumulative pressures and interactions within marine ecosystems. This supports the assessment of inter-related effects arising from multiple pressures on marine receptors.
Guidance	
CIEEM Guidelines for Ecological Impact Assessment (EcIA) (CIEEM, 2023)	The guidelines provide detailed methodology for ecological assessments in terrestrial, freshwater, marine, and coastal environments. This includes guidance on assessing ecosystem functions, interactions, and cumulative ecological effects, supporting robust inter-related effects assessment.
Scottish Government Planning EIA Guidance (Planning Circular 1/2017 and PAN 1/2013) (Scottish Government, 2017)	The guidance sets out expectations for EIA practice in Scotland, including identifying and assessing interactions between environmental topics. Supports consistency and compliance with the 2017 EIA Regulations.
Institute of Environmental Management and Assessment (IEMA) EIA Guide to Shaping Quality Development (IEMA, 2016).	The IEMA Guide to Shaping Quality Development outlines a structured approach and framework for embedding environmental considerations into project planning, design, and decision-making processes. The guidance emphasises that high-quality EIA should identify inter-relationships between environmental topics, recognise how individual impacts may combine or influence one another, and ensure that assessment does not consider effects in isolation.
The Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (EC, 1999);	The guidelines provide recommended approaches and tools for identifying and evaluating interrelated environmental impacts throughout the EIA process. Their purpose is to ensure that all potentially significant environmental effects are thoroughly considered, contributing to more robust and effective assessments.
Sectoral Marine Plan for Offshore Wind Energy (Scottish Government, 2020) and Draft Updated Sectoral Marine Plan (2025)	The Sectoral Marine Plan identifies key environmental sensitivities and pressures associated with offshore wind development and recognises the need to consider combined and interacting effects at a plan and project level, providing strategic context for inter-related effects assessment.

9. Other than this, there is no policy in Scotland that specifically addresses inter-related effects. Therefore, this chapter has been prepared based on the available guidance, stakeholder advice, latest sectoral expectations, current best practice and technical guidance relevant to EIA in Scotland/UK and professional judgement, as outlined in **Section 22.3**.

22.3 CONSULTATION

10. This Inter-related Effects and Ecosystem Assessment chapter has been informed by engagement with stakeholders, including those listed below:

- Argyll and Bute Council;
- Argyll District Salmon Fishery Board (ADSFB)
- Fisheries Management Scotland (FMS);
- MD-LOT;
- NatureScot; and
- Royal Society for the Protection of Birds (RSPB).

11. As part of the consultation process, the Applicant presented the approach to assessment to stakeholders in order to offer transparency around the assessment methodology and rationale, capture stakeholder advice and guidance, and incorporate stakeholder feedback, where appropriate. A summary of the approach to stakeholder communication and consultation is outlined in **Chapter 6 Consultation and Stakeholder Engagement**.

12. The consultation outcomes in relation to the Inter-related Effects and Ecosystem Assessment are outlined in **Table 22.2**, which summarises stakeholder feedback, outlines how the Applicant has responded to the feedback received, and details how it has been considered within this chapter.

Table 22.2 Summary of consultation relevant to Inter-related Effects and Ecosystem Assessment

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
Scoping Opinion				
1.	MD-LOT	09 January 2025: Scoping Opinion – Written Feedback (MD-LOT)	The Scottish Ministers direct the Developer to the NatureScot representation on the need to understand potential impacts holistically at a wider ecosystem scale, rather than just as discrete individual receptor assessments. The Scottish Ministers therefore advise that potential impacts should be given consideration across key trophic levels, particularly in relation to the availability of prey species.	Potential impacts across key trophic levels are assessed within the Ecosystem Effects Assessment (**Section 22.8**). This includes consideration of prey availability and how changes in prey distribution or abundance may influence wider ecosystem pathways. Links between prey species and higher trophic-level receptors, such as marine mammals and seabirds, are addressed within the relevant technical chapters and also in **Section 22.8.2.1**.
2.	MD-LOT	09 January 2025: Scoping Opinion – Written Feedback (MD-LOT)	The Scottish Ministers are broadly content on the approach to the assessment as detailed in Section 9.12, however advise the Developer to fully consider the comments from NatureScot regarding PMFs and changes in prey availability. The Scottish Ministers direct the Developer to the Predators and Prey Around Renewable Energy Developments project in this regard. Additionally, the Scottish Ministers draw attention to the NatureScot representation regarding UWN modelling for consideration.	As noted in Consultation ID 1, Priority Marine Features (PMFs) and changes in prey availability are addressed within the Inter-related Effects and Ecosystem Assessment (**Section 22.8**). This chapter draws on **Chapter 9 Fish (including Basking Shark) and Shellfish** and incorporates relevant emerging evidence from the PrePARED project. UWN and its influence on prey-related pathways is also addressed in **Section 22.8.8.1.5**.
3.	NatureScot	09 January 2025: Scoping Opinion – Written Feedback (NatureScot)	Increasingly, there is a need to understand potential impacts holistically at a wider ecosystem scale in addition to the standard set of discrete individual receptor assessments. This assessment should focus on potential impacts across predator prey interactions. This will enable a better understanding of the consequences (positive or negative) of any potential changes in prey distribution and abundance from the development of the wind farm on bird and mammal (as well as other top predator) interests and what influence this may have on population level impacts.	An ecosystem-based assessment is included in **Section 22.8**, where predator-prey interactions and trophic-level pathways are addressed. Effects on seabirds and marine mammals arising from variations in prey distribution and abundance are considered. See Consultation ID 1 and 2 for further information.
4.	NatureScot	09 January 2025: Scoping Opinion –	Potential inter-related effects are discussed generally within Section 4.4.2.6 of the Scoping Report. We advise that the EIA	As noted in Consultation IDs 1-3, impacts on key prey species and their habitats, including proposal-alone and cumulative

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
		Written Feedback (NatureScot)	Report should clearly set out impacts to key prey species (such as sandeel, herring, mackerel and sprat) and their habitats arising from the proposal alone and cumulatively. The PrePARED (Predators and Prey Around Renewable Energy Developments) project may be helpful in the understanding of predator-prey relationships in and around offshore wind farms.	effects, are assessed within **Section 22.8**. The assessment draws on **Chapter 9 Fish (including Basking Shark) and Shellfish** and provides cross-links to marine mammal and offshore ornithology receptors. The PrePARED project has also been drawn upon where relevant.
5.	NatureScot	09 January 2025: Scoping Opinion – Written Feedback (NatureScot)	Unexploded Ordnance (UXO) clearance presents a risk to seabirds both directly and indirectly during the pre-construction / construction phase. Detonation of UXO may directly risk injury or death to seabirds within the vicinity of the detonation. Therefore, we expect direct impacts of UXO clearance on seabirds to be assessed within the potential impact 'temporary disturbance and displacement'. As noted above, UXO clearance also presents an indirect impact to seabirds in relation to UWN impacts on prey species. This impact should also be included within the assessment.	Direct effects of UXO clearance on seabirds are considered under temporary disturbance and displacement (**Section 22.8.10.3**). Indirect effects from UWN acting on prey species are assessed within **Section 22.8.8.1.5**. See Consultation ID 3 and ID 4 for further information on prey-linked pathways.
6.	RSPB	09 January 2025: Scoping Opinion – Written Feedback (RSPB)	The UK is of outstanding international importance for its breeding seabirds and wintering marine birds. As with all Annex I and regularly migratory species, the UK has a particular responsibility under the Birds Directive to secure their conservation. Their survival and productivity rates can be impacted by offshore windfarms directly (i.e. collision) and indirectly (e.g. displacement from foraging areas, additional energy expenditure, potential impacts on forage fish and wider ecosystem impacts such as changes in stratification). RSPB Scotland encourage the adoption of a precautionary approach to the identification of relevant protected sites for seabirds with clear methodology on the exclusion of sites and species. We generally agree with the collection and analysis methods advised by NatureScot, with some exceptions as set out below. We recommend use of the guidance notes available on their website to inform assessment. If an Applicant chooses to	Relevant seabird considerations are assessed within **Chapter 11 Offshore Ornithology**. Ecosystem-scale pathways, including forage fish availability and physical processes such as stratification, are addressed in **Section 22.8.10.3**.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			undertake supplementary modelling using alternative parameters to that recommended, we suggest this is clearly labelled.	
7.	RSPB	09 January 2025: Scoping Opinion – Written Feedback (RSPB)	As set out in Searle et al (2023)1, assessing impacts of offshore windfarms and other renewables developments is inherently uncertain. This uncertainty is propagated throughout the impact assessments, as there are not only direct impacts, but ecosystem wide impacts that can change, for example, the abundance and availability of prey. Multiple data sources and modelling techniques are used to capture a simplified version of reality. They do not fully capture the complexity of seabird behavioural or demographic processes in a dynamic marine environment. Not recognising these uncertainties risks poorly informed decisions being made. Furthermore, an underestimation of impacts will have repercussions when consenting later offshore wind development. If a precautionary approach is taken from the beginning, the likelihood of irreversible damage occurring is reduced even whilst our knowledge base is incomplete, and modelling improves. The precautionary principle requires the Applicant to demonstrate with scientific certainty that something would not be harmful. The concept of something being overly precautionary dismisses the inherent uncertainty in modelling and overlooks the simplistic version of reality that the modelling captures.	Uncertainty associated with ecosystem-wide effects, prey availability and modelling assumptions is acknowledged in **Section 22.8**. A precautionary approach has been adopted in line with RSPB Scotland's advice.
8.	ADSFB	09 January 2025: Scoping Opinion – Written Feedback (ADSFB)	Offshore renewable developments have the potential to directly and indirectly impact diadromous fish. We would therefore expect developers to assess and, where necessary, mitigate the potential impacts of deployed devices on such fish during the deployment, operation and decommissioning phases. These potential impacts have been highlighted through ScotMER, and include:	Potential impacts on diadromous fish, including avoidance, disorientation and migration delay, are assessed in **Chapter 9 Fish (including Basking Shark) and Shellfish**. In addition, the assessment explicitly considers ecosystem-based pathways, including those raised by ADSFB. In particular: • Predator aggregation around offshore structures is included as an indirect effect pathway (**Section 22.8.8.1.4**).

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			• Avoidance (including exclusion from particular rivers and subsequent impacts on local populations); • Disorientation effects that could potentially affect behaviour, susceptibility to predation or by-catch; and • Impaired ability to locate normal feeding grounds or river of origin; and delayed migration. Argyll DSFB request that, in addition to the evidence gaps identified by ScotMER, the EIA considers the effects of predator aggregation (e.g. large gadoids/ grey seals) around the proposed development on migrating salmonids at both the smolt and adult stages and, additionally, physical barrier effects on salmon during construction and operation (e.g. noise, shadow flicker). In this regard, it should be noted that NatureScot has formally conceded that shadow flicker from moving turbine blades (and the direct visual effects of moving blades) may adversely affect salmonids in freshwater habitat. Since the same physical principles apply in the marine environment, surface-orientated fish such as salmonids are likely to be exposed to equivalent adverse effects.	• Physical barrier effects, including temporary behavioural disruption from construction-phase UWN (**Section 22.8.8.1.5**). • Effects across all project phases have been screened and assessed to align with ADSFB's request that diadromous fish are considered throughout the full project lifecycle (**Section 22.8.10**). Where data limitations exist (e.g., fine-scale predator distribution or variability in year-class strength of salmonid cohorts), these are acknowledged within the relevant chapters, and a precautionary approach has been applied to ensure effects are not under-estimated. Due to absence of evidence that offshore Wind Turbine Generator (WTG) blade flicker influences marine species, alongside the lack of any identified mechanism by which turbine related shading or movement would alter predator behaviour in the marine environment, shadow flicker impacts have not been scoped in for assessment.
9.	FMS	09 January 2025: Scoping Opinion – Written Feedback (FMS)	FMS request that, in addition to the evidence gaps identified by ScotMER, the EIA considers the effects of predator aggregation (e.g. large gadoids/ grey seals) around the proposed development on migrating salmonids at both the smolt and adult stages and, additionally, physical barrier effects on salmon during construction and operation (e.g. noise, shadow flicker). In this regard, it should be noted that NatureScot has formally conceded that shadow flicker from moving turbine blades (and also the direct visual effects of moving blades) may adversely affect salmonids in freshwater habitat. Since exactly the same physical principles apply in the	Predator aggregation and barrier-type interactions affecting salmonids are assessed in **Section 22.8** and **Chapter 9 Fish (including Basking Shark) and Shellfish**. See Consultation ID 8 for further information regarding shadow flicker.

I.D.	Consultee	Date/Engagement Activity	Stakeholder Comment	Applicant Response
			marine environment, surface-orientated fish like salmonids are likely to be exposed to equivalent adverse effects	

22.4 EXISTING DATA SOURCES

13. The baseline environment for each receptor group described in **Section 22.7** is characterised within the relevant technical chapters, as set out in **Section 22.1**. This chapter draws upon the conclusions of those chapters to evaluate the effects acting on each receptor group and to identify where interactions between receptors may give rise to inter-related effects.

14. The inter-related effects and ecosystem assessment considers the LSE arising solely from the WDA, as assessed in **Chapters 7** to **21**. It does not assess effects associated with other external cumulative developments, with the exception of the combined assessment of future MachairWind components (i.e. the Offshore ECC and OnTDA). Inter-related effects associated with other projects or plans are addressed within the cumulative effects assessments presented in each of the relevant technical chapters.

15. The guidance informing the assessment methodology used throughout this chapter is provided in **Section 22.6**.

22.5 INTER-RELATED EFFECTS AND ECOSYSTEM ASSESSMENT STUDY AREA

16. Given the varying spatial extents of effects experienced by different offshore receptors, the Study Area for potential inter-related effects and ecosystem impacts differs by topic and receptor. Consequently, the likely significant inter-related effects considered in this chapter are confined to the Study Areas defined within each of the topic-specific chapters referenced in **Section 22.5**.

17. As offshore ornithology covers the largest Study Area (Figure 11.1**, Chapter 11 Offshore Ornithology**), it is used as the maximum extent for the Inter-related Effects and Ecosystem Assessment.

22.6 ASSESSMENT METHODOLOGY

22.6.1 Overview

18. Understanding how different components of the Project may interact is important for protecting the environment and nearby communities. This assessment considers how the Project's effects may combine, overlap or interact, rather than assessing each effect in isolation. For example, effects associated with UWN, changes to water quality, or disturbance to ecological receptors may occur at the same time or in the same areas, potentially affecting the same receptors.

19. Effects that appear minor when considered individually can become more notable when they occur together. Assessing these inter-related effects allows for a more realistic understanding of potential impacts and supports the identification of appropriate mitigation, helping to ensure that the Project is developed responsibly and with minimal adverse effects.

20. This section sets out the approach and methodology used to assess inter-related effects for the Project. The scope of the assessment has evolved alongside refinements to the Project design and has been informed by consultation feedback received to date, as described in **Section 22.3**.

21. Inter-related effects are assessed by identifying all potential effects acting on a particular receptor and determining whether these effects may interact spatially (occurring in the same location) or temporally (occurring at the same time). Where such interactions are identified, the potential for combined effects on that receptor is considered. The EIA process for the Project adopts a holistic approach to ensure that all LSE on relevant receptors are assessed.

22. In some topic chapters, inter-related effects are inherently addressed as part of the assessment. For example:

- **Chapter 8 Benthic Ecology** considers the potential for multiple Project-related pressures, including seabed disturbance, changes to suspended sediment concentrations (SSCs) and sediment re-deposition, introduction of hard substrate, electromagnetic fields (EMF) and the potential introduction of invasive non-native species, to interact and affect benthic receptors;
- **Chapter 9 Fish (including Basking Shark) and Shellfish** considers the potential for combined effects arising from UWN and vibration, habitat disturbance or loss, changes in prey availability, EMF from subsea cables and vessel activity, including where these effects overlap spatially or temporally;
- **Chapter 10 Marine Mammals and Leatherback Turtle** considers the potential for combined effects arising from multiple impact pathways, including UWN from piling, geophysical surveys, non-piling construction activities and vessels, behavioural disturbance and displacement, barrier effects, vessel interaction, disturbance at protected seal haul-out sites, and indirect effects through changes to prey availability, including where these effects overlap spatially or temporally; and
- **Chapter 11 Offshore Ornithology** considers how different impact pathways, such as disturbance and displacement, collision risk and indirect effects associated with changes in prey availability, may interact to affect offshore ornithological receptors.

23. This chapter provides a summary of the inter-related effects on linked receptors that have been identified and assessed within the individual topic chapters.

22.6.2 Part One: Inter-related Effects Assessment Method

24. The following sections outline the methodology used to assess inter-related effects within the WDA.

22.6.2.1 Approach to Assessment

25. **Chapter 5 EIA Methodology** provides a summary of the general impact assessment methodology applied throughout this WDA EIAR.

26. **Table 22.3** summarises the key steps used to assess potential inter-related effects for each receptor or receptor group.

Table 22.3 Staged approach to assessing inter-related effects

Stage	Description
1	Assessment of effects undertaken for individual WDA EIAR topic areas within Chapter 7 to 20[1]
2	Review of the topic-specific assessments to identify receptor groups requiring consideration within the inter-related effects assessment.
3	Identification of potential inter-related effects on receptor groups through examination of the assessments presented in the respective WDA EIAR chapters.
4	Assessment of how individual effects may interact or combine to give rise to inter-related effects for each receptor group, including:

[1] No specific receptors unique to **Chapter 21 Major Accidents and Disasters** have been identified. To avoid duplicating receptor groups already assessed within other topic chapters, a dedicated major accidents and disasters chapter has not been included within this assessment.

Stage	Description
	• WDA lifetime effects: combined effects arising across the construction, O&M, and decommissioning phases; and • Receptor-led effects: multiple effects acting concurrently or sequentially upon a single receptor.

22.6.2.1.1 Stage 1: Topic Specific Assessment

27. The first stage of the inter-related effects assessment is undertaken within each of the WDA EIAR topic chapters. This stage comprises the evaluation of impacts on receptors arising during the construction, O&M, and decommissioning phases of the Project.

22.6.2.1.2 Stage 2: Identification of Receptor Groups

28. The second stage of the assessment involved reviewing the assessments presented in the topic-specific chapters to identify the relevant receptor groups for inclusion in this chapter. The term receptor group refers to a collection of receptors that display similar sensitivities or are likely to respond in comparable ways to Project-related effects, for example, marine mammals.

For clarity and consistency, the receptor groups have been categorised into three broad environmental domains, as outlined below:

- Physical Environment:
  - Marine Physical Environment.
- Biological Environment:
  - Benthic Ecology;
  - Fish (including basking shark) and Shellfish;
  - Marine Mammals; and
  - Offshore Ornithology.
- Human Environment
  - Commercial Fisheries;
  - Shipping and Navigation;
  - Offshore Archaeology and Cultural Heritage;
  - Military and Civil Aviation;
  - Seascape Landscape and Visual Impacts;
  - Infrastructure and Other Marine Users;
  - Socio-economics; and
  - Climate Change.

22.6.2.1.3 Stage 3: Identification of Potential Inter-Related Effects on Receptor Groups

29. After identifying the receptor groups, potential inter-related effects have been determined through a detailed review of the assessment conclusions presented within each relevant topic chapter. This process involved identifying where individual effects, assessed separately within **Chapters 7 to 20**, may act together on the same receptor group. The determination of which effects could contribute to inter-related impacts on receptors associated with the WDA has been based on the professional judgement and expertise of the project team, supported by topic-specific technical specialists.

30. It is recognised that topic-specific chapters may not operate in isolation. Effects identified in one chapter may lead to secondary or consequential effects on receptors considered in others. Examples of such interactions include, but are not limited to:

- **Chapter 8 Benthic Ecology**: assesses effects on benthic habitats and species arising from changes to the physical environment (**Chapter 7 Marine Physical Environment**);
- **Chapter 9 Fish (including Basking Shark) and Shellfish**: assesses effects on fish and shellfish receptors arising from changes within benthic habitats (**Chapter 8 Benthic Ecology**);
- **Chapter 10 Marine Mammals and Leatherback Turtle** and **Chapter 11 Offshore Ornithology**; assesses effects on marine mammals and seabirds arising from potential changes in benthic habitats and associated shifts in prey distribution including key forage fish species (**Chapter 8 Benthic Ecology** and **Chapter 9 Fish (including Basking Shark) and Shellfish**); and
- **Chapter 15 Military and Civil Aviation**: assesses impacts on aviation and radar receptors linked to restrictions on helicopter and vessel access to infrastructure, drawing upon impact pathways described in **Chapter 17 Infrastructure and Other Marine Users**.

31. Where interconnections between receptors and their associated effects have been identified, these have been fully assessed within the relevant topic-specific chapters. This chapter therefore consolidates those considerations by summarising the linked receptor pathways already evaluated elsewhere in the EIAR.

32. It should be noted that the Inter-related Effects Assessment does not include cumulative effects on receptors as a result of the Project and other plans and projects, with these being assessed within each individual topic chapter.

33. Furthermore, despite the uncertainty around the location of the offshore export cable and location of the landfall for export cable in South Ayrshire, with the embedded mitigation measures in place for the WDA, the Applicant considers it to be unlikely that there will be any combined receptor-led effects from offshore and onshore activities associated with the WDA. However, taking a precautionary approach, the Applicant has assessed the combined potential for inter-related effects with the Offshore ECC infrastructure in **Section 22.7.2**. This will be further assessed in a separate EIAR for the Offshore ECC and OnTDA, to be submitted when additional Project details become available, in accordance with the relevant EIA Regulations.

22.6.2.1.4 Stage 4: Assessment of Inter-Related Effects on each Receptor Group

34. The assessment has identified the effects associated with each key receptor group across all three phases of the WDA reflecting the full lifecycle of the development. This includes consideration of receptor-focused impacts, where multiple environmental effects may act simultaneously or sequentially on the same receptor and influence its overall response.

35. The significance of these individual effects is presented within the relevant topic chapters through impact, mitigation and monitoring summary tables for each receptor group. These conclusions are based on the assumption that all proposed mitigation measures are implemented effectively. **Section 22.7** then provides an overarching narrative evaluation of the potential for these individual effects to combine or interact, including qualitative descriptions and, where data allow, quantitative consideration. Each topic-specific assessment (refer to **Table 22.4** to **Table 22.14**) identifies and reports any inter-related effects deemed relevant.

36. The inter-related effects assessment draws upon the greatest adverse effect significance identified for the WDA topic-specific assessments. This incorporates a realistic worst-case scenario and mitigation measures embedded within the project design. While some effects may not be significant within their individual topic assessments, their interaction with other effects may elevate their combined significance. Inter-related effects assessed as being of moderate significance or greater are therefore considered important for decision-making purposes, whereas effects of minor significance or lower carry limited weight.

22.6.2.2 Combined Assessment

37. This section outlines the approach used to assess potential interactions and additive effects between the WDA and the future Offshore ECC and OnTDA. This combined assessment considers whether effects from these development areas could overlap or act together to increase the significance of effects beyond those identified for the WDA alone. This approach enables potential interactions between each Development Area to be identified and assessed, ensuring a whole Project assessment is undertaken in a manner that is meaningful and proportionate.

38. Interactions refer to spatial or temporal overlap of effects, while additive effects refer to situations where separate effects may act sequentially or incrementally on the same receptor. The WDA-alone assessment already includes the full worst-case scenario for all infrastructure within the WDA boundary, including WTGs, Offshore Substation Platforms (OSPs), OSP link cables and up to 200 km of export cable(s), ensuring these elements are fully considered before combined effects are examined.

39. To inform the combined assessment, a set of assumptions were developed which includes a preliminary boundary for the Offshore ECC and OnTDA, anticipated project components and associated construction methods and timelines. These are set out in **Chapter 3 Project Description**, Sections 3.7 and 3.8. The combined assessment recognises that detailed design and preliminary boundaries will be refined through future survey work. The assessment is qualitative and proportionate to the current stage of development. When the Offshore ECC and OnTDA progress to their own EIA stages, those assessments will incorporate the findings of the WDA EIAR and provide updated combined assessments using refined project information.

40. Only residual effects from the WDA-alone assessment are taken forward into the combined assessment. A qualitative review is then undertaken to identify whether interactions or additive effects with the Offshore ECC or OnTDA could lead to effects of greater significance than those assessed for the WDA alone.

22.6.3 Part Two: Ecosystem-based Effects Assessment Method

41. The purpose of the ecosystem-based effects assessment is to qualitatively assess the potential effects of the WDA at the ecosystem level, to better understand how predator-prey relationships could be altered and how this could impact the functioning of the ecosystem.

42. The structure of Part Two: Ecosystem-based effects assessment is as follows:

- Overview;
- Ecosystem baseline;
- The marine food web;
- The key predator species;
- The key prey species;
- How the food system works;
- Future ecosystem baseline;
- Existing pressures on prey species;
- Effects of the WDA on prey species; and
- Effects of the WDA on predator species.

43. Information and conclusions from the relevant chapters of the WDA EIAR and their corresponding technical reports have been used to build up a picture of the marine ecosystem in the locality of the WDA and inform the baseline for the ecosystem assessment. This information has also been used to inform the assessments within these sections to ultimately conclude whether the WDA alone,

combined assessment and cumulative assessment (with other plans and projects), is likely to result in changes to prey species which in turn will result in changes to predator species (or vice versa) and therefore result in likely significant ecosystem effects.

22.7 PART ONE: RECEPTOR BASED INTER-RELATED EFFECTS ASSESSMENT

22.7.1 Assessment of Inter-related Effects

44. For each of the receptor groups listed in Stage 2 (**Section 22.6.2.1.2**), the scope for impact on these receptors to create WDA lifetime effects over all phases and/or receptor-led effects through interacting together on a particular group has been explored and discussed in the following sections.

22.7.1.1 Physical Environment

22.7.1.1.1 Marine Physical Environment

45. For the marine physical environment, a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.4**.

46. Impacts related to changes to water column structure are either confined to a single WDA phase or occur in ways that do not combine to increase their magnitude when viewed across construction, O&M and decommissioning. Therefore, for this impact, **no significant** WDA lifetime inter-related effects are expected.

Table 22.4 Summary of Likely Significant Potential Inter-related Effects for Marine Physical Environment from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Changes in SSCs and Seabed Level	✓	✓	✓	Construction activities (including seabed preparation, foundation installation, sandwave clearance), O&M works (e.g. cable repairs, reburial), and decommissioning will disturb sediments, generating temporary increases in SSCs and localised deposition. These effects dissipate quickly and remain within natural variability due to the dynamic hydrodynamic regime of the WDA. Although SSC-related effects may recur in multiple phases, they do not overlap in a way that would increase the overall magnitude or duration of impacts. WDA lifetime effects remain **negligible** at worst and **not significant** in EIA terms.
Changes in Sediment Transport Regime and Seabed Morphology	✓	✓	✓	Localised modification of currents and bed shear stress may occur during construction (through seabed preparation) and during O&M (due to the presence of infrastructure). These changes can cause small-scale adjustments in sediment transport pathways and seabed form (e.g. scour and deposition), but these remain limited in extent and recover through natural tidal and wave-driven processes. There is no evidence that these process-level changes combine across phases to create more extensive or longer-term effects. WDA lifetime effects remain **minor adverse** at worst and **not significant**.

Description of Impact	Phase			Likely Significant Inter-related Effects
Changes to Water Column Structure	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA
Receptor-led Effects				
Across all phases, changes to suspended sediments, seabed morphology, tidal and wave regimes, and water column structure are small, localised and short-lived, and remain within natural variability. Construction related sediment plumes disperse rapidly and do not overlap with operational hydrodynamic or wave-regime changes. Operational effects, such as minor alterations to currents, waves or mixing, are very small and do not interact in a way that alters seabed mobility or large-scale physical processes. Because these receptors are naturally dynamic and highly resilient, the limited changes introduced by the WDA do not combine or reinforce each other across phases. Overall, receptor-led inter-related effects on the marine physical environment remain **minor adverse** at worst and are **not significant** in EIA terms.				

22.7.1.2 Biological Environment

22.7.1.2.1 Benthic Ecology

47. For benthic ecology, a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.5**.

48. Impacts related to permanent habitat loss, colonisation of introduced hard substrate, EMF, and Invasive Non-Native Species (INNS) are either specific to a single stage (for example, EMF is limited to the O&M stage) or not expected to have a greater significance than the effects of each WDA stage considered alone. Therefore, for these impacts, **no significant** WDA lifetime inter-related effects are expected.

49. Because benthic impacts occur at small spatial scales, with only limited overlap and full recovery predicted for temporary disturbance, these pressures do not interact in a way that elevates their significance, and therefore **no significant** receptor-led inter-related effects are expected for benthic ecology.

Table 22.5 Summary of Likely Significant Potential Inter-related Effects for Benthic Ecology from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Increased SSCs and sediment re-deposition;	✓	✓	✓	Activities during construction, O&M, and decommissioning may temporarily increase SSCs and cause localised sediment deposition. Plumes are short-lived, small in spatial extent and disperse rapidly, with no meaningful overlap between phases. Receptors show **negligible-low** sensitivity and high recoverability. WDA lifetime effects remain **minor adverse** and **not significant**.
Temporary physical disturbance and habitat loss;	✓	✓	✓	Seabed disturbance arises from foundation preparation, cable trenching, jack-up vessel footprints and anchor deployment. Disturbance occurs in small, discrete areas and is episodic in nature across phases. Benthic communities are resilient and recover quickly. No evidence that phase-to-phase interactions increase overall effect significance. WDA lifetime effects remain **minor adverse** and **not significant**.
Introduction of marine invasive non-native species (INNS);	✓	✓	✓	Vessel movements and installation of artificial substrates could provide vectors for INNS. Mandatory ballast water management, biofouling controls and **Appendix 8 INNS Plan** significantly reduce risk. Effects are localised and do not accumulate across phases. WDA lifetime effects remain **minor adverse** and **not significant**.
Permanent habitat loss	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Colonisation of introduced hard substrate;	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.

Description of Impact	Phase			Likely Significant Inter-related Effects
Interactions with EMFs	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Heat exposure from subsea electrical cabling	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Receptor-led Effects				
There is potential for both spatial and temporal overlap between the different pathways of effect on benthic habitats within the WDA. In particular, interactions may occur between temporary and permanent habitat loss, and the increases in SSCs and sediment redeposition that arise from construction, O&M and decommissioning activities. The greatest potential for inter-related effects is associated with two key mechanisms, direct habitat disturbance, including both temporary habitat loss (e.g. seabed preparation, cable trenching, jack-up vessel footprints) and permanent habitat loss resulting from foundations, scour protection and cable protection; and indirect disturbance arising from short-term increases in SSCs and sediment redeposition generated during seabed preparation, cable installation and maintenance works. Individually, these impacts have been assessed as producing **negligible** to **minor adverse** effects, with full recovery predicted where disturbance is temporary and with permanent losses restricted to a very small proportion of the WDA footprint. When considered in combination, although some limited overlap in space and time may occur, the affected areas remain confined to the immediate project footprint, and the habitats concerned are widespread throughout the broader regional benthic environment. As a result, the combined influence of these effects is not considered to elevate the overall level of impact beyond that determined for the individual pathways. Overall, receptor-led inter-related effects on benthic ecology remain **minor adverse** at worst and are **not significant** in EIA terms.				

22.7.1.2.2 Fish (including Basking Shark) and Shellfish

50. For fish and shellfish, a WDA-lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.6.**

51. Impacts associated with permanent habitat loss, introduction of hard substrate, EMF, and INNS are either limited to a single WDA phase (for example, EMF effects occur only during the operational period) or are not expected to result in a higher level of effect than those assessed for each WDA stage individually. As such, **no significant** WDA-lifetime inter-related effects are anticipated for these impact pathways.

52. Because fish and shellfish impacts occur at different times, affect limited areas, and are further reduced through embedded mitigation and the mobility or recoverability of affected species, these pressures do not combine across phases to elevate their significance, and therefore **no significant** receptor-led inter-related effects are expected for fish (including basking shark) and shellfish.

Table 22.6 Summary of Likely Significant Potential Inter-related Effects for Fish (including Basking Shark) and Shellfish from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Temporary Physical Disturbance / Habitat Loss	✓	✓	✓	Temporary physical disturbance and temporary habitat loss will occur during construction, O&M and decommissioning, primarily through seabed preparation, cable installation, jack-up vessel footprints, and localised cable repair or reburial works. When considered across the full WDA lifetime, these activities could theoretically overlap in time or space; however, such disturbance events are highly localised, short-lived, and largely concentrated along the same infrastructure corridors, particularly cable routes. Although the total disturbed area increases when all phases are viewed together, this does not represent a continuous or expanding footprint. Much of the disturbance occurs repeatedly in the same discrete locations, rather than creating new areas of impact. Sediment habitats within the WDA are widespread across the wider Fish and Shellfish Regional Study Area, and benthic and demersal communities show strong recoverability, with recolonisation beginning rapidly once works cease. Because the duration, extent and intensity of disturbance are limited, and because affected habitats are widespread and recover rapidly under natural hydrodynamic conditions, there is no mechanism for temporary habitat disturbance across different phases to interact in a way that amplifies ecological effects or elevates overall significance. As such, the inter-related effects of temporary physical disturbance across the WDA lifetime remain **minor adverse** at worst and **not significant** in EIA terms.
Increased SSC and sediment redeposition	✓	✓	✓	SSC elevations may occur repeatedly across the project lifetime from construction, cable repair and eventual decommissioning. However, modelled SSC plumes are short-lived, disperse rapidly, and return to baseline conditions under natural hydrodynamic mixing within hours. Repeated events do not overlap spatially or temporally in a way that would intensify effects. WDA lifetime effects therefore remain **minor adverse** at worst and **not significant** in EIA terms.
UWN and Vibration	✓	✓	✓	UWN is greatest during construction (e.g. piling) but reduces substantially during O&M, where only low-intensity operational noise occurs, and during decommissioning, where noise sources mirror construction (with the notable absence of piling noise) but generally at lower intensity. These phases do not overlap in a way that compounds behavioural disturbance. Receptors also tend to be mobile and capable of avoiding noisy areas. WDA lifetime effects therefore remain **minor adverse** and **not significant** in EIA terms.
Disturbance and Displacement of Basking Shark	✓	✓	✓	Disturbance could theoretically occur during all phases due to vessel presence and UWN. However, basking shark density in the WDA is low and individuals are highly mobile. Any displacement would be temporary and unlikely to overlap across project phases.

Description of Impact	Phase			Likely Significant Inter-related Effects
				WDA lifetime effects remain as **negligible** and **not significant** in EIA terms.
Vessel Collision for Basking Shark	✓	✓	✓	Collision risk is highest during construction when vessel traffic is most intense. Risk reduces during O&M and decommissioning and remains **nnegligible** overall due to low basking shark abundance and embedded vessel-management measures. There is no cross-phase mechanism for cumulative escalation in collision risk. WDA lifetime effects remain as **minor adverse** and **not significant** in EIA terms.
Introduction of marine invasive non-native species (INNS)	✓	✓	✓	The potential for the introduction or spread of INNS is present throughout the WDA lifetime because vessel activity occurs during all phases and because hard infrastructure (such as foundations, scour protection and cable protection) provides artificial substrates that can be colonised by marine fouling organisms. Key controls include mandatory hull-fouling management, vessel-cleaning protocols, compliance with the Ballast Water Management Convention, and full implementation of the Project's Invasive Non-Native Species Management Plan (INNSMP). These measures are designed to prevent the transport of viable propagules, reduce the risk of colonisation on newly introduced hard structures, and ensure rapid response procedures are in place should a suspected INNS be detected. As a result, even when INNS risk is considered across the full WDA lifetime, the potential for inter-related effects remains limited. There is no evidence that INNS-related impacts combine across phases in a way that would elevate ecological significance beyond the individual, phase-specific assessments. As such, effects do not accumulate across phases. WDA lifetime effects remain **minor adverse** at worst and **not significant** in EIA terms.
Changes in Fishing Activity	✓	✓	✓	Temporary displacement of fishing effort may occur during all phases of the WDA (e.g. safety zones), but these areas are small, short-lived and do not interact with other pressures to increase ecological significance. As such, effects do not accumulate across phases. WDA lifetime effects remain **negligible** and **not significant** in EIA terms.
Permanent Habitat Loss	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Electro-Magnetic Fields	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Introduction of Hard Substrate	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Receptor-led Effects				
Across the WDA lifetime, potential overlap between habitat disturbance, SSC increases, UWN, hard-substrate introduction and EMF exposure is limited in space and time, and these pressures generally occur in different phases				

Description of Impact	Phase	Likely Significant Inter-related Effects
or different parts of the WDA. All effects assessed individually were **negligible** to **minor adverse**, and no mechanism exists for these pressures to combine in a way that would elevate their significance. Fish and basking shark receptors are highly mobile and can readily avoid short-lived disturbances, while shellfish and other less mobile species experience localised and low-magnitude effects that dissipate quickly. Embedded mitigation, including noise controls, biosecurity measures, and micro-siting, further reduces any potential for combined or reinforcing effects. For these reasons, the small and short-term effects that occur during construction, O&M and decommissioning do not interact in a way that elevates their significance, and receptor-led inter-related effects remain **minor adverse** at worst and **not significant** in EIA terms.		

22.7.1.2.3 Marine Mammals

53. For marine mammals and leatherback turtle, a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.7**.

54. Impacts associated with construction piling noise, UXO clearance, operational turbine noise, and EMFs are either limited to a single WDA phase (for example, EMF effects occur only during the operational period) or are not expected to result in a higher level of effect than those assessed for each WDA phase individually. As such, **no significant** WDA-lifetime inter-related effects are anticipated for these impact pathways.

55. Because UWN, vessel disturbance, operational sound and prey-related changes occur at different times, over different spatial scales, and are further reduced through embedded mitigation and the high mobility of marine mammals, these pressures do not combine across phases to elevate their significance, and therefore **no significant** receptor-led inter-related effects are expected for marine mammals.

Table 22.7 Summary of Likely Significant Potential Inter-related Effects for Marine Mammals and Leatherback Turtle from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
UWN during geophysical surveys	✓	✓	✓	Geophysical surveys may occur during construction, O&M and decommissioning, but these activities are brief, intermittent, and highly localised. Although they occur across the project lifetime, they do not create overlapping acoustic footprints because they are separated spatially and temporally and disperse immediately once equipment is powered down. Marine mammals typically show only short-term avoidance and rapidly return to surveyed areas, preventing disturbances in one phase from carrying into another. As geophysical noise is low-intensity compared with piling and is not persistent enough to accumulate across phases, there is no mechanism through which

Description of Impact	Phase			Likely Significant Inter-related Effects
				lifetime exposures could interact or amplify. WDA lifetime effects therefore remain **minor adverse** at worst and **not significant** in EIA terms.
UWN during UXO clearance	✓	✗	✗	As this impact occurs during the construction phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Auditory injury from UWN during piling	✓	✗	✗	As this impact occurs during the construction phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Disturbance and behavioural impacts from UWN during piling	✓	✗	✗	As this impact occurs during the construction phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Auditory injury and behavioural impacts from non-piling activities	✓	✓	✓	Non-piling noise sources such as trenching, drilling, rock placement, and cable reburial occur intermittently across all phases. However, they are low-intensity, short-term and spatially limited, and their acoustic fields dissipate rapidly. Even where similar activities occur along cable routes during construction and later during O&M repairs, each event is independent, separated by long intervals and short in duration, preventing cumulative reinforcement. There is no mechanism for non-piling noise from different phases to interact in ways that elevate significance. WDA lifetime effects remain **minor adverse** at worst and **not significant** in EIA terms.
Auditory injury and behavioural impacts from vessel noise	✓	✓	✓	Vessels will be present throughout construction, O&M, and decommissioning, but movement patterns, vessel speeds, and operational roles differ between phases. Vessel noise is low-frequency, low-intensity, and transient, with animals typically showing minimal or brief behavioural reactions. Because vessel activity is dispersed in time and space and does not create persistent acoustic fields, exposures do not overlap between phases in a way that compounds disturbance. WDA lifetime effects remain **minor adverse** at worst and **not significant** in EIA terms.
Barrier Effects due to UWN	✓	✓	✓	Barrier effects require sustained or large-scale acoustic propagation that restricts movement. Across the WDA lifetime, noise sources are temporary, localised, and separated between phases. Construction produces the highest noise levels, but these are short-duration and

Description of Impact	Phase			Likely Significant Inter-related Effects
				tied to discrete locations, while O&M and decommissioning noise sources are substantially quieter. Marine mammals have wide movement ranges and multiple available pathways, with no single phase producing persistent or large-scale exclusion zones. Because no noise sources across the lifetime overlap sufficiently to create additive obstruction. WDA lifetime effects remain **minor adverse** and **not significant** in EIA terms.
Vessel interaction (collision risk)	✓	✓	✓	Although vessels are active throughout the WDA lifetime, collision risk remains low in every phase due to reduced speeds, predictable transit routes, and embedded mitigation (e.g., adherence to the Scottish Marine Wildlife Watching Code). Vessel operations in different phases do not interact or reinforce one another because they occur at different intensities and with different vessel types, and collision events do not accumulate temporally. Marine mammals are habituated to regional vessel traffic and typically avoid approaching vessels, further reducing lifetime interaction potential. WDA lifetime effects remain **minor adverse** and **not significant** in EIA terms
Disturbance at protected seal haul-out sites	✓	✓	✓	All protected seal haul-out sites lie well beyond the WDA footprint, and vessel routes remain several kilometres away in every phase. Because vessel movements during construction, O&M, and decommissioning do not spatially overlap with haul-out locations, and because any disturbance would be brief and non-repetitive, phase-to-phase interactions cannot occur. Seals demonstrate high resilience and rapid return rates following disturbance, so effects do not carry over into later phases. Accordingly, WDA-lifetime inter-related effects remain **minor adverse** and **not significant** in EIA terms.
Changes to prey availability	✓	✓	✓	Activities that may affect prey species such as sediment disturbance, temporary habitat alteration, or noise-related fish movements occur separately across the construction, O&M and decommissioning phases. These effects are localised and short-lived, with fish communities recovering quickly once disturbance ends. Because prey changes do not persist across phase boundaries and occur in isolated areas, there is no ecological pathway for small-scale effects in one phase to combine with later activities in ways that escalate impacts on predators. WDA lifetime effects remain

Description of Impact	Phase			Likely Significant Inter-related Effects
				minor adverse at worst and **not significant** in EIA terms.
UWN from operating WTG	✘	✓	✘	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Receptor-led Effects				
Across the full WDA lifetime, marine mammals may be exposed to a range of temporary pressures, including short-duration impulsive noise during construction, brief disturbance from vessel movements in all phases, low-level operational noise from turbines during O&M, and small-scale, temporary changes in prey distribution during both construction and maintenance works. These pressures, however, arise at different times, in different parts of the WDA, and at markedly different intensities. Because they do not coincide spatially or temporally, they cannot combine or reinforce one another in a way that would elevate effects on individual animals or populations. Marine mammals in the region are highly mobile, routinely moving through dynamic acoustic and ecological conditions. This mobility allows individuals to avoid short-term disturbances when they occur and return to the area once activity has ceased, preventing exposure from accumulating across phases. Importantly, none of the assessed pressures persist long enough to overlap with subsequent phases, and no effects on prey species have been identified that could give rise to indirect or trophic-level consequences. Embedded mitigation applied across all phases, including JNCC-compliant marine mammal protocols, ADD use and soft-start for piling (see **Appendix 9 Draft Marine Mammal Mitigation Protocol**) and vessel-management measures (see **Appendix 6 Outline Environmental Management Plan**), further limits the duration, extent and intensity of exposures. These measures ensure that pressures remain discrete, localised, and non-interactive across the lifetime of the Project. For these reasons, when considered across construction, O&M and decommissioning together, receptor-led inter-related effects remain **minor adverse** at worst **and not significant** in EIA terms.				

22.7.1.2.4 Ornithology

56. For ornithology, a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.8**.

57. Impacts associated with disturbance and displacement, prey-related effects, artificial lighting, collision risk, and operational habitat changes are either confined to a single WDA phase (for example, collision risk and prey mediated habitat change occur only during O&M) or occur as short-term, localised and reversible effects during construction and decommissioning. None of these pathways combine across phases in a manner that would increase the overall level of effect above that assessed for each phase individually. As such, **no significant** WDA-lifetime inter-related effects are anticipated for ornithology.

58. Because construction-related disturbance, decommissioning vessel activity, operational displacement, collision risks, artificial lighting, and prey-mediated changes arise at different times, operate over different spatial scales, and are further reduced through embedded mitigation and the high mobility of seabirds, these pressures do not act simultaneously or reinforce one another (over and above those impacts already assessed together, such as summed collision risk and displacement for species such as gannet and kittiwake). Seabird receptors therefore do not experience any elevation in risk due to combined or cross-phase interactions. Accordingly, **no significant** receptor-led inter-related effects are expected for ornithology.

Table 22.8 Summary of Likely Significant Potential Inter-related Effects for Ornithology from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Direct distributional responses, displacement and barrier effects	✓	✓	✓	Disturbance and displacement during construction and decommissioning are temporary, spatially limited, and reversible. These effects do not coincide with operational displacement, collision or barrier impacts, preventing cross-phase reinforcement. WDA lifetime effects remain **minor adverse** and **not significant** in EIA terms.
Indirect disturbance and displacement of prey species	✓	✓	✓	Prey-related changes are minor, short-lived, and constrained by the benthic and fish ecology findings. These effects do not interact with operational turbine presence or collision risk to elevate magnitude. WDA lifetime effects remain **negligible** and **not significant** in EIA terms.
Artificial lighting	✓	✓	✓	Artificial lighting at night, associated with vessels, temporary works, operational WTGs/OSPs and decommissioning activities may attract or disorient species such as Manx shearwater and European storm-petrel. During construction and decommissioning, sources of artificial lighting at night will be from vessels in the WDA and using transit corridors, as well as lighting associated with works in the WDA. This lighting is temporary and spatially limited. During operation, lighting will be primarily on Project infrastructure within the WDA but also some vessels. Lighting on infrastructure has the potential to cause attraction and/or disorientation which could elevate risk of collision or displacement mortality at night. Collision and displacement mortality during daylight for these species is very low. Infrastructure lighting is subject to strict controls through **Appendix 12 Outline Lighting and Marking Plan**. Operational lighting on infrastructure is minimal, highly regulated, and designed to avoid upward spill or unnecessary illumination. Because lighting pressures occur at different intensities across phases, do not coincide spatially or temporally, and are independently mitigated, they do not combine in a way that elevates overall risk. Accordingly, artificial-lighting effects across all phases remain **minor adverse** and **not significant** in EIA terms.
Collision risk	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Indirect habitat loss / change for prey species	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.

Description of Impact	Phase	Likely Significant Inter-related Effects
Receptor-led Effects		
Across the WDA lifetime, seabird receptors may be exposed to a range of pressures associated with construction, O&M, and eventual decommissioning of the WDA. Although these effects act through different ecological pathways, they do not overlap in a manner that would cause combined or amplified impacts on seabird populations. Construction phase pressures, such as temporary displacement from vessel activity, noise from piling or UXO clearance, and lighting from construction vessels, are short-term, spatially limited and reversible. Decommissioning activities result in broadly similar but generally lower-magnitude pressures, again confined to a limited time window. By contrast, operational phase pressures such as collision risk, long-term displacement and barrier effects occur within a stable and predictable array layout and do not coincide temporally with construction-related disturbance. Indirect effects on prey availability are minor, localised and ecologically constrained and therefore do not contribute to increased population-level risk when considered alongside operational ornithology impacts. Likewise, artificial lighting effects during construction and operation are, limited in scale, and do not interact with displacement or collision pathways in a way that elevates significance. Seabirds are generally highly mobile, capable of avoiding temporary disturbances and adjusting foraging activity across wide areas. This ecological resilience, combined with embedded mitigation ensures that seabird receptors are not exposed to simultaneous or reinforcing pressures across phases of the Project. For these reasons, and because the assessed effects occur either sequentially or through independent pathways that do not accumulate to increase pressure at the population scale, the receptor-led inter-related effects on ornithology remain **minor adverse** at worst and **not significant** in EIA terms.		

22.7.1.3 Human Environment

22.7.1.3.1 Commercial Fisheries

59. For commercial fisheries, a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.9**.

60. Impacts relating to changes in commercial fisheries are either highly localised, phase-specific, or do not interact in a way that increases their overall magnitude across construction, O&M and decommissioning. Therefore, **no significant** WDA lifetime inter-related effects are expected for commercial fisheries.

61. Similarly, because commercial-fisheries-related pressures occur at different times, over different spatial areas, and are further reduced through established mitigation and fleet adaptability, they do not combine across phases to elevate their significance, and therefore **no significant** receptor-led inter-related effects are expected for commercial fisheries.

Table 22.9 Summary of Likely Significant Potential Inter-related Effects for Commercial Fisheries from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Reduction in access to, or exclusion from the WDA	✓	✓	✓	Construction-related Safety Zones, seabed preparation and vessel activity temporarily restrict access to potting grounds, with much smaller, intermittent exclusions during O&M and decommissioning. Although exclusion occurs in all phases, these periods do not overlap in a

Description of Impact	Phase			Likely Significant Inter-related Effects
				way that increases the overall scale of foregone access. Construction effects are short-lived at any given location and operational constraints are limited to the footprint of infrastructure and occasional maintenance activities. Access restrictions therefore do not combine across phases to elevate significance. WDA lifetime remain **minor adverse** at worst and **not significant** in EIA terms.
Displacement leading to gear conflict and/or increased fishing pressure	✓	✓	✓	Temporary displacement from parts of the WDA occurs during construction and, to a lesser extent, during decommissioning. O&M-related displacement is minimal and highly localised. Because each phase affects different areas at different times, displaced effort does not accumulate or shift into the same adjacent grounds in a way that would materially increase long-term gear conflict or local fishing pressure. Vessels adapt to short-term exclusions and no mechanism exists for phase-to-phase reinforcement. WDA lifetime effects remain **minor adverse** at worst and **not significant** in EIA terms.
Displacement or disruption of commercial resources	✓	✓	✓	Short-term ecological disturbance (noise, sediment, vessel presence) during construction may temporarily influence the local distribution of some commercial species, with much smaller, highly localised influences during O&M and decommissioning. As these changes are spatially limited, brief in duration and dominated by construction-phase conditions, they do not accumulate across phases or reinforce one another in a way that would reduce catch rates at a wider scale. No stock-level or sustained availability effects are predicted. WDA lifetime effects remain **minor adverse** and **not significant** in EIA terms.
Increased Project vessel traffic leading to interference	✓	✓	✓	Vessel traffic is highest during construction, low and routine during O&M, and short-duration during decommissioning. These activity peaks occur at different times, so interference risks (encounters with gear, restricted manoeuvring space, visual presence) do not overlap or compound. Embedded measures (Navigational Safety Plan, Marine Coordination Centre, Notices to Mariners, guard vessels) ensure real-time coordination in all phases. As traffic levels fall between phases, there is no pathway for cross-phase intensification. WDA lifetime effects remain **minor adverse** at worst and **not significant** in EIA terms.
Gear snagging leading to loss of earnings	✓	✓	✓	Potential snagging risk arises mainly from exposed construction equipment and partially installed subsea assets during construction and decommissioning. During O&M, properly buried or charted infrastructure greatly reduces risk. Because O&M has the lowest snagging potential and no additional snagging hazards are introduced later in the WDA lifetime, risks do not

Description of Impact	Phase			Likely Significant Inter-related Effects
				accumulate or escalate across phases. Cable burial, minimal surface protection and charting ensure snagging remains low throughout. WDA lifetime effects remain **minor adverse** and **not significant** in EIA terms.
Receptor-led Effects				
Across the WDA lifetime, fisheries pressures (exclusion, displacement, vessel interactions, resource disturbance, snagging risk) arise at different times and at different scales. None overlap in a way that reinforces or amplifies effects. The highly adaptive nature of local fleets, combined with extensive embedded mitigation (cable burial, Safety Zones management, communication protocols, Fisheries Liaison Officer / Fisheries Mitigation, Monitoring and Communication Plan), prevents multi-phase interactions from elevating significance. For these reasons, receptor-led inter-related effects remain **minor adverse** at worst and **not significant** in EIA terms.				

22.7.1.3.2 Shipping and Navigation

62. For shipping and navigation, a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.10**.

63. Effects related to vessel displacement and associated collision risk occur only during construction and decommissioning, are temporary and spatially limited, and do not interact with O&M-phase activities in a way that would elevate their magnitude across the project lifecycle. Therefore, **no significant** WDA lifetime inter-related effects are expected for shipping and navigation.

64. Because navigation-related pressures occur at different times, over different spatial areas, and are experienced within an environment where mariners routinely adapt to changing conditions, these effects do not overlap or reinforce one another across project phases, and therefore **no significant** receptor-led inter-related effects are expected for shipping and navigation.

Table 22.10 Summary of Likely Significant Potential Inter-related Effects for Shipping and Navigation from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Vessel displacement and increased third-party vessel to vessel collision risk	✓	✓	✓	Displacement occurs in all phases but at **different times**, with construction and decommissioning generating temporary buoyed areas and O&M generating only occasional maintenance-related constraints. Deviations affect approx. six vessels per week with <0.4% route-length increase, and sufficient searoom exists both east and west of the WDA. Although displacement during construction/decommissioning coincides with low-level displacement during O&M, the spatial and temporal patterns do not overlap in a way that reinforces collision risk. Collision frequencies remain extremely low (e.g. post-windfarm return period ~1 in 1,748 years). WDA lifetime inter-related effects remain **Tolerable with mitigation** and **not significant** in EIA terms.

Description of Impact	Phase			Likely Significant Inter-related Effects
Increased third-party vessel to project vessel collision risk	✓	✓	✓	Each phase has different levels of project vessel presence (up to 1,140 movements/year in construction/decommissioning; 423/year in O&M), but these do not combine to elevate overall lifetime risk because vessel activity is not concurrent across phases. Marine coordination, safety zones, advisory passing distances, Automatic Identification System carriage and COLREGs compliance operate consistently throughout all phases. No mechanism exists for phase-on-phase intensification of collision risk. WDA lifetime inter-related effects remain **Broadly Acceptable** and **not significant** in EIA terms.
Reduced access to local ports and harbours	✓	✓	✓	Deviations around the WDA slightly alter approaches for a very small subset of vessels. The nearest port (Port Ellen) lies ~24 nm away, and regular Glensanda vessels primarily use the Sound of Mull, unaffected by the WDA. Across phases, deviations occur only during construction/decommissioning and are very low-magnitude. These do not accumulate with the low-intensity O&M vessel activity, nor do they constrain port approaches. WDA lifetime inter-related effects remain **Broadly Acceptable** and **not significant** in EIA terms.
Reduction of emergency response capability	✓	✓	✓	The presence of infrastructure could theoretically constrain Search and Rescue (SAR) operations, but design spacing (min 944 m), lighting/marking, SAR checklist compliance, and Emergency Response Co-operation Plan procedures including potential of assistance from project vessels where appropriate will facilitate SAR response in all phases. Temporary construction/decommissioning buoyed areas do not spatially overlap with O&M in a way that would reinforce reductions in capability. Any constraints are short-term, isolated, and do not combine across phases. WDA lifetime inter-related effects remain **tolerable with mitigation and as low as reasonably practicable (ALARP)** and **not significant** in EIA terms.
Vessel-to-structure allision risk	✓	✓	✓	Allision mechanisms differ by phase (e.g., temporary construction vessels vs. fully installed WTGs during O&M), but they do not compound over time. Allision modelling shows extremely low return periods (e.g. powered allision ~1 in 4,231 years; drifting allision ~1 in 15,680 years). The same embedded mitigation (marking, lighting, COLREGs, marine coordination) applies consistently across all phases, preventing escalation of risk over the WDA lifetime. Lifetime inter-related effects remain **Tolerable with mitigation and ALARP** at worst and **not significant** in EIA terms.
Reduction of under keel clearance	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Anchor interaction with subsea cables	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.

Description of Impact	Phase	Likely Significant Inter-related Effects
Receptor-led Effects		
Across the WDA lifetime, vessel users may intermittently experience deviations (during construction and decommissioning) and occasional interaction with project vessels (during O&M). However, these occur at different times, over different spatial footprints, and are greatly reduced during O&M before re-emerging briefly in decommissioning. Mariners routinely adapt to environmental/operational conditions, and the area has low historic incident rates. No phase-to-phase reinforcement occurs. For these reasons, receptor-led inter-related effects remain **Tolerable with mitigation and ALARP** and **not significant** in EIA terms.		

22.7.1.3.3 Offshore Archaeology and Cultural Heritage

65. For offshore archaeology, a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.12**.

66. Effects relating to offshore archaeology and cultural heritage are either confined to a single phase or do not interact across construction, O&M and decommissioning in a way that would increase their overall magnitude, meaning WDA lifetime inter-related effects are expected to remain as ranging between **no change** and **major adverse**, therefore effects are both **not significant** and **significant** in EIA terms.

67. Because archaeological receptors experience different types of pressures at different times, with all known assets avoided through AEZs and any potential finds managed through established protocols, these effects do not overlap or reinforce one another across phases, and therefore receptor-led inter-related effects remain as ranging between **no change** and **major adverse**, therefore effects are both **not significant** and **significant** in EIA terms.

Table 22.11 Summary of Likely Significant Potential Inter-related Effects for Offshore Archaeology from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Direct Impacts to Heritage Assets	✓	✓	✓	Across the WDA lifetime, the Project could disturb the seabed and therefore risk direct impacts on heritage assets. However, all known assets, such as the wreck of the Eli and other identified anomalies, are completely protected through Archaeological Exclusion Zones (AEZs), which stay in place for the entire life of the Project. This means no direct impacts on known heritage assets are expected at any stage. For unknown or potential assets, any discoveries would be isolated finds rather than whole sites, and these would be managed through the Protocol for Archaeological Discoveries. Because each phase of the Project affects different areas of seabed at different times, impacts do not overlap or build on one another. As a result, there is no combined or escalating risk across the Project’s lifetime. Overall, direct impacts remain very limited, with no effect on known assets and only minor, low-level effects possible for any unexpected finds. WDA lifetime effects remain **minor adverse** and **not significant** in EIA terms.

Description of Impact	Phase			Likely Significant Inter-related Effects
Indirect impact to heritage assets associated with changes to physical processes	✓	✓	✓	Across the WDA lifetime, construction, O&M and decommissioning each give rise to temporary or localised changes in SSCs, seabed levels and bedload transport, these changes are small in magnitude, highly localised, and insufficient to expose or degrade buried archaeological material. Because these physical-process effects occur independently in time, affect different spatial footprints, and are too small to alter preservation conditions, they do not combine across phases in a way that increases archaeological risk. WDA lifetime effects remain **no change** and **not significant** in EIA terms.
Change to the setting of heritage assets	✓	✓	✓	Effects on the setting of designated coastal heritage assets arise almost entirely from the presence of turbines during O&M, with construction and decommissioning contributing only temporary, short-lived activity that is visually read as transient. The setting effects do not reinforce one another across phases, because construction and decommissioning change only movement/activity, not long-term visual context. The long-term change in views occurs only during O&M, when infrastructure is in place, the magnitude of setting change is static, not cumulative with other phases and temporary vessel/helicopter presence does not materially compound the operational baseline. Where moderate or major setting effects are predicted for a small number of high-sensitivity assets (e.g. Beinn a' Chaisteil, Dun Bheolain, Iona Abbey, Dubh Artach Lighthouse), these effects stem solely from the operational turbine presence, not from cross-phase interactions. Accordingly, WDA lifetime effects remain as up to **major adverse**, and at this level are considered **significant** in EIA terms.
Receptor-led Effects				
Across the WDA lifetime, archaeological receptors may experience different pressures at different times: temporary seabed disturbance and vessel activity during construction and decommissioning, and long-term visual change or limited seabed intervention during O&M. However, these pressures occur at different times, have distinct mechanisms of effect, are independently mitigated and do not overlap to increase vulnerability for any receptor. Known heritage assets will be fully avoided through Archaeological Exclusion Zones (AEZs), resulting in **no change** across all phases. Potential assets, principally isolated finds, may encounter occasional risk during intrusive works, but these occur within tightly managed Protocol for Archaeological Design procedures and do not aggregate across the Project lifetime. Similarly, setting effects reflect a single, long-term operational change and are not amplified by short-term construction/decommissioning activity. For these reasons, receptor-led inter-related effects remain as up to **major adverse**, and at this level are considered **significant** in EIA terms.				

22.7.1.3.4 Military and Civil Aviation

68. For military and civil aviation, a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.12**.

69. Impacts associated with aviation obstacles during construction, operation and decommissioning occur sequentially rather than concurrently and therefore do not interact across phases to increase their overall magnitude, meaning WDA lifetime inter-related effects remain as up to **major adverse**, and at this level are considered **significant** in EIA terms.

70. Similarly, because military and civil aviation-related pressures arise at different times, affect different spatial areas, and are subject to established regulatory safeguards and dedicated mitigation, they do not combine across project phases to elevate risk, and therefore receptor-led inter-related effects remain as up to **major adverse**, and at this level are considered **significant** in EIA terms.

Table 22.12 Summary of Likely Significant Potential Inter-related Effects for Military and Civil Aviation from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Creation of an aviation obstacle environment – installation of above sea level infrastructure obstructing low flying aircraft; WTGs and OSPs obstructing low flying aircraft; removal of above sea level infrastructure obstructing low flying aircraft.	✓	✓	✓	During construction and decommissioning, temporary aviation obstacles arise from heavy-lift crane vessels and the progressive installation or removal of WTGs and OSPs. During O&M, these obstacles become fixed and long-term as the full turbine array and OSPs remain in place. These pressures occur sequentially rather than simultaneously, and therefore do not interact or reinforce one another across phases. As a result, no meaningful inter-phase amplification of effect occurs. Accordingly, WDA lifetime effects remain as up to **minor adverse**, and at this level are considered **significant** in EIA terms.
Increased air traffic in the area related to Project activities	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Impact on Civil PSR Systems	✗	✓	✗	As this impact occurs during the O&M phase, no WDA lifetime effects of significance are expected to arise across the full lifetime of the WDA.
Receptor-led Effects				
Across the WDA lifetime, aviation users, may experience different aviation pressures at different times. Construction and decommissioning introduce a temporary and evolving obstacle environment, while O&M presents a stable long-term obstacle envelope and occasional maintenance helicopter traffic. Radar-related pressures arise only during O&M and are fully mitigated through the Tiree Indra Primary Surveillance Radar (PSR) upgrade agreed with National Air Traffic Services and MoD. Because these effects occur at different times, affect different spatial areas, and are independently mitigated, they do not combine across phases to elevate risk. Aviation users operate within a highly regulated environment, with established procedures for obstacle avoidance, Instrument Flight Procedure safeguarding, Class G see-and-avoid, and SAR coordination, all of which provide resilience to individual and compound pressures. For these reasons, receptor-led inter-related effects remain as up to **minor adverse**, and at this level are considered **significant** in EIA terms.				

22.7.1.3.5 Seascape, Landscape and Visual Impacts

71. For Seascape, Landscape and Visual Impact Assessment (SLVIA), a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.14**.

72. Effects on recreational visual receptors during construction, O&M and decommissioning occur sequentially, are experienced as separate and time-bound sources of visual change, and do not

interact across phases to increase their magnitude; therefore, WDA lifetime inter-related effects remain as up to **major adverse**, and at this level are considered **significant** in EIA terms.

73. Similarly, because visual influences on receptors occur at different times, over different distances, and under varying visibility conditions, they do not overlap or reinforce one another across project phases, and therefore receptor-led inter-related effects remain as up to **major adverse**, and at this level are considered in **significant** in EIA terms.

Table 22.13 Summary of Likely Significant Potential Inter-related Effects for SLVIA from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Effects on recreational visual receptors	✓	✓	✓	Across the lifetime of the Project, the construction, O&M, and decommissioning phases each influence the seascape, landscape and visual environment in different ways. Construction and decommissioning give rise to temporary and evolving visual change associated with the presence of installation or removal vessels, crane operations, and partially erected or dismantled turbines. These effects diminish as each phase progresses and do not coincide in time with the long-term operational presence of complete WTGs and OSPs. During operation, the visual environment is characterised by the stable and predictable presence of the full turbine array, occasionally supplemented by maintenance vessel activity. Because these effects arise in sequence rather than simultaneously, and because each phase is contained within a discrete temporal window, they do not combine or reinforce one another. Consequently, no inter-phase amplification occurs, and the overall level of effect is no greater than that assessed for each individual phase in **Chapter 16 Seascape, Landscape and Visal Impact Assessment**. Accordingly, WDA lifetime effects remain as up to **major adverse** and at this level are considered **significant** in EIA terms.
Receptor-led Effects				
Across the WDA lifetime, recreational visual receptors may experience different types of visual influence at different times. During construction and decommissioning, receptors are exposed to a temporary and evolving pattern of visual change arising from installation or removal vessels, crane activity and partially erected or dismantled WTGs. During O&M, this temporary influence is replaced by a stable, long-term visual presence as the completed turbine array becomes a consistent element in outward coastal views, with occasional maintenance vessel movements providing intermittent additional activity. Night-time visual change is confined to the operational phase, as construction and decommissioning do not introduce an equivalent lighting environment. Because these effects occur at different times, are experienced over different distances, and diminish or intensify in line with well-understood visibility constraints such as coastal orientation, landform screening and atmospheric clarity, they do not combine across phases in a way that could elevate visual impact. Receptors with the greatest sensitivity, those on Colonsay, Oronsay and parts of northwest Islay, experience operational effects that are already fully captured within the phase-specific assessment, and these are not intensified by earlier or later phases. More distant receptors on Mull, Iona, Jura, Scarba, Tiree and Coll experience reduced or intermittent visibility, ensuring no opportunity for visual effects from separate phases to compound.				

Description of Impact	Phase	Likely Significant Inter-related Effects
In conclusion, the significance of receptor-led inter-related effects to SLVIA is not anticipated to exceed the magnitude of change (and therefore overall significance of effect). Therefore, receptor-led effects remain as up to **major adverse**, and at this level are considered **significant** in EIA terms.		

22.7.1.3.6 Infrastructure and Other Marine Users

74. For infrastructure and other marine users, a WDA lifetime inter-related effects and receptor-led inter-related effects assessment is presented in **Table 22.14**.

75. Impacts associated with infrastructure and other marine users during construction, operation and decommissioning occur sequentially rather than simultaneously and therefore do not interact across phases to increase their magnitude, meaning **no significant** WDA lifetime inter-related effects are expected for infrastructure and other marine users.

76. Similarly, receptor-led effects arise at different times, affect different spatial areas, and are independently mitigated across all phases of the Project, meaning these pressures do not reinforce one another and **no significant** receptor-led inter-related effects are expected for infrastructure and other marine users.

Table 22.14 Summary of Likely Significant Potential Inter-related Effects for Infrastructure and other Marine Users from individual effects occurring across the construction, O&M and decommissioning phases of the WDA (WDA Lifetime Effects) and from multiple effects interacting across all phases (Receptor-led Effects)

Description of Impact	Phase			Likely Significant Inter-related Effects
	C	O&M	D	
WDA Lifetime Effects				
Disruption to Ministry of Defence maritime navigational interests (including exercise areas for training and defence maritime navigational interests)	✓	✓	✓	Across the lifetime of the Project, the construction, O&M, and decommissioning phases each influence Ministry of Defence (MoD) maritime navigational interests in different ways. During construction and decommissioning, temporary and evolving restrictions arise from the presence of installation or removal vessels, rolling safety zones, and short-term construction activities. These effects diminish as each phase progresses and do not coincide in time with the long-term operational presence of fixed WTG and OSP infrastructure. During operation, the navigational environment is characterised by the stable and predictable presence of the turbine array, supplemented only occasionally by maintenance vessels and intermittent 500 m safety zones around major maintenance activities. Because these effects arise sequentially and remain spatially limited, they do not combine or reinforce one another. Embedded procedures such as vessel coordination, safety zoning, charting, lighting/marking, and continued engagement with the MoD ensure that no cross-phase amplification of effect occurs. Accordingly, the WDA lifetime effects on MoD maritime navigational interests remain **minor adverse and not significant** in EIA terms, and are no greater than those assessed for each phase individually.

Description of Impact	Phase			Likely Significant Inter-related Effects
Limitation of access and displacement of recreational charter angling and wildlife tours	✓	✓	✓	Throughout the Project lifetime, the construction, O&M, and decommissioning phases affect recreational angling and wildlife tour activity in different and time-bound ways. Construction and decommissioning introduce temporary and shifting restrictions associated with construction vessels, short-term safety zones, and phased installation or removal of offshore infrastructure. These changes occur progressively and reduce as each phase concludes. During operation, the environment becomes stable, with predictable turbine spacing enabling continued transit and activity within the WDA, interrupted only occasionally by maintenance vessels or limited-scale temporary safety zones. Recreational activity in this area is inherently flexible, and operators can readily adjust routes or target areas during periods of temporary constraint. Because the timing and spatial extent of these effects do not overlap in a way that compounds or reinforces them, and because each phase occupies a discrete temporal window, no inter-phase amplification arises. Embedded measures such as advance notifications, charting and safe-routeing information further reduce the potential for combined effects. Accordingly, lifetime inter-related effects on recreational charter angling and wildlife tours remain **minor adverse** and **not significant** in EIA terms, with no greater effect than assessed for individual phases.
Receptor-led Effects				
Across the lifetime of the WDA, infrastructure and other marine users encounter different pressures during the construction, O&M, and decommissioning phases. During construction and decommissioning, temporary and evolving conditions arise from vessel activity, rolling safety zones, installation or removal operations, and the incremental presence or reduction of offshore structures. These conditions change progressively as each phase advances and do not coincide with the long-term, predictable operational footprint of the completed WTG and OSP infrastructure. During the operational phase, the marine environment becomes stable, defined by fixed turbine spacing, clearly marked structures, and intermittent vessel movements associated with planned and unplanned maintenance. Access arrangements, safety zones for major maintenance, and navigational procedures are well established, and marine users continue to operate within an environment that is charted, regulated, and supported by embedded mitigation such as Notices to Mariners, vessel coordination, lighting and marking, and adherence to navigational safety protocols. Because the pressures experienced by marine users arise at different times, affect different spatial extents, and are each subject to phase-specific mitigation, they do not overlap or reinforce one another across the Project lifetime. Marine users, including commercial operators, recreational vessels, and the MoD, operate within regulatory frameworks that incorporate routeing flexibility, vessel traffic procedures, established safety practices and, where relevant, ongoing engagement between the Applicant and maritime authorities. These features provide resilience to both isolated and combined pressures. As a result, there is no inter-phase amplification of effects, and receptor-led inter-related effects for infrastructure and other marine users remain **minor adverse** and **not significant** in EIA terms.				

22.7.1.3.7 Socio-economics

77. The socio-economics assessment incorporates relevant findings from other technical chapters where these create pathways to socio-economic outcomes. As set out in **Chapter 18 Socio-economics**, the following technical chapters provide inputs to the socio-economics assessment where their effects may influence employment, communities, housing, labour markets, infrastructure, tourism or wider economic activity:

- **Chapter 12: Commercial Fisheries** – potential changes to commercial fisheries activity that may affect employment, ancillary businesses and the wider supply chain feeding into socio-economic outcomes;
- **Chapter 13: Shipping and Navigation** – changes to vessel movements and port usage that could have secondary socio-economic implications through effects on marine operations, access and tourism;
- **Chapter 16: SLVIA** – visual and landscape changes that may have an influence on visitor behaviour and tourism-related socio-economic activity; and
- **Chapter 17: Infrastructure and Other Marine Users** – interactions with marine and coastal infrastructure that may affect coastal tourism, recreational users and local socio-economic conditions.

78. These inter-relationships have been considered as relevant within the socio-economics assessment. As stated in Section 18.13 of **Chapter 18 Socio-economics**, the socio-economics chapter integrates effects from these topics where a valid socio-economic receptor pathway exists.

79. There are no inter-related effects identified in which socio-economic effects themselves give rise to secondary environmental effects.

22.7.1.3.8 Greenhouse Gas Assessment

80. The effects identified in other technical chapters do not create pathways leading to effects on greenhouse gas (GHG) emissions. The receptor for the GHG assessment is the global atmosphere, and no other topic assessed in the EIAR has a direct effect on this receptor. There are therefore no inter-relationships with other topics for the purposes of the GHG assessment.

81. There are no inter-related effects identified in which GHG effects give rise to secondary environmental effects.

22.7.1.3.9 Climate Change Risk Assessment

82. The impact of climate change occurs throughout the Project lifetime, and the Climate Change Risk (CCR) assessment has therefore considered effects across the construction, O&M and decommissioning phases. As each phase involves different activities and is exposed to different climate-related hazards, there is no potential for the assessment of effects to alter should Project lifetime stages interact. The CCR assessment independently evaluates exposure, vulnerability and risk for each phase, and the outcomes are not affected by sequential or overlapping phases.

83. The CCR assessment differs from other technical assessments within the EIAR because, rather than examining effects on environmental receptors, it assesses the effects of climate change on the Project itself. The receptor in this assessment is the WDA infrastructure and associated activities, and not environmental or socio-economic receptors. No receptor-led inter-relationships arise, as no other environmental topics influence the climate risks assessed in this chapter.

22.7.2 Combined Assessment

84. While cumulative effects from other offshore developments are assessed within the topic-specific chapters (**Section 22.6.2.1**), the potential for combined effects arising specifically from interactions between the WDA, the Offshore ECC and OnTDA is considered in this section, considering both lifetime effects from the WDA and receptor-led effects, where effects from the two components may overlap. As outlined in **Section 22.6.1.1.3**, this combined assessment examines instances where effects from both components may overlap spatially or temporally and therefore act together on the same receptors.

85. At this stage of the Project, the Offshore ECC and OnTDA remains at an early stage of design, and a full standalone EIA has not yet been undertaken. As such, detailed construction methodologies and precise spatial footprints are still to be confirmed. However, based on the preliminary design parameters set out in Section 3.7.1, **Chapter 3 Project Description**, installation of the offshore export cable(s) is anticipated to involve activities that are typical of comparable subsea cable projects, such as linear trenching, pre-lay grapnel runs, localised seabed preparation (including potential sandwave levelling), and cable lay and burial operations. These activities are expected to be temporary, spatially constrained and highly reversible, and therefore provide an appropriate basis for evaluating how Offshore ECC pressures may interact with WDA lifetime effects.

86. Given the current level of design information, the Offshore ECC is not expected to generate meaningful cumulative effects with the WDA, except in the immediate vicinity of the WDA boundary where limited spatial overlap may occur. Any such interaction would be short in duration, reflecting the linear nature of cable installation, and restricted to small, discrete areas. The combined footprint would therefore represent only a very small proportion of both the WDA and the wider Offshore ECC corridor.

87. When considered in the context of WDA lifetime effects, the scale of disturbance associated with Offshore ECC installation is predicted to be equal to or less than that for the WDA alone, particularly as the Offshore ECC involves substantially fewer cable-installation activities within any given area and does not require foundation installation. Effects such as temporary seabed disturbance, sediment mobilisation and trenching impacts are expected to be short-lived, highly localised and fully recoverable, mirroring the impact profiles already assessed for cable works within the WDA.

88. Disturbance within the OnTDA will comprise of terrestrial and intertidal works associated with onshore cable installation and connection infrastructure, as described in Section 7.3.2 of **Chapter 3 Project Description**. Potential effects arising from the OnTDA are therefore spatially confined to intertidal and land-based environments which do not overlap spatially with marine receptors within the WDA. Where an intertidal landfall method is required, construction activities would be temporary, localised and undertaken over a short duration, consistent with standard trenching and reinstatement practices. Given the separation distance between the WDA and the OnTDA (in excess of 150 km), there is no scope for direct spatial interaction, temporal overlap or additive effects on the same receptors, including mobile receptors such as fish, marine mammals or seabirds.

89. Construction within the WDA will be undertaken intermittently over the up to five-year offshore construction period, with only a fraction of the total worst-case scenario footprints being realised at any one time. Any temporal overlap with Offshore ECC or OnTDA construction would be limited in extent, likely affecting only short cable sections within the Offshore ECC close to the WDA boundary and for brief periods. From a receptor-led perspective, this means the opportunity for compounding or additive effects is minimal.

90. Overall, the combined assessment of WDA lifetime effects and receptor-led effects with both the Offshore ECC and the OnTDA shows that any overlapping effects are expected to be localised, short term, intermittent and highly reversible. For the Offshore ECC, limited spatial overlap may occur close to the WDA boundary, while for the OnTDA no spatial or receptor overlap with the WDA is predicted. Given the low magnitude of additional disturbance associated with the Offshore ECC and OnTDA and the receptor sensitivities identified in the relevant technical chapters, the combined inter-related effects of WDA, Offshore ECC and OnTDA activities are assessed as **minor adverse** and **not significant** in EIA terms. When the Offshore ECC and OnTDA progress to their own EIA stages, those assessments will incorporate the findings of the WDA EIAR and provide updated combined assessments using refined project information.

22.8 PART TWO: ECOSYSTEM BASED EFFECTS ASSESSMENT

22.8.1 Overview

91. An ecosystem comprises a community of living (biotic) organisms interacting with non-living (abiotic) elements of their environment, connected through nutrient cycles and energy flows (Odum & Barrett, 2005). In marine ecosystems, biotic components include plankton, seaweed, benthic communities, fish, shellfish, seabirds, and marine mammals, while abiotic components consist of air, salt water, seabed materials, and rock.

92. Biodiversity refers to the variety of genomes, species, and ecosystems within a defined geographic area (Naeem et al., 2012). It serves as a key indicator of ecosystem health, with greater species diversity enhancing resilience to external pressures such as climate change and human activity. Ecosystems with broader biodiversity are more likely to adapt and maintain functionality despite disturbances (Oliver et al., 2015).

93. This ecosystem-based assessment aims to qualitatively evaluate the potential effects of the WDA at the ecosystem level, focusing on how changes in predator-prey dynamics may influence overall ecosystem function.

22.8.2 Ecosystem Baseline

94. This section provides an overview of both the non-living (abiotic) and living (biotic) elements of the marine ecosystem as they relate to the WDA. For the assessment, Study Areas will be defined differently according to each specific topic.

95. The WDA is a 448 km^2 area located off the west coast of Scotland, 15 km northwest of Islay and 12.4 km west of Colonsay. Water depths within the WDA range from approximately 21.6 m to 81.7 m, with a gently undulating seabed shaped by strong tidal currents and an exposed wave climate. These hydrodynamic conditions contribute to a naturally mobile seabed, and maximum tidal excursion modelling indicates that suspended sediment can disperse several kilometres beyond the WDA, informing the spatial extent of subsequent ecological assessments.

96. The seabed substrate is dominated by circalittoral sands, interspersed with slightly gravelly sand, gravelly sand, coarse sediment, and localised patches of cobbles and boulders. Recent geophysical and site-investigation surveys identified a variety of morphological features typical of dynamic shelf environments, including sandwaves, megaripples, areas of shell-rich sediment, and occasional bedrock outcrops. Shallow depressions and infilled channels also occur across parts of the WDA. These seabed forms reflect the influence of tidal currents and wave action and provide a heterogeneous physical environment for benthic communities (see **Chapter 7 Marine Physical Environment**).

97. The benthic habitats within the WDA are characteristic of offshore circalittoral environments and comprise three key biotope complexes: offshore circalittoral sand, offshore circalittoral coarse sediment, and echinoderm- and crustose-dominated circalittoral rock communities. These habitats support diverse infaunal and epifaunal assemblages.

98. Polychaete worms such as *Lanice conchilega* and *Spiophanes bombyx* are common across sandy sediments, while echinoderms, including the burrowing heart urchins *Spatangus purpureus* and *Echinocardium cordatum*, form an important component of benthic biomass. Sessile fauna, including hydroids and bryozoans (e.g. *Flustra foliacea*), occur in areas where gravel, cobbles or boulders provide stable surfaces for attachment.

99. A notable feature of the benthic assemblage is the presence of ocean quahog (*Arctica islandica*), a Priority Marine Feature and OSPAR Threatened & Declining species. Both adult and juvenile individuals were recorded at several stations, indicating available habitat suitable for long-lived bivalves of conservation importance. Potential stony reef features were identified near, but not within, the WDA footprint. A summary of the broad habitat types and associated species is provided in **Chapter 8 Benthic Ecology**.

22.8.2.1 The Marine Food Web

100. Trophic levels represent the hierarchical positions organisms occupy within a food web (Lindeman, 1942). In marine ecosystems, primary producers such as phytoplankton and seaweed form the base of the trophic structure. These are consumed by primary consumers, including zooplankton, copepods, and molluscs (Field et al., 1998). Secondary consumers, such as fish larvae, herring (*Clupea harengus*), lesser sandeel (*Ammodytes marinus*), and certain crustaceans feed on both primary producers and consumers. These species, in turn, support tertiary consumers like larger fish and cephalopods (e.g. squid and octopus). At the top of the marine food web are apex predators, including seabirds, marine mammals, large fish, and elasmobranchs such as sharks, skates, and rays.

101. The Local and Regional Fish and Shellfish Study Areas support a diverse assemblage of pelagic, demersal and shellfish species. Key forage fish, sandeel, herring, sprat *(Sprattus sprattus)*, whiting *(Merlangius merlangus)*, blue whiting *(Micromesistius poutassou)*, and Norway pout *(Trisopterus esmarkii)*, occur widely, with multiple sandeel species confirmed through site-specific grab sampling and Drop-Down Video analysis. Sediment particle size data show that much of the WDA comprises preferred sandeel habitat, explaining their presence across several survey stations.

22.8.3 The Key Predator Species

102. **Chapter 9 Fish (including Basking Shark) and Shellfish**, **Chapter 10 Marine Mammals and Leatherback Turtle** and **Chapter 11 Offshore Ornithology** provide details on the fish, marine mammals and seabirds which are most abundant in the associated topic Study Areas and are the receptors most likely to be impacted by activities associated with all phases of the WDA. From information on these receptor groups it is possible to ascertain which fish, seabird and marine mammal species are likely to be key predators in the marine ecosystem within the Study Areas outlined in **Section 22.5**.

22.8.3.1.1 Piscivorous Fish

103. A broad assemblage of predatory fish is expected to utilise habitats within and in proximity to the WDA. Species such as cod *(Gadus morhua)*, haddock *(Melanogrammus aeglefinus)*, whiting *(Merlanguis merlangus)*, ling *(Molva molva)*, monkfish *(Lophius piscatorius)*, plaice (*Pleuronectes platessa*) and European hake *(Merluccius merluccius)* form an important upper-trophic group in this

region. These species feed primarily on small forage fish, including sandeel, juvenile gadoids, sprat, herring, and other pelagic schooling species, as well as crustaceans and benthic invertebrates (Chassot et al., 2008).

104. Elasmobranch species also contribute to the predator community. Spurdog *(Squalus acanthias)*, thornback ray *(Raja clavate)*, flapper skate *(Dipturus intermedius)*, common skate *(Dipturus floassada)*, and other rays occur in the wider Study Area and feed on a similar suite of prey, including small demersal fish, forage species and crustaceans (McAllister & Fraser, 2023). These species are of particular ecological interest given their slow growth rates and, for some species, conservation sensitivity (Thorburn et al., 2018).

105. In addition to resident predators, several diadromous species, notably Atlantic salmon *(Salmo salar)* and sea trout *(Salmo trutta)*, migrate through the Regional Study Area, feeding opportunistically on small pelagic species as they move between freshwater and open ocean habitats (Malcolm et al., 2010). Although they occur only transiently offshore, they interact with the wider trophic system during key migratory periods.

22.8.3.1.2 Marine Mammals

106. Marine mammal predators form an important component of the pelagic ecosystem of the wider regional area including the WDA. The most abundant species recorded within the Study Area, and therefore most likely to interact with the WDA are harbour porpoise *(Phocoena phocoena)*, common dolphin *(Delphinus delphis)*, bottlenose dolphin *(Tursiops truncatus)*, minke whale *(Balaenoptera acutorostrata)*, and grey seal *(Halichoerus grypus)*. Occasional sightings of fin whale *(Balaenoptera physalus)*, humpback whale *(Megaptera novaeangliae)*, killer whale *(Orcinus orca)* and Risso's dolphin *(Grampus griseus)* demonstrate additional, though less frequent, predator presence (**Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**).

107. These predators rely on a prey base dominated by sandeel, herring, sprat, whiting, and other schooling fish, supplemented in some cases by cephalopods and crustaceans (Waggitt et al. 2019; Jones et al. 2022; Russell et al. 2023). Their foraging behaviour and seasonal distribution patterns closely reflect the availability and distribution of these mid-trophic species, and this relationship is considered further in the marine food web and receptor-specific assessments.

108. Occasional records of larger or less frequently encountered species, including fin whale, humpback whale, killer whale, and Risso's dolphin, indicate wider ecological connectivity, although these species occur in low numbers and play a more limited role in defining the local predator assemblage (**Appendix 10.2 Marine Mammals and Leatherback Turtle Baseline**).

22.8.3.1.3 Seabirds

109. Seabirds form a major component of the upper-trophic predator community within the marine ecosystem of the WDA and wider regional Study Areas. **Chapter 11 Offshore Ornithology** identifies a suite of abundant and regularly occurring species that utilise the waters around the WDA for foraging, commuting, migration, and resting. These species collectively represent key marine predators that exert significant ecological influence on pelagic food webs.

110. The most numerous and consistently recorded species within the WDA are kittiwake (*Rissa tridactyla*), guillemot (*Uria aalge*), razorbill (*Alca torda*), puffin (*Fratercula arctica*), fulmar (*Fulmarus glacialis*) and gannet (*Morus bassanus*). Each of these species feeds extensively on small pelagic schooling fish such as sandeel, sprat, herring and juvenile gadoids, as well as other mid-trophic marine organisms including small crustaceans and cephalopods. These species forage widely

across shelf waters, often making large-scale movements during the breeding and non-breeding seasons in response to prey availability.

111. A second assemblage of species, including great black-backed gull (*Larus marinus*), herring gull (*Larus argentatus*), common gull (*Larus canus*), Arctic tern (*Sterna paradisaea*), common tern (*Sterna hirundo*) and great skua (*Stercorarius skua*), also contributes to the predator community. These species display mixed foraging strategies, ranging from pursuit-diving and plunge-diving to surface seizing and opportunistic scavenging, and exploit a broad prey base that includes small pelagic fish, demersal species, crustaceans and, in the case of skuas and large gulls, other seabirds, carrion and discards. Their presence reflects a diverse and flexible guild of predators capable of capitalising on variable prey resources in offshore habitats.

112. The WDA also supports nocturnally active predators such as Manx shearwater (*Puffinus puffinus*) and European storm-petrel (*Hydrobates pelagicus*). Though more cryptic and less detectable in daylight aerial surveys, these species are known to transit and forage within the regional marine environment, feeding predominantly on small pelagic fish, squid and macro-zooplankton. Their ecology underscores the importance of diel processes and night-time foraging dynamics within the predator assemblage.

113. Collectively, these seabird species occupy key trophic positions within the marine ecosystem, linking mid-trophic forage species to higher predators and contributing to the regulation and transfer of energy through pelagic food webs. Their seasonal abundance, wide foraging ranges and reliance on shared prey groups also result in strong ecological connectivity between the WDA and adjacent marine areas, including influence from major breeding colonies on Islay, Colonsay, Rathlin Island and other sites within regional foraging range.

22.8.4 The Key Prey Species

114. **Chapter 9 Fish (including Basking Shark) and Shellfish** identifies a suite of small forage fish that represent the primary prey base for predatory fish, marine mammals, and seabirds within the WDA. These species occupy central positions within the marine food web, transferring energy from planktonic production to upper-trophic predators. The key prey species relevant to the WDA include sandeel, herring, mackerel (*Scomber scombrus)*, and sprat, each of which is present within the Fish and Shellfish Regional Study Area and is considered an Important Ecological Feature for the purposes of assessment. More detail surrounding their life history, habitat preferences, spawning and nursery requirements and sensitivities to Project-related pressures are provided in **Chapter 9 Fish (including Basking Shark) and Shellfish** and **Appendix 9.1 Fish (including Basking Shark) and Shellfish Baseline Technical Report.** Their abundance, distribution and ecological function are summarised below.

22.8.4.1 Sandeel

115. Sandeel are classified as a PMF and represent one of the most influential forage species in Scottish shelf waters and within the WDA, acting as a major energy pathway between planktonic production and higher-trophic predators, particularly marine mammals and seabirds (Marine Scotland, 2023).

116. Sandeel form a locally important prey resource within the WDA. Their distribution is tightly linked to seabed characteristics and reflects the availability of suitable sandy sediments within the WDA. Given their ecological sensitivity and key trophic function, sandeel availability is a major driver of predator distribution and behaviour.

22.8.4.2 Herring

117. Herring contribute to the regional pelagic prey base used by a range of predators, including fish, marine mammals and seabirds (Casini et al., 2004). As a Scottish PMF, herring is recognised for its importance to both ecosystem functioning and conservation objectives (NatureScot, 2025).

118. Within the WDA, their ecological role is limited by the small extent of suitable spawning habitat, with principal spawning grounds located outside the site (Barreto & Bailey, 2015; ICES, 2022). However given the widespread nursery habitat for juvenile herring along the west coast of Scotland (Coull et al., 1998; Ellis et al., 2012), herring are considered an intermittent and supporting prey resource within the ecosystem assessment.

22.8.4.3 Mackerel

119. Atlantic mackerel are highly mobile, seasonally occurring pelagic fish that provide an energetically valuable but temporally variable prey resource (Mackinson et al., 2024). Their trophic importance is reflected in regional predator diets, with mackerel forming prey for larger fish, dolphins, seals and seabirds (Kvaavik et al., 2019). Mackerel are therefore expected to represent an intermittently available but energetically valuable prey resource within the broader Regional Study Area (Gillson et al., 2019). They are considered a supplementary prey species within ecosystem pathways.

22.8.4.4 Sprat

120. Sprat are widely distributed across UK marine waters and are one of the most important forage species in Northeast Atlantic ecosystems (Edwards et al., 2020). Sprat provide a direct link between lower trophic levels and predators including piscivorous fish, seals, dolphins and seabirds.

121. Sprat spawning and nursery grounds are typically widespread, with evidence indicating broad areas of low to moderate intensity spawning potential in UK waters (Natural England & Cefas, 2024). Within the WDA, sprat form part of the wider regional forage assemblage rather than a spatially or habitat-limited prey resource of site-specific importance (Coull et al., 1998).

22.8.5 How the Food System Works

122. Energy flow within marine ecosystems follows a structured progression through multiple trophic levels. At the base of the food web, primary producers, mainly phytoplankton and microalgae, convert solar energy into organic matter through photosynthesis. This primary production supports diverse communities of primary consumers, including zooplankton and the larval stages of many marine species, which assimilate and transfer energy into higher trophic pathways (Edwards et al., 2020).

123. In offshore and shelf-sea ecosystems, this energy transfer is typically mediated through a “wasp-waist” trophic structure, in which a relatively small group of mid-trophic forage fish species exert strong control over ecological dynamics (Casini et al., 2004). Despite their limited species richness, forage fish often occur in high biomass and play a central role in linking lower trophic production to a wide array of predators. Across the WDA, the key forage species fulfilling this function include sandeel, herring, mackerel, and sprat. These species consume zooplankton and other planktonic prey, and in turn form essential prey for predatory fish, elasmobranchs, seabirds, and marine mammals.

124. The timing of ecological processes, referred to as phenology, is also fundamental to food-web function. Many marine species exhibit life-history strategies that are finely tuned to seasonal cycles in primary and secondary productivity (Capet et al., 2020). For instance, spawning periods, larval development windows and peak feeding activity often coincide with seasonal increases in phytoplankton or zooplankton abundance. Disruptions to these cycles, including those influenced by

climatic variability, may alter the synchrony between prey availability and predator demand, potentially affecting growth, survival and reproductive success at higher trophic levels. Species with strong dietary specialisation, such as certain seabirds that depend heavily on sandeel during the breeding season, may be particularly sensitive to such changes (Fauchald et al., 2011).

125. **Section 22.8.3** identifies the principal fish, seabird and marine mammal species that utilise forage fish within the relevant Study Areas. While sandeel, herring, mackerel and sprat feature widely in predator diets, their relative importance varies across predator groups depending on foraging strategy, energetic requirements and seasonal availability of prey (Langton et al., 2021). For example, kittiwake are more reliant on sandeel than the other key seabird species potentially present within the site boundary. Kittiwake would therefore be more sensitive to changes in sandeel distribution and availability. Understanding these trophic dependencies is essential for assessing how environmental change or project-related pressures may influence ecological interactions.

22.8.6 Future Ecosystem Baseline

126. The EIA Regulations require that a "*a description of the relevant aspects of the current state of the environment (baseline scenario) and an outline of the likely evolution thereof without implementation of the Array 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 WDA EIAR.

127. An assessment of the 'without development' future baseline conditions has been carried out and is described within this section.

22.8.6.1 Climate Change Effects

128. Climate change is already altering marine ecosystem processes across Scottish waters, including the Atlantic shelf regions west of Scotland. Recent observations show that sea surface temperatures around the UK and Ireland have increased markedly, with several marine heatwave events documented in the past decade (Hughes et al*.,* 2018). Rising temperatures contribute to stronger and earlier seasonal stratification, which reduces mixing between nutrient-rich deeper waters and the sunlit upper layer where primary production occurs. This reduced vertical mixing can limit nutrient availability for phytoplankton and alter the composition of primary producer communities (Walther, 2010). Evidence shows that shifts towards smaller, less nutrient-demanding phytoplankton species are occurring in stratifying shelf-sea environments, reducing the quality and energy density of food available to higher trophic levels (Howells et al., 2017).

129. These physical and biochemical changes have consequences for forage-fish species central to the trophic structure of Scottish waters. Earlier or more intense stratification affects the timing and abundance of zooplankton, which are key prey for species such as sandeel, sprat, herring and juvenile mackerel. Observed changes in seasonal ecosystem timing (phenology) can disrupt the synchrony between the peak availability of planktonic prey and critical life-history stages in fish, such as larval development and early growth (Ottersen et al., 2023). This is of particular relevance to sandeel, whose growth and recruitment are closely linked to the timing of copepod availability. Studies off Scotland's coasts have documented temperature-driven changes in sandeel condition and abundance, including shifts in their spatial distribution and local recruitment success (MacDonald et al., 2019).

130. Climate-related changes in forage-fish populations propagate through the wider ecosystem. Altered phenology, changes in abundance, or declines in prey quality can lead to mismatches between predator energy demand and prey availability, a driver already identified in Scottish seabird

population dynamics. NatureScot reports that warming waters are contributing to shifts in marine species dominance in Scotland, including declines in cold-water-associated species and corresponding increases in warm-water taxa on the west coast. Such shifts mirror broader projections that warming seas will promote northward expansions of warm-water species and may reduce the suitability of local habitats for cold-adapted forage fish over time (NatureScot, 2025).

131. Continued increases in sea temperature and changes in stratification are expected to reshape species assemblages within west-coast Scottish waters. Projections for UK shelf seas indicate that stratification is likely to begin earlier and persist longer into autumn, with reduced nutrient mixing and potential declines in primary production (Sharples, 2025). For forage species such as sandeel, herring, mackerel and sprat, these physical drivers may alter growth patterns, recruitment strength and spatial distribution. Similarly, predators dependent on these species, including marine mammals and seabirds, may experience shifts in foraging success, distribution and population trajectories.

132. Overall, climate change is a primary driver of ecosystem change in Scottish marine waters. While community-level restructuring may unfold gradually, measurable changes in species composition, seasonal timing and trophic interactions are already evident and are expected to intensify over the coming decades.

22.8.6.2 Highly Pathogenic Avian Influenza (HPAI)

133. The ongoing outbreak of HPAI has had substantial consequences for marine and coastal wildlife across the UK. The virus was first detected in wild birds in 2020 and initially produced limited impacts, affecting mainly gulls and gannets. By spring 2022, however, the number of infected species and geographic spread increased markedly, with successive waves of mortality recorded in breeding seabird colonies. Government assessments confirm that warming conditions in UK waters have contributed to shifts in marine wildlife health pressures, including increased disease susceptibility linked to climate change-related stressors in coastal ecosystems. Within this context, HPAI is recognised as a major contributor to observed declines, with recent estimates indicating that several seabird populations, including gannets, experienced significant reductions between 2022 and 2023 (DEFRA, 2025; Tremlett et al., 2024).

134. Migratory birds remain a key vector in the introduction and onward transmission of HPAI into the UK each year, following established flyways linking northern Europe, Iceland, the Faroes, Greenland and Arctic regions. Although the virus is avian-adapted, cross-species transmission events have been documented. NatureScot reports that climate-driven pressures are already contributing to physiological stress, habitat change and increased susceptibility to disease in Scotland's marine fauna and in parallel with this broader vulnerability, HPAI has been detected in seals in the UK and is associated with mass mortality events in marine mammals internationally. Reports highlight that the virus has also been detected in various dolphin species and is linked to unusual mortality patterns in harbour and grey seals, demonstrating its capacity to affect multiple components of the marine ecosystem (Webby and Uyeki, 2024).

135. The effects of HPAI extend beyond direct mortality. Large-scale reductions in seabird populations can reduce predation pressure on mid-trophic prey species such as small pelagic fish. Such changes risk altering competitive dynamics within the forage-fish community and may contribute to trophic misalignment, where the seasonal availability of prey no longer matches predator requirements. Ecosystem assessments across Scotland note that even modest changes in temperature and ecological stressors can lead to shifts in species dominance and declines in characteristic species, including those important to coastal food. Over time, these compounding pressures may influence

species composition, decrease biodiversity and reduce the resilience of coastal marine ecosystems to further environmental change.

22.8.7 Existing Pressures on Prey Species

136. Before evaluating the potential ecosystem-level effects of the WDA on key prey species, it is necessary to consider the baseline pressures influencing these species within the wider western Scottish marine environment. The west coast is subject to multiple ecological drivers, climate-related shifts in productivity, historical fishing activity, and ongoing trophic restructuring that influence forage-fish populations.

137. Globally, forage fish support a substantial proportion of total marine catches (Alder et al., 2008), and several species have historically been exploited in Scottish waters. Sandeel have experienced pressures from climate change and previous fishing activity across Scottish waters (NatureScot, 2022). Herring have also long been commercially harvested in Scottish waters, including west-coast areas relevant to the WDA. The well-documented stock collapse in the 1970s, attributed to overfishing (Scottish Herring, 2023), demonstrates the species' sensitivity to sustained exploitation. Subsequent management measures, including recovery planning and discard bans, have supported improvements in some regional stocks, although ongoing management remains necessary to maintain stock stability (Dickey-Collas et al., 2010).

138. As outlined in **Section 22.8.6.1**, climate change exerts pressure across all trophic levels. Sandeel and herring are particularly sensitive to temperature-driven changes. Studies show that reductions in the abundance and quality of zooplankton have influenced sandeel populations (MacDonald et al., 2015; Clausen et al., 2017; Wanless et al., 2018; MacDonald et al., 2019), and climate change is likely to affect distribution, recruitment and ecosystem interactions in west-coast waters. Sandeels are also directly affected by warming seas through increased metabolic demand, reduced energy reserves, delayed spawning and poorer synchronisation between larval hatching and spring zooplankton blooms, all of which influence reproductive success (Boulcott & Wright, 2008; Wright et al., 2017).

139. Sandeel distribution is strongly constrained by substrate conditions. Substrate within the WDA is comprised of predominantly "Sand" and "gravelly Sand" sediments which are suitable for sandeel. Their habitat dependency means that shifts in distribution under climate change rely primarily on larval dispersal rather than adult movement (MacDonald et al., 2015). Herring exhibit similar environmental constraints. As demersal spawners, they require coarse substrates such as gravel or cobble for adhesive egg deposition. Such substrates occur only in small patches within the WDA. This reliance on fixed spawning grounds limits the ability of herring populations to respond spatially to changing marine conditions (Wright et al., 2020).

140. These pressures collectively define the ecological baseline for prey species within the WDA and surrounding waters. The overlap between the WDA and spawning/nursery habitats is small relative to regional habitat extent. Understanding the combined influence of environmental change, historical exploitation and habitat dependency is therefore essential for assessing any potential effects of the WDA on prey availability and food-web dynamics.

22.8.8 Effects of the WDA Alone - Prey Species

141. This section assesses the potential effects of the WDA on prey species and any effects on physical processes which may impact prey species indirectly by altering their availability to food sources such as plankton and zooplankton.

142. Information to support this assessment has been extracted from the relevant receptor topic WDA EIAR chapters. Conclusions on LSE have also been extracted from these chapters. Each assessment of an impact focuses on the prey species most vulnerable to the impact and therefore represents the greatest potential impact.

22.8.8.1 Potential Impacts on Prey Species

143. **Chapter 8 Benthic Ecology** and **Chapter 9 Fish (including Basking Shark) and Shellfish** identified that the WDA has the potential to generate several impacts on both benthic habitats and fish and shellfish receptors:

- Increased SSCs and sediment re-deposition;
- Temporary physical disturbance / habitat loss;
- Permanent habitat loss;
- Introduction and colonisation of hard substrate;
- UWN and vibration; and
- EMF

22.8.8.1.1 Increased SSCs and Sediment Redeposition

144. Increases in SSCs and sediment re-deposition may arise during construction activities such as seabed preparation, cable installation and the installation of foundations. Section 7.12.1.1 of **Chapter 7 Marine Physical Environment** identifies that SSC plumes generated during these activities are expected to be highly localised and short-lived, with modelling indicating rapid dissipation back to background levels within hours. Deposition is also predicted to be spatially limited to areas immediately adjacent to construction footprints, generally not exceeding a few centimetres in depth and therefore insufficient to cause any material alteration to seabed morphology or sediment transport pathways (Dernie et al., 2003). Given this limited spatial and temporal footprint, any effects on benthic prey communities, and therefore on the availability of prey to predators, would be similarly constrained.

145. Section 8.11.1.1 of **Chapter 8 Benthic Ecology** provides further context on the habitats most likely to experience sediment re-deposition. The WDA is dominated by offshore circalittoral sand biotopes and coarse sediment communities, which exhibit **low** to **medium** sensitivity to smothering and SSC increases and high natural recoverability due to their presence in an inherently mobile environment. This natural dynamism greatly reduces the duration of any depositional effects on benthic assemblages (Stride, 1983). As a result, any short-term changes in benthic prey abundance would be highly localised and unlikely to influence prey availability at scales relevant to predator foraging.

146. Section 9.11.1.2 of **Chapter 9 Fish (including Basking Shark) and Shellfish** identifies sandeel and herring as the most sensitive receptors to sediment deposition, due to their reliance on the seabed during key life stages such as spawning (herring) or burrowing (sandeel). Much of the WDA comprises preferred sandeel habitat, however predicted levels of SSC and redeposition are below thresholds known to affect sandeel spawning success or larval development. The temporary nature of redeposition means that any fine material deposited on the seabed would be naturally re-mobilised in a short period. Accordingly, no sustained reduction in sandeel availability to predators is anticipated. For herring, the WDA contains very limited areas of preferred herring habitat. Given the low overlap of the WDA with suitable substrates and minimal predicted deposition, the potential for adverse effects on herring is restricted and no meaningful change in herring availability to predators is expected.

147. At an ecosystem scale, the limited spatial extent, short duration and rapid recovery of SSC-related effects prevent any sustained reduction in prey availability. Accordingly, and consistent with the topic-specific assessments, impacts on prey species from increased SSCs and sediment re-deposition are predicted to be **minor adverse** and **not significant** at the population level, with no alteration of predator-prey dynamics.

22.8.8.1.2 Temporary Physical Disturbance / Habitat Loss

148. Temporary physical disturbance to seabed habitats will occur during construction activities, including seabed preparation, foundation installation, anchoring, vessel manoeuvring and cable trenching. As concluded in Section 7.8.3 of **Chapter 7 Marine Physical Environment**, these activities will result in spatially restricted, short-lived and reversible impacts, reflecting the naturally dynamic sediment conditions of the west coast.

149. Benthic habitat within the WDA is dominated by offshore circalittoral sand and coarse sediment habitats (Section 8.8 of **Chapter 8 Benthic Ecology**), that are inherently adapted to frequent disturbance from tidal currents and wave action (Elliott et al., 1998). The benthic invertebrate communities typical of these habitats recolonise rapidly following disturbance (Rees et al., 2006). As described in Section 8.10.2.1 of **Chapter 8 Benthic Ecology**, WDA species composition is dominated by mobile polychaetes, crustaceans and echinoderms capable of re-establishing quickly through larval recruitment and adult movement. This resilience and rapid recolonisation limits the potential for disturbance to cause sustained reductions in benthic prey availability.

150. Section 9.11.1.1 of **Chapter 9 Fish (including Basking Shark) and Shellfish** identifies sandeel and herring as the two receptors most sensitive to temporary habitat loss due to their reliance on seabed substrates during critical life stages (Wright et al., 2000). Sandeel burrow into sandy sediments for overwintering and nighttime refuge, making them potentially sensitive to disturbance of these areas (Johansen, 1919). However, given the spatial and temporal limitations associated with temporary disturbance, no measurable reduction in sandeel availability to predators is anticipated. Herring preferred habitat within the WDA is limited, with only low-intensity spawning potential mapped within or immediately adjacent to the WDA. Therefore, while herring eggs are vulnerable to smothering or disturbance if present, the minimal temporal overlap between sensitive substrates and construction footprints limits the likelihood of significant interaction. Consequently, no meaningful change in herring availability to predators is expected.

151. Other prey species, including sprat, mackerel and pelagic juvenile fish, utilise the water column rather than fixed benthic habitats. These species display high mobility, allowing them to avoid localised areas of disturbance (Blaxter and Hunter, 1982). Due to their inherently mobile nature and the temporary nature of seabed disturbance, no long-term change to feeding or foraging opportunities for these species is anticipated.

152. Considering the limited spatial extent of disturbance, high natural recoverability of benthic habitats and low overlap with sensitive life-stage habitats, temporary physical disturbance and habitat loss is assessed as **minor adverse** and **not significant** with no meaningful change in prey availability to predators expected, and therefore predator-prey dynamics will remain unaffected.

22.8.8.1.3 Permanent Habitat Loss

153. As discussed in Section 9.11.1.8 of **Chapter 9 Fish (including Basking Shark) and Shellfish**, permanent habitat loss may occur during the O&M phase of the WDA due to the long-term presence of foundations, scour protection and cable protection. As with temporary disturbance, the prey species most sensitive to these changes are sandeel and herring. Although sandeel show **medium**

sensitivity to permanent habitat loss, given the relatively small area of seabed permanently occupied by WDA infrastructure and the availability of similar preferred sandeel habitats elsewhere, **no significant** effects on sandeel populations are predicted. Accordingly, no measurable reduction in sandeel availability to predators is expected.

154. For herring, given the low spatial overlap between low-intensity spawning habitat and the areas in which permanent structures will be installed, herring spawning habitat affected is expected to be very minimal, especially in the context of the broader availability of favourable coarse sediments across the wider Study Area. Permanent habitat loss is therefore assessed as **not significant** for herring and is not expected to alter population-level patterns of spawning or recruitment. Given this limited interaction, no meaningful change in herring availability to predators is anticipated.

22.8.8.1.4 Introduction and Colonisation of Hard Substrate

155. The introduction of hard structures within the WDA, such as foundations, scour protection and any required cable protection, will create new areas of seabed habitat within what is otherwise a predominantly soft-sediment environment. Section 8.11.1.5 of **Chapter 8 Benthic Ecology** identifies that these structures are expected to be rapidly colonised by epifaunal species already present in the wider region, resulting in localised changes in community composition and a small-scale increase in biodiversity relative to the existing sediment-dominated baseline (Glasby & Connell, 2001), which may be considered a beneficial effect.

156. The Offshore Wind Evidence and Knowledge Hub (OWEKH) Evidence Review Note (OWEKH, 2025) recognises that offshore windfarm projects can deliver a range of positive effects, including those through habitat enhancement or fisheries exclusion zones. The report encourages projects to '*clearly identify and provide evidence for beneficial effects as a distinct part of the assessment process'* and '*ensure that beneficial effects are realistic, verifiable and proportionate; not speculative or overstated*'.

157. Although colonisation of hard substrate alters local ecological interactions near the seabed, potentially influencing predation and competition dynamics (Bulleri & Chapman, 2010), the area of new habitat represents only a very small proportion of the benthic Study Area. Potential effects, including attachment of INNS are therefore spatially restricted and further limited by the implementation of biosecurity measures through the INNSMP. Any resulting changes in benthic community structure are not expected beyond the immediate footprint of the structures.

158. Species such as ocean quahog and other soft-bottom specialists may lose habitat where natural sediment is replaced by hard materials (Witbaard & Bergman, 2003). However, this loss is expected to be small in scale relative to the available soft sediment across the Study Area, and therefore effects are assessed as **minor adverse** and **not significant**. Conversely, species associated with harder substrates may benefit locally from the new habitat, although these communities remain confined to the footprint of the artificial structures. Given the spatial extent of these changes, no alteration in prey availability to predators is anticipated.

159. For fish and shellfish, Section 9.11.1.10 of **Chapter 9 Fish (including Basking Shark) and Shellfish** identifies that colonisation of hard structures may produce a localised reef effect by increasing the abundance of epifaunal prey and therefore attract fish to these structures, potentially acting as aggregation points (Bohnsack et al., 1991). These effects are highly localised, with no evidence to suggest they would lead to population-level changes, particularly given the mobile nature of the wider fish and shellfish community within the WDA.

160. Overall while colonisation of hard structures will introduce localised changes in community structure, these effects will remain spatially restricted and will result in **no significant** changes to prey species populations or prey at scales relevant to predator foraging, and predator-prey dynamics will remain unaffected.

22.8.8.1.5 Underwater Noise and Vibration

161. As discussed in Section 9.11.1.3 of **Chapter 9 Fish (including Basking Shark) and Shellfish**, UWN will arise during the construction phase of the WDA, particularly from piling associated with the installation of WTGs and OSPs. Embedded mitigation, such as the use of soft-start and ramp-up procedures, is expected to limit the potential for injury by allowing fish to move away from the noise source before sound levels reach intensities capable of causing injury (Popper & Hastings, 2009). As a result, any effects on prey species, and therefore on prey availability to predators, are expected to be limited to short-term behavioural responses.

162. Behavioural effects are expected to occur over a wider area than injury effects. Herring, in particular, are noted in Section 9.11.1.3.1 of **Chapter 9 Fish (including Basking Shark) and Shellfish** as being more sensitive to UWN due to their hearing capabilities and association with seabed habitats during spawning (Blaxter et al., 1981). However, noise modelling indicates that overlap between mapped low-intensity herring spawning habitat and areas where predicted sound exposure levels exceed the behavioural response threshold is spatially limited (Figure 9.3 of **Chapter 9 Fish (including Basking Shark) and Shellfish**). Within these areas of overlap, predicted sound exposure levels exceed the behavioural response threshold only, and remain well below thresholds associated with auditory injury. Any behavioural response is therefore expected to be localised and temporary, with no population-level effects or meaningful change in prey availability anticipated.

163. For other prey species, including sandeel, sprat, mackerel and demersal fish, which are less sensitive to UWN, significant ecological impacts are unlikely (Hawkins & Popper, 2017). Overlap with sensitive sandeel spawning and nursery grounds is limited in the context of wider available habitat in the region, and pelagic species such as sprat and mackerel, are expected to temporarily move away from localised noise sources without long-term consequence and return once activity ceases. This mobility further limits the potential for UWN to affect prey availability within predator foraging ranges.

164. During the operational phase, UWN from turbine machinery will be generated at low levels. These operational noise levels are well below thresholds associated with injury or significant behavioural disturbance for fish or shellfish receptors (Tougaard et al., 2020). Turbine-related sound is expected to be comparable to ambient UWN conditions typical of the area, and therefore operational noise is not predicted to have any measurable effect on prey species distribution or behaviour. Accordingly, no operational-phase changes in prey availability to predators are expected.

165. Overall, UWN during both construction and operation is expected to lead only to localised and temporary behavioural responses, with **no significant** effects on prey species populations, spawning success or ecological function across the WDA. Given the limited spatial extent of predicted behavioural responses and the rapid return of prey species once noise ceases, no meaningful change in prey availability to predators is anticipated, and predator–prey dynamics will remain unaffected.

22.8.8.1.6 EMF

166. As discussed in Section 9.11.1.9 of **Chapter 9 Fish (including Basking Shark) and Shellfish**, the presence and operation of inter-array, OSP link and export cable(s) within the WDA will give rise to localised EMFs associated with the transmission of electrical current. These fields comprise only the

magnetic component and the induced electrical field, as the direct electrical field is contained within cable sheathing and therefore not emitted into the marine environment. Although certain fish groups can detect magnetic fields, the key prey species present within the WDA, sandeel, herring, sprat and mackerel, are not considered sensitive to EMFs at the magnitudes predicted (Gill et al., 2005; Normandeau et al., 2011). Accordingly, no mechanism exists by which EMFs would alter prey behaviour or availability to predators.

167. The spatial influence of EMFs is limited. Section 8.11.1.6 of **Chapter 8 Benthic Ecology** notes that EMF strength decays rapidly with distance, meaning that only a narrow band of seabed immediately above or adjacent to buried or protected cables would experience measurable field levels. As the majority of cables within the WDA are to be buried beneath the seabed, with any required protection occurring only in localised sections, the extent of habitat exposed to detectable EMFs is correspondingly small and ecologically insignificant.

168. For benthic species, EMFs from buried cables present negligible pressure, with no anticipated effects on benthic invertebrate behaviour, community structure or ecological function (Section 8.10 of **Chapter 8 Benthic Ecology**). Similarly for fish and shellfish species (Section 9.10 of **Chapter 9 Fish (including Basking Shark) and Shellfish**), EMFs are not expected to influence behaviour, distribution, spawning or burrowing, as these processes are driven primarily by substrate characteristics and habitat availability rather than magnetic cues.

169. Overall, EMFs associated with subsea cables are expected to produce **negligible** effects on benthic habitats and fish and shellfish receptors, including key prey species. The limited spatial footprint, the rapid attenuation of magnetic fields with distance and the absence of EMF sensitivity in these species all indicate that EMFs will result in **no significant** or measurable effects on prey availability or ecosystem functioning within the WDA.

22.8.9 Combined Assessment - Prey Species

170. The topic-specific assessments in **Chapters 8 Benthic Ecology** and **Chapter 9 Fish (including Basking Shark) and Shellfish** conclude that all Project-alone effects on key prey species (including sandeel, herring, sprat and mackerel) are of **minor adverse** or **negligible** significance, with no population-level consequences anticipated. When considering the potential for combined effects arising from construction and operation of both the WDA and the Offshore ECC, no additional pathways are identified that would elevate these effects.

171. Activities within the WDA and Offshore ECC act over spatially restricted and largely non-overlapping areas, and any pressures, such as sediment disturbance, temporary habitat loss, UWN or localised EMFs, remain short-lived, localised, and within the range of natural environmental variability. As a result, the combined influence of WDA and Offshore ECC activities does not increase the magnitude, duration or geographic extent of effects beyond those already assessed in the technical chapters.

172. Accordingly, no greater or more significant combined effects on prey species are predicted, and the overall conclusion of **minor adverse** or **negligible** significance remains unchanged. No meaningful change in prey availability to higher-trophic-level predators is anticipated, and predator-prey dynamics will remain unaffected.

22.8.9.1 Conclusions

173. This section summarises the assessments presented in the topic-specific chapters to inform the inter-related ecosystem-effects assessment of the WDA on prey species and to determine whether any of the pressures associated with the WDA could lead to meaningful changes in prey availability to higher trophic level predators. Accordingly, the assessment considers both direct effects on prey

populations and whether those effects could alter predator-prey dynamics within or near key foraging areas.

174. The impacts relevant to prey species across the construction, O&M, and decommissioning phases include increased SSCs and sediment redeposition; temporary habitat loss and disturbance; permanent habitat loss; introduction and colonisation of hard substrate; UWN and vibration; and EMFs associated with subsea electrical cables. For each of these pressures, the assessment has considered not only the sensitivity and recoverability of prey species themselves, but also whether any resulting changes could influence prey availability at scales relevant to predator foraging.

175. The introduction of hard structures will create small, isolated patches of artificial reef habitat, which will be rapidly colonised by epifaunal species already present in the wider area. Although colonisation may increase local biodiversity and provide feeding opportunities for some fish, these changes are confined to the footprint of individual structures and do not extend beyond the immediate area. Any associated reef-effect benefits are therefore expected to be highly localised and **not significant** in terms of prey species availability. Equally, because these changes are so spatially restricted, they are not expected to influence prey availability for predators or alter predator-prey interactions.

176. Overall, no individual impacts, nor their inter-related effects, are predicted to result in population-level changes in prey species, nor changes in the availability of prey to higher trophic levels. Effects are consistently assessed as **minor adverse** or **negligible**, and **no significant** change in prey distribution, abundance or ecosystem function is expected as a result of the WDA. Consequently, predator-prey dynamics are not expected to be altered, and no meaningful ecological consequences for predators are anticipated.

22.8.10 Effects of the WDA Alone on Predator Species

177. **Section 22.8.8** has shown that effects on prey species (sandeel, herring, sprat, mackerel) are predicted to be **minor adverse** or **negligible**, and **not significant** across all phases of the WDA. This section evaluates how those findings translate to potential effects on predator species, including piscivorous fish, marine mammals and seabirds, and considers whether any indirect pathways could lead to changes in predator distribution, behaviour or foraging success. It also considers the reverse pathway, whether predator species themselves, could exert pressures on prey populations that interact with, amplify, or otherwise modify the prey-related effects assessed for the WDA.

178. The assessment draws directly on the sensitivity of fish, seabird and marine mammal predator species to prey availability, as well as the inter-related effects described in **Section 22.8.8.1**, to determine whether reduced or increased prey availability could pose a potentially significant effect on predators.

179. During consultation, the ADSFB highlighted a concern that predator aggregation, for example, increases in large gadoids or grey seals within the WDA, could elevate predation pressure on migrating salmonids at both the smolt and adult stages. These concerns have been considered in the context of the prey-species assessment and the predator ecology described above. Evidence indicates that predator aggregation offshore is typically associated with localised, high-density prey concentrations or constraining physical features, rather than open offshore areas such as the WDA (Wells et al., 2025). Similarly, offshore studies show that increased salmonid mortality is generally linked to specific inshore or estuarine contact points or structurally confining features (Nelson et al., 2024; Phillips et al., 2021). Thus, while the ADSFB concerns are acknowledged, current scientific evidence shows no plausible mechanism by which the WDA would increase salmonid vulnerability through predator aggregation.

180. Given the highly mobile nature of both prey and predator species, and the localised and temporary scale of the predicted effects on prey resources, the likelihood of increased or decreased predation pressure is considered highly unlikely and has therefore not been assessed.

22.8.10.1 Piscivorous Fish

181. Piscivorous fish occurring within the WDA display broad, flexible diets, including a mix of pelagic prey as well as benthic invertebrates listed in **Section 22.8.4**. This dietary breadth suggests that piscivorous fish are not strongly dependent on any single prey species within the prey assemblage identified and therefore are likely to be resilient to short-term, localised changes in prey availability. As such, predation by piscivorous fish is not expected to exert localised pressure on prey species that would interact with or exacerbate WDA-related effects.

182. **Section 22.8.8.1** concludes that effects on prey species, including SSCs, disturbance, habitat loss, UWN and EMF, would be **not significant** and it is expected they will not alter prey populations within or beyond the WDA. In this context, natural predation by piscivorous fish is expected to continue at background levels and does not represent a pathway capable of modifying prey responses to WDA activities.

22.8.10.2 Marine Mammals

183. **Chapter 10 Marine Mammals and Leatherback Turtle** identifies sandeel, herring, sprat and mackerel as key prey species for several marine mammal receptors, including harbour porpoise, common dolphin, minke whale and grey seal. The marine mammal assessment recognises that changes in prey availability can influence predator foraging behaviour; however, these species generally forage over wide areas, show seasonal and regional dietary variation, and routinely switch between prey types in response to natural fluctuations in abundance (Santos et al., 2004; Pierce et al., 2004). This ecological flexibility reduces their sensitivity to localised or short-term shifts in prey distribution. Similarly marine mammal predation is not expected to impose localised pressure on prey species.

184. Given that prey-species impacts from the WDA are assessed as **negligible** to **minor adverse** and **not significant**, any associated variation in prey availability, it is expected to be small in scale, temporary, and restricted to discrete parts of the WDA. Marine mammals are able to access extensive alternative foraging habitat within the wider region, and no constraints on their ability to meet energetic requirements are anticipated (Haug et al., 2006). As such, the WDA is not predicted to influence marine mammal populations through prey-availability pathways.

185. For some species, such as minke whale, sandeel represent an important energetic resource (Macleod et al., 2004). While suitable sandeel habitat occurs across the WDA, the predicted effects on this prey species are minor, short-lived, and **not significant**. Consequently, any localised reduction in sandeel availability would not be of a magnitude capable of constraining foraging success for predators that utilise this prey type (Skern-Mauritzen et al., 2011).

186. Grey seal, harbour seal and harbour porpoise also display broad diets and employ flexible foraging strategies, with documented capacity for prey switching and foraging over large spatial scales (Hammond & Grellier, 2006; Sveegaard et al., 2012). These behavioural traits provide resilience to fine-scale or temporary changes in prey density and further reduce the likelihood of any meaningful effect on predator condition or distribution. Accordingly, marine mammal predation does not represent a pathway capable of altering prey responses to WDA activities.

187. Overall, based on the sensitivity of marine mammals to prey-related pressures and the **negligible** to **minor adverse** magnitude of predicted changes in prey availability, **no significant** effects on marine

mammals are expected as a result of prey-mediated pathways arising from the WDA. No predator-driven amplification of prey effects is expected.

22.8.10.3 Seabirds

188. **Chapter 11 Ornithology** identifies a diverse assemblage of seabird predators regularly occurring within the WDA (**Section 22.8.3.1.3**). These species feed predominantly on sandeel, sprat, herring and juvenile gadoids (Wanless et al., 1998), which collectively form the principal mid-trophic prey base within the WDA.

189. The ornithology assessment shows that indirect effects on prey species from construction, O&M or decommissioning, such as temporary habitat disturbance, changes to benthic communities, EMF from cables, and operational hard-substrate colonisation, are localised, small in magnitude and short-lived, and do not alter prey availability at scales relevant to seabird foraging ecology. Seabird predators exhibit a wide range of foraging strategies, including pursuit-diving (auks), plunge-diving (gannet), surface feeding (fulmar, kittiwake) and nocturnal foraging (shearwaters and storm-petrels), and routinely feed across large spatial ranges, often extending tens to hundreds of kilometres from breeding colonies. This mobility, combined with well-documented dietary flexibility for many species, enables seabirds to adjust their foraging distribution in response to natural prey variability (Searle et al., 2023).

190. Several species of high ecological interest, such as kittiwake, razorbill, guillemot and puffin, show sensitivity to changes in the availability of energy-rich prey like sandeel (Greenstreet et al., 2008). However, **Chapter 11 Ornithology** concludes that WDA-related prey effects are too small in spatial and temporal extent to influence foraging success, adult survival or population-level processes for any of the assessed species. Mean Seasonal Peak abundance and displacement/collision modelling demonstrate that prey-mediated pathways do not drive significant effects for any Important Ornithological Feature.

191. Similarly, there is no evidence that seabirds could exert increased predation pressure on prey species in a manner that would interact with or amplify WDA-related effects. Although large aggregations of seabirds can form where prey density is high, such aggregations are typically associated with naturally occurring oceanographic features or localised prey hotspots, rather than broad offshore areas like the WDA.

192. Species such as Manx shearwater and European storm-petrel, which may be more vulnerable to artificial lighting or nocturnal attraction effects, are also shown to be unlikely to experience changes in prey accessibility attributable to the WDA, and operational lighting effects are independently mitigated. Prey availability therefore does not present a mechanism for indirect population-level effects for these species.

193. Overall, given the small, temporary and localised nature of predicted prey-species effects, alongside the high mobility, broad foraging ranges and dietary adaptability of seabird predators, there is no plausible pathway by which the WDA alone could affect seabird populations via prey availability. No predator-driven amplification of prey effects is expected. Accordingly, **no significant** effects on seabirds are predicted through prey-mediated pathways.

22.8.11 Combined Assessment - Predator Species

194. Predator species, including piscivorous fish, marine mammals and seabirds, are expected to experience **no significant** indirect effects from changes in prey availability under the WDA-alone scenarios. Given this baseline, the potential for combined effects with the Offshore ECC and OnTDA

has been examined to determine whether any additional pathways could result in altered foraging success, distribution or behaviour.

195. As prey-related effects from both the WDA, Offshore ECC and OnTDA are temporary, localised and small in magnitude, and predator species are highly mobile and opportunistic, there is no mechanism by which the combined operation of the three Development Areas would meaningfully alter prey supply at spatial or temporal scales relevant to predator populations. No amplification of pressure magnitude, duration, or spatial extent is predicted when considering the WDA, Offshore ECC and OnTDA together.

196. Therefore, combined effects on predator species are not expected to exceed those identified for the WDA alone, and **no significant** prey-mediated impacts on predator populations are anticipated.

22.8.11.1 Conclusions

197. This section assessed whether changes to prey species arising from the WDA could result in effects on predator species, including piscivorous fish, marine mammals and seabirds. Based on the findings of the prey-species assessment, the following conclusions have been reached:

- Piscivorous fish;
  - Have broad diets and are not strongly dependent on any single prey species;
  - **No significant** changes in prey availability are predicted.
- Marine mammals
  - Prey availability effects are minor and localised;
  - Harbour porpoise and seals can forage widely and switch prey;
  - Minke whale sensitivity to sandeel is acknowledged however the predicted effects on this prey species are minor, short-lived, and not significant;
  - No population-level effects are predicted.
- Seabirds
  - Predicted prey-species effects are minor, localised and short-lived;
  - Seabirds forage widely and show strong dietary and spatial flexibility, reducing sensitivity to small-scale prey variation;
  - Species sensitive to sandeel fluctuations, such as kittiwake and auks, would not experience changes of a magnitude capable of affecting population-level processes;
  - Predator aggregation is unlikely offshore, and seabirds are not expected to exert increased predation pressure that would interact with WDA-related prey effects; and
  - **No significant** prey-mediated effects on seabirds are predicted.

198. Overall, **no significant** effects on predator species are predicted via changes in prey availability. The mobility and ecological flexibility of predators, combined with the small-scale, non-significant effects on prey species, mean that the WDA will not result in increased predation pressure, altered predator distribution, or changes in ecosystem functioning.

22.9 CONCLUSION

199. The assessment of inter-related effects has considered all relevant pressures associated with the WDA and the ways in which they may combine across construction, operation and decommissioning. When the findings of each topic chapter are brought together, it is clear that the interactions between different impact pathways do not lead to effects of greater magnitude or significance than those already identified in the individual assessments. All pathways, alone or cumulative, remain within the range of **minor adverse** or **negligible**, meaning that inter-related effects are **not significant** in EIA

terms. This is supported by the topic-specific conclusions that none of the predicted changes to physical processes, benthic habitats or prey species would materially alter ecological functioning or species distributions within the WDA.

200. With respect to prey species, the ecosystem assessment shows that potential changes, whether through temporary disturbance, minor habitat loss, localised deposition, or the introduction of hard structures, would be limited in extent and short-lived, with no measurable reductions in prey populations or long-term changes to their availability. Although the addition of hard substrate can produce isolated patches of increased epifaunal biomass, these reef-type effects are expected to be contained to individual structures and are not predicted to influence prey abundance at a wider scale.

201. Consequently, the likelihood of indirect effects on predator species is also low. Some marine mammal species, such as harbour porpoise, seals and minke whale, could be sensitive to reductions in key prey types. However, because changes to sandeel, herring, sprat and mackerel within the WDA are predicted to be minimal, no population-level effects on these predators are expected. These species are also highly mobile and capable of switching prey or foraging across large areas, which further reduces their sensitivity to small-scale changes in prey distribution.

202. Seabirds within the WDA feed primarily on sandeel, sprat, herring and juvenile gadoids, but most species exhibit broad dietary flexibility and wide foraging ranges, allowing them to adjust to natural fluctuations in prey availability. Because predicted changes in prey species arising from the WDA are minor, localised and short-lived, they are not of a scale capable of affecting seabird foraging success, adult survival or population-level processes. Accordingly, **no significant** prey-mediated effects on seabirds are expected.

203. Taken together, the evidence demonstrates that the WDA will not alter prey populations in a way that would affect predators, nor will it cause interacting or cumulative pressures that elevate the significance of effects. **No significant** impacts on prey species or their predators are expected, and the overall functioning of the wider marine ecosystem is therefore not predicted to change as a result of the development.

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