Pentland floating offshore wind farm

Volume 2: Offshore EIAR

Chapter 6: EIA Methodology

PENTLAND FLOATING OFFSHORE WIND FARM

OFFSHORE EIAR (VOLUME 2): MAIN REPORT

CHAPTER 6: EIA METHODOLOGY

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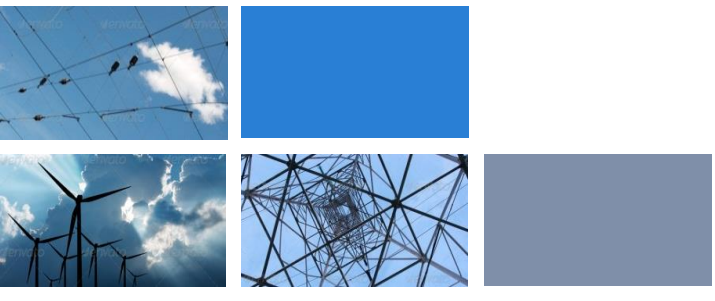

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GLOSSARY OF PROJECT TERMS

Key Terms	Definition
Dounreay Trì Floating Wind Demonstration Project (the 'Dounreay Trì Project')	The 2017 consented project that was previously owned by Dounreay Trì Limited (in administration) and acquired by Highland Wind Limited (HWL) in 2020. The Dounreay Trì Project consent was for two demonstrator floating Wind Turbine Generators (WTGs) with a marine licence that overlaps with the Offshore Development, as defined. The offshore components of the Dounreay Trì Project consent are no longer being implemented.
Highland Wind Limited	The Developer of the Project (defined below) and the Applicant for the associated consents and licences.
Landfall	The point where the Offshore Export Cable(s) from the PFOWF Array Area, as defined, will be brought ashore.
Offshore Export Cable(s)	The cable(s) that transmits electricity produced by the WTGs to landfall.
Offshore Export Cable Corridor (OECC)	The area within which the Offshore Export Cable(s) will be located.
Offshore Site	The area encompassing the PFOWF Array Area and OECC, as defined.
Onshore Site	The area encompassing the PFOWF Onshore Transmission Infrastructure, as defined.
Pentland Floating Offshore Wind Farm (PFOWF) Array and Offshore Export Cable(s) (the 'Offshore Development')	All offshore components of the Project (WTGs, inter-array and Offshore Export Cable(s), floating substructures, and all other associated offshore infrastructure) required during operation of the Project, for which HWL are seeking consent. The Offshore Development is the focus of this Environmental Impact Assessment Report.
PFOWF Array	All WTGs, inter-array cables, mooring lines, floating sub-structures and supporting subsea infrastructure within the PFOWF Array Area, as defined, excluding the Offshore Export Cable(s).
PFOWF Array Area	The area where the WTGs will be located within the Offshore Site, as defined.
PFOWF Onshore Transmission Infrastructure (the 'Onshore Development')	All onshore components of the Project, including horizontal directional drilling, onshore cables (i.e. those above mean low water springs), transition joint bay, cable joint bays, substation, construction compound, and access (and all other associated infrastructure) across all project phases from development to decommissioning, for which HWL are seeking consent from The Highland Council.
PFOWF Project (the 'Project')	The combined Offshore Development and Onshore Development, as defined.

ACRONYMS AND ABBREVIATIONS

EEA	European Economic Area
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EU	European Union
HRA	Habitats Regulations Appraisal
HWL	Highland Wind Limited
IEMA	Institute of Environmental Management and Assessment
LSE	Likely Significant Effect
m	metres
MS	Marine Scotland
MS-LOT	Marine Scotland Licensing Operations Team
MSS	Marine Scotland Science
NCA	Nature Conservation Appraisal
NCMPA	Nature Conservation Marine Protected Areas
Offshore EIAR	Offshore Environmental Impact Assessment Report
RIAA	Report to Inform Appropriate Assessment
THC	The Highland Council
TLP	Tension Leg Platforms
UK	United Kingdom
WTG	Wind Turbine Generator

6 EIA METHODOLOGY

6.1 Introduction

The principal aim of undertaking an Environmental Impact Assessment (EIA) is to ensure that the authority granting consent (the 'Competent Authority') for a proposed development makes its decision in full knowledge of any potentially significant effects on the environment.

EIA is a means of systematically evaluating a proposed development's likely environmental impacts and effects, both beneficial and adverse. This helps ensure that the significance of the predicted effects, and the scope for reducing any adverse effects, is properly understood by the public and statutory and non-statutory consultees, and allows the Competent Authority to make its decision. Early identification of potentially adverse environmental effects also leads to the identification and incorporation of appropriate mitigation measures into a proposed development's design.

This chapter sets out the approach and methods utilised in the EIA for the Offshore Development in support of the application for consent. It provides an overview of the key stages followed in line with EIA best practices and in accordance with the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 and the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 (collectively, the 'EIA Regulations').

6.2 EIA Legislation and Guidance

6.2.1 Legislation

EIA requirements are defined for European Union (EU) Members States in the EIA Directive (85/337/EEC), as codified by EIA Directive (2011/92/EU) and amended by EU Directive (2014/52/EU). Although the United Kingdom (UK) is no longer a member of the EU, for applications submitted under the Electricity Act 1989 and marine licences as required under the Marine (Scotland) Act 2010, these requirements have been fully transposed into Scottish law by the EIA Regulations.

In accordance with the EIA Regulations, an EIA is specifically required:

- Under Schedule 2 of the Marine Works Environmental Impact Assessment (Scotland) Regulations 2017 for installations for the harnessing of wind power for energy production (wind farms) if:
  - The development involves the installation of more than two Wind Turbine Generators (WTGs); or
  - The hub height of any WTG or height of any other structure exceeds 15 metres (m).
- Under Schedule 2 to the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 if:
  - A generating station will be constructed which will require a consent under the Electricity Act 1989 but is not a Schedule 1 development. An EIA will be required if the development is likely to have a significant effect on the environment, due to factors such as their size, nature or location.

The Offshore Development is therefore considered to be a development for which an EIA must be undertaken as the Pentland Floating Offshore Wind Farm Array will consist of more than two WTGs with a hub height of over 15 m, and the Project will include the construction of a generating station which will require consent under the Electricity Act 1989.

The EIA Regulations require that an EIA should consider the significance of environmental effects and be carried out by competent experts. The decision process related to defining whether a proposed development's impacts are likely to cause significant effects to the environment is central to the EIA process. Whilst the EIA Regulations themselves do not define 'significance', the methods used for identifying and assessing effects must be transparent and verifiable.

This Offshore Environmental Impact Assessment Report (Offshore EIAR) presents the written output of the EIA process for the Offshore Development. The information contained in this document fulfils the requirements of the EIA Regulations; once submitted, this Offshore EIAR will enable Scottish Ministers to decide on the application for consent for the Offshore Development.

Regulation 5 (2) of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 states that at least the following information is required in an Environmental Impact Assessment Report (EIAR):

Table 6.1 Information required within the EIAR as set out in Regulation 5 (2) of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017

Information Required	Offshore EIAR Reference
a) *a description of the development comprising information on the site, design, size and other relevant features of the development;*	Offshore EIAR (Volume 2) Main Report – Chapter 5: Project Description
b) *a description of the likely significant effects of the development on the environment;*	Offshore EIAR (Volume 2) Main Report – Chapters 7 to 21
c) *a description of the features of the development and any measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;*	Offshore EIAR (Volume 2) Main Report – Chapters 7 to 21
d) *a description of the reasonable alternatives studied by the developer, which are relevant to the development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment;*	Offshore EIAR (Volume 2) Main Report – Chapter 3: Site Selection and Alternatives
e) *a non-technical summary of the information referred to in sub-paragraphs (a) to (d); and*	Offshore EIAR (Volume 1) Non-Technical Summary
f) *any other information specified in schedule 4 relevant to the specific characteristics of the development and to the environmental features likely to be affected.*	Offshore EIAR (Volume 2) Main Report – Chapters 7 to 21

Regulation 6 (2) of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 states that at least the following information is required in an EIAR:

Table 6.2 Information required within the EIAR as set out in Regulation 6 (2) of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017

Information Required	Offshore EIAR Reference
a) *a description of the works comprising information on the site, design, size and other relevant features of the works;*	Offshore EIAR (Volume 2) Main Report – Chapter 5: Project Description
b) *a description of the likely significant effects of the works on the environment;*	Offshore EIAR (Volume 2) Main Report – Chapters 7 to 21
c) *a description of the features of the works and any measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;*	Offshore EIAR (Volume 2) Main Report – Chapters 7 to 21
d) *a description of the reasonable alternatives studied by the applicant, which are relevant to the works and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the works on the environment;*	Offshore EIAR (Volume 2) Main Report – Chapter 3: Site Selection and Alternatives
e) *a non-technical summary of the information referred to in sub-paragraphs (a) to (d); and*	Offshore EIAR (Volume 1) Non-Technical Summary

Information Required	Offshore EIAR Reference
f) any other information specified in schedule 4 relevant to the specific characteristics of the works or of the types of works in question and to the environmental features likely to be affected.	Offshore EIAR (Volume 2) Main Report – Chapters 7 to 21

In terms of the EIA process, Regulation 4 of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 requires that:

Table 6.3 EIA process as set out within Regulation 4 of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017

Information Required	Offshore EIAR Reference
(2) The environmental impact assessment must identify, describe and assess in an appropriate manner, in light of the circumstances relating to the proposed development, the direct and indirect significant effects of the proposed development (including, where the proposed development will have operational effects, such operational effects) on the factors specified in paragraph (3) and the interaction between those factors. *(3) The factors are—* *a) (a)population and human health;*	Offshore EIAR (Volume 2) Main Report > Chapter 8: Water and Sediment Quality > Chapter 19: Socio-economic, Recreation, and Tourism > Chapter 20: Climate Change and Carbon
b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC(34) and Directive 2009/147/EC(35);	Offshore EIAR (Volume 2) Main Report > Chapter 9: Benthic Ecology > Chapter 10: Fish and Shellfish Ecology > Chapter 11: Marine Mammals and Other Megafauna > Chapter 12: Marine Ornithology > Chapter 13: Commercial Fisheries
c) land, soil, water, air and climate[i];	Offshore EIAR (Volume 2) Main Report > Chapter 8: Water and Sediment Quality > Chapter 20: Climate Change and Carbon
d) material assets, cultural heritage and the landscape;	Offshore EIAR (Volume 2) Main Report > Chapter 16: Seascape, Landscape, and Visual Amenity > Chapter 17: Marine Archaeology and Cultural Heritage
e) the interaction between the factors referred to in sub-Paragraphs (a) to (d).	Offshore EIAR (Volume 2) Main Report Chapters 7 to 21

[i] Land, soil, and local air quality are not relevant as they are terrestrial receptors that have been scoped out of this Offshore EIAR as the Offshore Development will not impact these receptors. An assessment of these receptors will be included within the consent application for the Onshore Development submitted to The Highland Council (THC).

Information Required	Offshore EIAR Reference
(3) The effects referred to in Paragraph (2) on the factors set out in that Paragraph must include the operational effects of the proposed development, where the proposed development will have operational effects.	Offshore EIAR (Volume 2) Main Report Chapters 7 to 21
(4) The significant effects to be identified, described and assessed under Paragraph (2) include the expected significant effects arising from the vulnerability of the proposed development to major accidents or disasters that are relevant to that development.	Offshore EIAR (Volume 2) Main Report Chapter 21: Risk of Major Accidents and/or Disasters

Regarding the EIA process, Regulation 5 of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 requires that:

Table 6.4 EIA process as set out within Regulation 5 of the Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017

Information Required	Offshore EIAR Reference
(2) The environmental impact assessment must identify, describe and assess in an appropriate manner, in light of the circumstances relating to the proposed works, the direct and indirect significant effects of the proposed works on the factors specified in paragraph (3) and the interaction between those factors. *(3) The factors are—* *a) population and human health;*	Offshore EIAR (Volume 2) Main Report > Chapter 8: Water and Sediment Quality > Chapter 19: Socio-economic, Recreation, and Tourism > Chapter 20: Climate Change and Carbon
b) biodiversity, and in particular species and habitats protected under Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora(1) and Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds(2);	Offshore EIAR (Volume 2) Main Report > Chapter 9: Benthic Ecology > Chapter 10: Fish and Shellfish Ecology > Chapter 11: Marine Mammals and Other Megafauna > Chapter 12: Marine Ornithology > Chapter 13: Commercial Fisheries
c) land, soil, water, air and climate[ii];	Offshore EIAR (Volume 2) Main Report > Chapter 8: Water and Sediment Quality > Chapter 20: Climate Change and Carbon
d) material assets, cultural heritage and the landscape;	Offshore EIAR (Volume 2) Main Report > Chapter 16: Seascape, Landscape, and Visual Amenity > Chapter 17: Marine Archaeology and Cultural Heritage

[ii] Land, soil, and local air quality are not relevant as they are terrestrial receptors that have been scoped out of this Offshore EIAR as the Offshore Development will not impact these receptors. An assessment of these receptors will be included within the consent application for the Onshore Development submitted to THC.

Information Required	Offshore EIAR Reference
(4) The effects to be identified, described and assessed under paragraph (2) include the expected effects deriving from the vulnerability of the works to risks, so far as relevant to the works, of major accidents and disasters.	Offshore EIAR (Volume 2) Main Report – Chapter 21: Risk of Major Accidents and/or Disasters

6.2.2 Guidance and Best Practice

The EIA methodology adopted and applied within this Offshore EIAR was developed based on the experience of EIA technical experts in consideration of EIA principles and industry best practice guidance. The specific guidance utilised is detailed within the relevant technical chapters of this document (Chapters 7 to 21). Some of the key guidance and best practice documents used to inform the EIA include:

- OSPAR Commission (2008), Assessment of the Environmental Impact of Offshore Wind Farms;
- Scottish Natural Heritage (now NatureScot) (2018), A handbook on environmental impact assessment: Guidance for competent authorities, consultees and others involved in the Environmental Impact Assessment process in Scotland;
- Institute of Environmental Management and Assessment (IEMA), (2017) Delivering Proportionate EIA: A Collaborative Strategy for Enhancing Environmental Impact Assessment Practice;
- IEMA (2016), Environmental Impact Assessment Guide to Delivering Quality Development;
- IEMA (2017), Guidance on Delivering Proportionate EIA: A Collaborative Strategy for Enhancing UK Environmental Impact Assessment Practice;
- IEMA (2020), Impact Assessment Outlook Journal-Volume 7: Demystifying Cumulative Effects;
- Chartered Institute of Ecology and Environmental Management (2016), Guidelines for Ecological Impact Assessment (EcIA); and
- Scottish Government (2022). Good Practice Guidance for Applications under Section 36 and 37 of the Electricity Act 1989.

6.3 EIA Process

As illustrated in Figure 6.1, EIA is a process of systematically identifying the potential impacts and resultant effects (both beneficial and adverse) of a proposed development throughout all phases of the project, including during construction, operation and maintenance, and decommissioning. The impacts identified for each phase are assessed in isolation as well as cumulatively with impacts from other projects. For the Offshore Development, the EIA process has required a detailed understanding across all phases of the Offshore Development's life-cycle and the environment within which the Offshore Development will be located.

Once identified, potential impacts are then evaluated to determine whether a proposed development will result in any effects on the environment and what the significance of those effects may be. Where potential effects are likely to be significant, specific measures may be identified to manage, reduce, remove, or offset such effects where possible.

For all EIA topics assessed, the approach utilised assesses the potential impacts of the Offshore Development based on the worst case parameters as defined by the Offshore Development's Design Envelope (as discussed below in Section 6.4.1 and detailed in Chapter 5: Project Description). These worst case parameters have been discussed with consultees throughout the EIA process, where appropriate. The worst case parameters identified and assessed represent the most realistic scenario that would give rise to the greatest potential impact for the topic assessed; design parameter values that are less than the worst case defined would give rise to a reduced impact. Worst case parameters will necessarily differ from topic to topic and from receptor to receptor. Further detail on the specific Design Envelope parameters identified for each EIA topic is provided within each of the relevant technical chapters of this Offshore EIAR (Chapters 7 to 21).

In conjunction with the EIA, a Habitats Regulations Appraisal (HRA) is also carried out under a separate legislative regime. The HRA process for the Offshore Development is discussed further in Section 6.5.

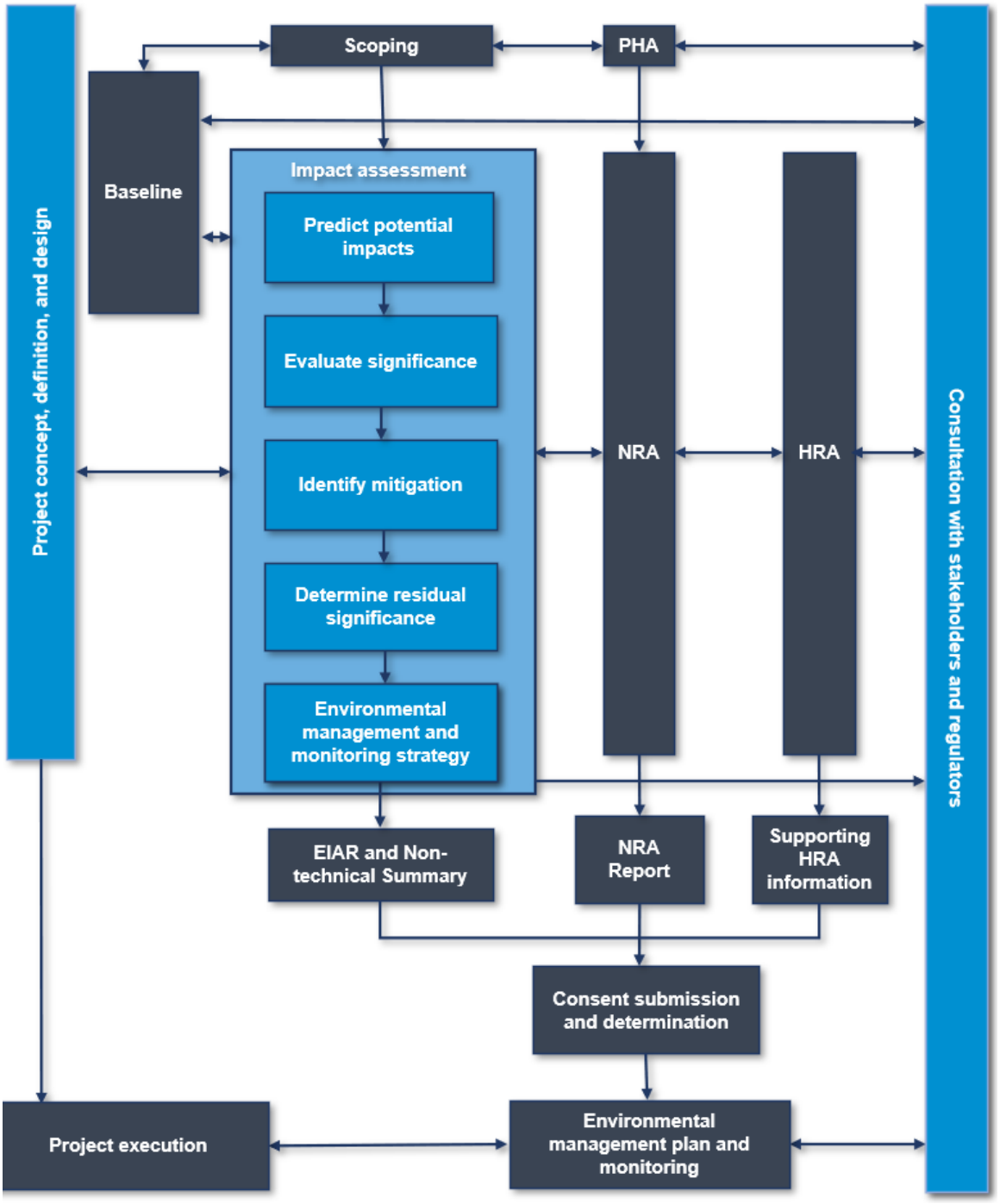

Figure 6.1 Overview of the EIA process

6.3.1 Scoping and Consultation

The process to determine which elements of the environment are likely to experience significant effects as a result of a proposed development, and thus need to be considered by an EIA, is referred to as 'scoping'. In line with the EIA Regulations, a developer may request a Scoping Opinion from a determining authority, this being an opinion on the scope and level of detail to be provided within an EIAR. Where a Scoping Opinion has been adopted, the EIA must be based on the Scoping Opinion.

6.3.1.1 Scoping Report December 2020

In December 2020, Highland Wind Limited (HWL) submitted a Scoping Report for the Project to Marine Scotland Licensing Operations Team (MS-LOT) on behalf of Scottish Ministers. The Scoping Report (HWL, 2020) detailed the physical, biological, and human receptors which the Offshore Development and Onshore Development could potentially interact with and proposed impacts which could reasonably be expected to occur, with these to be taken forward for assessment within this Offshore EIAR. The Scoping Report also identified impacts on the identified receptors which were unlikely to occur, and, as such, should be scoped out of the assessment based on the baseline characterisation undertaken and applied expert judgement.

The Scoping Report was submitted to 87 consultees for consultation by MS-LOT. In response to the Scoping Report, a Scoping Opinion (MS-LOT, 2021) was received in September 2021 which collated the consultation responses on the Project's EIA proposal from 23 statutory and non-statutory consultees that had provided comments.

Following the submission of the Scoping Report, HWL took the decision to submit a separate consent application to THC for the Onshore Development. Consequently, the original deemed planning approach proposed within the Scoping Report is no longer being progressed. In line with this new approach, a separate consent application for the Offshore Development has been prepared and submitted to Marine Scotland (MS), supported by this Offshore EIAR. Therefore, only advice within the Scoping Opinion of relevance to the Offshore Development is considered within this Offshore EIAR.

6.3.1.2 Scoping Report Addendum December 2021

Since the submission of the December 2020 Scoping Report (HWL, 2020), a series of changes have been made to the design of the Offshore Development. To ensure scoping consultation feedback on the Offshore Development was appropriate, HWL submitted a Scoping Report Addendum to MS in December 2021 (HWL, 2021). The addendum detailed the revised Offshore Development parameters and any required amendments to the EIA methodology for appropriate environmental receptors. Subsequently, a Scoping Opinion 'Addendum' for the Offshore Development was received from MS-LOT in May 2022 (MS-LOT, 2022).

6.3.1.3 Topics Assessed Within the EIA

The Scoping Opinion (MS-LOT, 2021) and the Scoping Opinion 'Addendum' (MS-LOT, 2022), together with feedback from stakeholder engagement undertaken throughout the EIA process (see Chapter 4: Stakeholder Engagement), have been reviewed and the implications for the Offshore Development and EIA considered. A summary of the key technical topics 'scoped in' for assessment within the EIA, based on the Scoping Opinion and the Scoping Opinion 'Addendum', are listed in Table 6.5, which also signposts to where these assessments are considered within this Offshore EIAR. No topics have been scoped out of the EIA.

Further detail of the Scoping Opinion consultation responses and how these have been considered are discussed within each of the relevant technical assessment chapters of this Offshore EIAR (Chapters 7 to 21).

Table 6.5 Technical topics 'scoped in' to the EIA

EIA Topic	Key Consultees / Bodies	Scoped in/ out of EIA	Offshore EIAR Reference
Biological Environment			
Marine Physical Processes	Marine Scotland Science (MSS) NatureScot	Scoped In	Offshore EIAR (Volume 2) Main Report – Chapter 7: Marine Physical Processes
Water and Sediment Quality	MSS Scottish Water	Scoped In	Offshore EIAR (Volume 2) Main Report – Chapter 8: Water and Sediment Quality
Benthic Ecology	MSS NatureScot THC	Scoped In	Offshore EIAR (Volume 2) Main Report – Chapter 9: Benthic Ecology
Fish and Shellfish Ecology	Caithness District Salmon Fishery Board Fisheries Management Scotland MSS NatureScot Northern District Salmon Fisheries Board Scottish Fishermen's Federation THC	Scoped In	Offshore EIAR (Volume 2) Main Report – Chapter 10: Fish and Shellfish Ecology
Marine Mammals and Other Megafauna	MSS NatureScot THC Whale and Dolphin Society	Scoped In	Offshore EIAR (Volume 2) Main Report – Chapter 11: Marine Mammals and Other Megafauna
Marine Ornithology	MSS NatureScot Royal Society for the Protection of Birds THC	Scoped In	Offshore EIAR (Volume 2) – Chapter 12: Marine Ornithology
Human Environment			
Commercial Fisheries	MSS North and East Coast Regional Inshore Fishery Group Northern District Salmon Fisheries Board Scottish Fishermen's Federation	Scoped In	Offshore EIAR (Volume 2) Main Report – Chapter 13: Commercial Fisheries
Shipping and Navigation	Marine and Coastguard Agency Northern Lighthouse Board Orkney Islands Council - Marine Services and Transportation	Scoped in	Offshore EIAR (Volume 2) Main Report – Chapter 14: Shipping and Navigation

EIA Topic	Key Consultees / Bodies	Scoped in/ out of EIA	Offshore EIAR Reference
	Royal Yachting Association Scottish and Southern Energy UK Chamber of Shipping		
Aviation and Radar	Aberdeen and Glasgow Airports Aberdeen International Airport Civil Aviation Authority Highlands and Islands Airports Ministry of Defence National Air Traffic Services THC	Scoped in	EIAR (Volume 2) Main Report – Chapter 15: Aviation and Radar
Seascape, Landscape, and Visual Amenity	Historic Environment Scotland NatureScot Orkney Islands Council THC	Scoped in	EIAR (Volume 2) Main Report – Chapter 16: Seascape, Landscape, and Visual Amenity
Marine Archaeology and Cultural Heritage	Historic Environment Scotland THC	Scoped In	EIAR (Volume 2) Main Report – Chapter 17: Marine Archaeology and Cultural Heritage
Other Users of the Marine Environment	British Telecoms (Radio Network Protection Team) Joint Radio Company Ministry of Defence MSS Scottish and Southern Energy Scottish Sea Farms SIMEC Atlantis Energy Ltd THC	Scoped in	EIAR (Volume 2) Main Report – Chapter 18: Other Users of the Marine Environment
Socio-economics, Recreation, and Tourism	Marine Scotland Marine Analytical Unit THC	Scoped in	EIAR (Volume 2) Main Report – Chapter 19: Socio-economics, Recreation, and Tourism
Climate Change and Carbon	MSS Royal Society for the Protection of Birds THC	Scoped in	EIAR (Volume 2) Main Report – Chapter 20: Climate Change and Carbon
Risk of Major Accidents or Disasters	THC	Scoped In	EIAR (Volume 2) Main Report – Chapter 21: Risk of Major Accidents and/or Disasters

EIA Topic	Key Consultees / Bodies	Scoped in/ out of EIA	Offshore EIAR Reference
Turbine Noise Assessment	THC	Scoped in	EIAR (Volume 2) Main Report – Chapter 5: Project Description EIAR (Volume 3) Appendix 5.1: Operational Turbine Noise

6.4 EIA Methodology

6.4.1 Application of the Design Envelope

The Offshore Development's EIA is based on a Design Envelope approach. This approach is standard practice in Scotland and the UK for large scale-developments where the exact project requirements cannot be confirmed at the pre-application stage; for example, the exact WTG model will not be selected until later in the development process due to technology advances. To address such uncertainty, a degree of flexibility within consent applications is necessarily required at the point of application. Under the Design Envelope approach, a number of consent conditions are included within the issued consent notices which will ensure that the final design of the Offshore Development does not exceed the Design Envelope on which the assessment was based or lead to a significant effect which has not been assessed. This allows for the detailed design of the Offshore Development to be further refined, within the consented Design Envelope, as engineering design details and environmental information become available, without rendering the supporting EIA inadequate.

Under the Design Envelope approach, the assessment for each receptor and potential impact is based on the project design parameters likely to result in the maximum adverse effect (i.e. the worst case scenario) to a given receptor. If a combination of design parameters leads to a scenario that cannot realistically occur, then the worst case scenario is reconsidered and a realistic set of worst case parameters is assessed. The result is an EIA based on clearly defined environmental parameters that will define the range of development possibilities and the likely environmental impacts that could result from a proposed development.

Utilising the Design Envelope approach means that receptor-specific potential impacts draw on the options from within the wider Design Envelope that represent the most realistic worst case scenario. As a result, the worst case scenario may differ from one receptor to another and from one impact to another based on the combination of parameters selected. The worst case scenarios assessed for the Offshore Development for each impact are detailed in the relevant technical assessment chapters within this EIAR (Chapters 7 to 21).

The use of the realistic 'worst case scenario' approach used within this Offshore EIAR provides for a cautious assessment of the potential impacts of the Offshore Development on the environment, in alignment with the recently updated Scottish Government guidance 'Good Practice Guidance for Applications under Section 36 and 37 of the Electricity Act 1989' (Scottish Government, 2022).

6.4.2 Characterisation of the Existing Environment

Characterisation (a description) of the existing environment was undertaken to establish the baseline conditions in the Offshore Site, where the Offshore Development is located, and relevant surrounding study areas. Characterisation of the baseline environment for each EIA receptor chapter follows the steps listed below:

- Defining study areas for each receptor based on the relevant characteristics of the receptor (e.g. mobility/range);
- Reviewing available information;
- Reviewing likely or potential impacts that might be expected to arise from the Offshore Development;
- Determining if sufficient data are available to make the EIA judgements with sufficient confidence;

- If further data are required, ensuring the data gathered are targeted and directed at answering key question(s) and filling key data gaps; and
- Reviewing information gathered to ensure the environment can be characterised in sufficient detail and confirming that the data are suitable to make the EIA judgements with sufficient confidence.

The specific approach to establishing a robust baseline (upon which impacts can be assessed) for each receptor is set out in the relevant technical assessment chapters within this Offshore EIAR (Chapters 7 to 21).

6.4.3 Assessment of Significant Effects

Central to the identification and assessment of the potential effects of a proposed development is the conceptual 'source-pathway-receptor' model (see Figure 6.2).

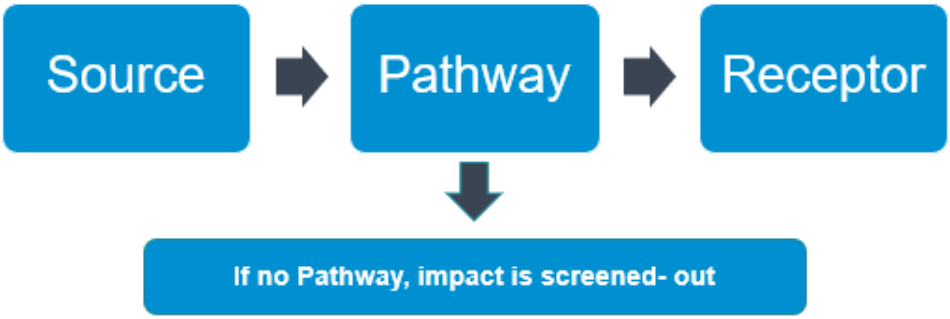

Figure 6.2 Source-pathway-receptor model

In the source-pathway-receptor model, the source represents an activity related to a proposed development (e.g. anchoring leading to an increase in suspended sediment), the pathway represents the route through the environment by which the effects of an activity are transmitted (e.g. sediment transported through tidal flows and currents), and the receptor is the environment or resource that receives the impact which causes an effect to the receptor (e.g. benthic habitats). Where there is no known 'pathway' then no effect is considered to occur on a receptor.

In the context of this Offshore EIAR, an 'impact' is considered to result in an 'effect' if a pathway to a receptor exists:

- **Impact:** An impact is a change to the baseline environment arising from an activity or event related to the Offshore Development. Impacts can be defined as direct, indirect, transboundary, cumulative, and inter-related. They can also be positive or negative, temporary or permanent. A permanent impact may occur when recovery is not possible within a reasonable timescale. In contrast, a temporary impact is one where natural recovery is possible over a short time period or where mitigation measures can be utilised to reverse the impact.
- **Effect:** An effect is the consequence of an impact on a given receptor. Effects are presented as 'significance of effect', which combines the magnitude of an impact with the sensitivity (or importance) of a receptor in line with defined significance criteria.

The approach to making balanced assessments for the Offshore Development for each identified receptor was guided by the authoring technical experts using available data, experience, and expert judgement. The approach also considered the following:

- The magnitude and likelihood of impact on the receptor;
- The sensitivity of the receptor to the impact;
- The significance of the resultant environmental effect on the receptor; and
- Any mitigations required to offset the resultant effect to the receptor.

Whilst assessing the significance of effects is necessarily a subjective exercise, a defined methodology and matrix have been used in each EIA receptor chapter to ensure the assessment is as objective as possible and to allow for the comparison of effects. This standardised matrix is set out in Section 6.4.4.

Whilst the assessment of effects follows a defined methodology to ensure consistency across assessments, the competent topic expert utilises professional judgement to ensure that the significance assigned is appropriate and in line with best practice guidance and experience. Deviations from this standardised approach are discussed below in Section 6.4.5.

6.4.3.1 Defining impact magnitude

Defining impact magnitude requires consideration of how the following factors will impact on the baseline conditions:

- Spatial extent: The area over which the impact will occur;
- Duration: The period of time over which the impact will occur;
- Frequency: The number of times the impact will occur over the Offshore Development's life-cycle;
- Intensity: The severity of the impact;
- Likelihood: The probability that the impact will occur and the probability that the receptor will be present; and
- Reversibility: The ability for the receiving environment / exposed receptor to return to baseline conditions.

Based on these parameters and expert judgement, a summarised description on the assignment of impact magnitude criteria is provided in Table 6.6.

Table 6.6 Impact magnitude criteria

Magnitude	Criteria
High	The impact occurs over a large spatial extent resulting in widespread, long-term, or permanent changes in baseline conditions or affects a large proportion of a receptor population. The impact is very likely to occur and/or will occur at a high frequency or intensity.
Moderate	The impact occurs over a local to medium extent with a short- to medium-term change to baseline conditions or affects a moderate proportion of a receptor population. The impact is likely to occur and/or will occur at a moderate frequency or intensity.
Low	The impact is localised and temporary or short-term, leading to a detectable change in baseline conditions or a noticeable effect on a small proportion of a receptor population. The impact is unlikely to occur or may occur but at low frequency or intensity.
Negligible	The impact is highly localised and short-term, with full rapid recovery expected to result in very slight or imperceptible changes to baseline conditions or a receptor population. The impact is very unlikely to occur; if it does, it will occur at a very low frequency or intensity.
No Change	No change from baseline conditions.
Note: The magnitude of an impact is based on a variety of parameters. The definitions provided above are for guidance only and may not be appropriate for all impacts. For example, an impact may occur in a very localised area but at a very high frequency / intensity for a long period of time. In such cases, expert judgement is used to determine the most appropriate magnitude ranking as explained through the narrative of the assessment.	

6.4.3.2 Receptor sensitivity

Determining receptor sensitivity is part of the significance of effects assessment. Receptor sensitivity is defined as 'the degree to which a receptor is affected by an impact'.

Overall receptor sensitivity is determined by considering a combination of value, adaptability, tolerance, and recoverability. This is achieved by applying known research and information on the status and sensitivity of the receptor under consideration coupled with professional judgement and past experience.

The key to assessing a receptor's vulnerability is determining the ability of a receptor to adapt to change, tolerate, and/or recover (along with the timing for recovery) from potential impacts. Table 6.7 details the criteria used to define sensitivity in terms of adaptability and recoverability.

Table 6.7 Receptor sensitivity (ability to recover and adaptability)

Receptor Sensitivity	Definition
Very high	The receptor has no capacity to accommodate a particular effect and no ability to recover or adapt.
High	The receptor has a very low capacity to accommodate a particular effect with a low ability to recover or adapt.
Moderate	The receptor has a low capacity to accommodate a particular effect with a low ability to recover or adapt.
Low	The receptor has some tolerance to accommodate a particular effect or will be able to recover or adapt.
Negligible	The receptor is generally tolerant and can accommodate a particular effect without the need to recover or adapt.

Receptor value considers whether, for example, a receptor is rare, has protected or threatened status, and/or has importance on a local, regional, national, or international scale. In the case of biological receptors, receptor value also considers whether a receptor plays a key role in ecosystem function. Value is therefore receptor-specific and is defined within each technical chapter of this Offshore EIAR (Chapter 7 to 21).

The overall sensitivity for each receptor is determined through professional judgement in line with the recoverability, adaptability, and sensitivity criteria provided above and the receptor value, as defined by the technical specialist for each receptor assessed.

6.4.4 Evaluation to Determine Significance of Effect

The significance of an effect is determined within each technical chapter by correlating the magnitude of the impact and the sensitivity of the receptor whilst utilising professional judgement and industry best practice guidance, science, and accepted approaches.

To ensure transparency and consistency throughout this Offshore EIAR, a matrix approach has been adopted to guide the significance of effects assessment (see Table 6.8). Importantly, latitude for professional judgement in the application of this matrix is permitted where deemed appropriate. Deviations from this matrix are set out within the relevant technical chapters of this Offshore EIAR (Chapters 7 to 21).

Table 6.8 Significance of effects matrix

Significance of Effects Matrix					
Receptor Sensitivity	**Magnitude of Impact**				
	No Change	Negligible	Low	Moderate	High
Negligible	Negligible	Negligible	Negligible	Negligible	Minor
Low	Negligible	Negligible	Minor	Minor	Moderate
Moderate	Negligible	Minor	Minor	Moderate	Major
High	Negligible	Minor	Moderate	Major	Major
Very High	Negligible	Minor	Major	Major	Major

Definitions of significance of effect are provided in Table 6.9. For this Offshore EIAR, any effect with a significance of moderate or greater is generally considered 'significant' in EIA terms and additional mitigations may be required. Effects identified as minor or negligible are generally considered to be ‘not significant’ in EIA terms. For each topic-specific chapter, ‘significant’ is clearly defined. Where further mitigation is not possible, a residual significant effect may remain.

Table 6.9 Assessment of consequence

Assessment Consequence	Description (consideration of receptor sensitivity and value and impact magnitude)	Significance of Effect
Major Effects	Effects (beneficial or adverse) are likely to be highly noticeable and long-term, or permanently alter the character of the baseline and are likely to disrupt the function and/or status / value of the receptor population. Effects may have broader systemic consequences (e.g. to the wider ecosystem). Such adverse effects are a priority for mitigation in order to avoid or reduce the anticipated significance of the effect.	Significant
Moderate Effects	Effects (beneficial or adverse) are likely to be noticeable and result in lasting changes to the character of the baseline and may cause hardship to, or degradation of, the receptor population, although the overall function and value of the baseline / receptor population are not disrupted. Such adverse effects are a priority for mitigation in order to avoid or reduce the anticipated significance of the effects.	Significant
Minor Effects	Effects (beneficial or adverse) are expected to comprise noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause long-term degradation or hardship or impair the function and value of the receptor. Such adverse effects are typically not contentious and generally will not require additional mitigation but may be of interest to stakeholders.	Not Significant
Negligible	Effects are expected to be either indistinguishable from the baseline or within the natural level of variation. Such effects do not require mitigation and are not anticipated to be a stakeholder concern and/or a potentially contentious issue in the decision-making process.	Not Significant

6.4.4.1 Mitigation

Where an impact assessment identifies that an aspect of the Offshore Development is likely to give rise to significant adverse effects, mitigation measures have been considered to avoid impacts, reduce impacts to acceptable levels, or, if possible, enhance the environment.

For the EIA, two types of mitigation have been defined:

- **Embedded mitigation:** Mitigation measures that are identified and adopted as part of the evolution of the Offshore Development's design. Such measures are considered in the significance of effect assessment (i.e. they are assumed to form part of the design of the Offshore Development prior to any assessment).
- **Additional mitigation:** Mitigation measures that are identified during the EIA process specifically to reduce or eliminate any predicted significant adverse effects. Additional mitigation measures are therefore subsequently adopted for the Offshore Development as a project commitment and will be agreed upon in consultation with the relevant stakeholders where possible.

6.4.4.2 Residual effects

Residual effects are those that remain once all options for removing, reducing, or managing potentially significant adverse effects have been taken into account. Ideally, after taking into account relevant mitigation measures (as discussed in Section 6.4.4.1), any residual effects should no longer be significant (i.e. reduced to an acceptable or insignificant level). In some cases, however, significant residual effects may remain. Where this is the case, explanations as to why such effects cannot be reduced are provided in the relevant technical chapters of this document (Chapters 7 to 21).

It is the role of the regulator, with necessary advice from statutory bodies, through the decision-making process to determine how any remaining residual effects influence the determination of the consent application.

6.4.4.3 Environmental management and monitoring

In certain circumstances, it may be pertinent to implement monitoring of any identified residual effects. Details of any post-consent management and monitoring proposed for the Offshore Development are set out within the relevant technical assessment chapters. This includes, where appropriate, proposals to measure the effectiveness of identified mitigation measures. Monitoring proposals will be discussed and agreed upon with relevant stakeholders prior to implementation.

6.4.4.4 Inter-relationships

The EIA Regulations require consideration of the inter-relationship between environmental topics which may lead to environmental effects. Interrelated effects describe the potential interaction of multiple project impacts upon one receptor which may interact to create a more significant impact on a receptor than when considered in isolation. For example, underwater noise and increased sedimentation impacts may combine to cause synergistic environmental effects on a single receptor. Interrelated impacts may have a temporal or spatial element and may be temporary, short-term, or long-term over the life-cycle of the Offshore Development.

Where relevant, identification of potential inter-relationships between different effects is provided within each technical chapter. It is important to note that the identification of inter-relationships considers only effects produced by the Offshore Development and not those generated by other projects as these are assessed within the Assessment of Cumulative Effects (see Section 6.4.4.6).

6.4.4.5 Transboundary effects

Within the EIA process, transboundary effects are those that would affect the environment of another country in the European Economic Area (EEA). Under the EIA Regulations, the Competent Authority is tasked with determining whether a proposed development is likely to have significant effects on the environment of EEA countries.

The Espoo (EIA) Convention also requires consideration of transboundary environmental effects. Adopted in 1991 in Espoo, Finland, this international agreement requires states, including the UK, to assess the environmental impact of certain activities and to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries. The Espoo (EIA) Convention entered into force on 10 September 1997.

Where the Offshore Development creates the potential for transboundary effects, such effects are assessed and detailed within the relevant technical assessment chapters of this Offshore EIAR (Chapters 7 to 21).

6.4.4.6 Cumulative effects

The consideration of potential cumulative effects is an important stage in the EIA process. Although the Offshore Development may not result in significant residual effects in isolation, when the Offshore Development is considered cumulatively with other developments in the vicinity, significant residual effects may occur. Cumulative effects considered in relation to the Onshore Development and the Offshore Development are discussed in Section 6.4.6 below.

Cumulative effects have been considered within each of the technical chapters and have been considered for all stages of the Offshore Development (i.e. construction, operation and maintenance, and decommissioning). Specific receptors may need to consider a varying list of cumulative projects, depending on the cumulative pathways identified; therefore, the specific cumulative projects considered are detailed within each technical chapter.

The list of cumulative projects has been agreed upon, where appropriate, through consultation with MS and other statutory consultee bodies and takes into account appropriate industry-specific guidance. The list of cumulative projects identified for each receptor and agreed upon through consultation is provided in Offshore EIAR (Volume 3): Appendix 6.1: Cumulative Projects Approach.

The cumulative effects assessment includes the consideration of projects that:

- Are located within the zone of influence of the Offshore Development (the scale of the zone of influence varies depending on the receptor assessed);
- Require an EIA as defined by the EIA Regulations; and
- Have advanced at least to the EIA scoping stage (i.e. an EIA Scoping Report and requests for an EIA Scoping Opinion have been submitted to the relevant regulatory authority) six months prior to the submission of this Offshore EIAR.

The above list is not exhaustive and projects were also considered on a case-by-case basis depending on the specific receptors assessed. Clear justification for the selected projects taken forward is provided within each of the technical assessment chapters. It is important to note that the ability to assess any identified 'future projects' was dependent upon the degree to which information on those projects was publicly available when the cumulative assessment was conducted.

6.4.5 Deviations from the Standard Approach

As set out within this chapter, certain topic-specific impact assessments deviate from the standard approach presented above. This can be due to, for example, specific guidance / practices endorsed by professional accreditation organisations and consultees. Deviations from the standard approach are detailed and explained within the relevant technical chapters.

6.4.6 Assessment of Impacts Cumulatively with the Onshore Development

The Project is comprised of the Offshore Development and the Onshore Development; the latter is the focus of this document. Consents/permissions for each component are being sought separately under different planning regimes: this Offshore EIAR is being submitted to MS to obtain consent for the Offshore Development and a separate consent application will be submitted to THC for the Onshore Development.

In consideration of this, an assessment of the potential cumulative impacts of the Offshore Development with the Onshore Development, on specific topic receptors, is presented within each technical assessment chapter of this Offshore EIAR. The intent is to provide a holistic overview of the cumulative impacts and associated effects of Project activities on the receptors assessed for the Offshore Development. This ensures that the Project's impacts and effects are understood and that neither the Offshore Development nor Onshore Development is considered in isolation.

For the vast majority of receptors assessed in this Offshore EIAR, no pathway exists for Onshore Development activities to cause an impact and result in cumulative effects with the Offshore Development. However, potential pathways may exist for assessment topics which are not wholly marine or terrestrial (e.g.

Ornithology), which creates the possibility for these assessment topics to be affected by Onshore Development activities. As such, a high-level assessment of the cumulative effects of Onshore Development activities is presented, where appropriate, within the technical assessment chapters of this EIAR.

6.5 Habitats Regulations Appraisal

Whilst not specifically a part of the EIA process, an HRA has been carried out for the Offshore Development, in line with Article 6 of the Habitats Directive (92/43/EEC), HRA Case Law, and best practice guidance. The HRA process is carried out to allow the Competent Authority to assess whether a proposed development plan or programme is likely to have significant effects on European sites designated for their nature conservation interests.

A Nature Conservation Appraisal (NCA) Screening Report for the Offshore Development was issued to MS and other relevant stakeholders for comment. The NCA Screening Report included designated sites that were to be assessed for Likely Significant Effects (LSE) under the Habitats Regulations, to fulfil the requirements of HRA, as well as other designated sites (i.e. Nature Conservation Marine Protected Areas [NCMPAs] that required assessment under the Marine [Scotland] Act 2010).

Subsequently, for the HRA process, a Report to Inform the Appropriate Assessment (RIAA) has been prepared and submitted with this application. The RIAA considers whether the potential exists for adverse effects from the Offshore Development on the conservation objectives and integrity of the relevant European sites (Special Areas of Conservation, Special Protection Areas, and Ramsar Sites) where LSE could not be ruled out at screening. The Competent Authority will undertake an Appropriate Assessment based on these findings and must be satisfied that the Offshore Development will not result in LSE on these European sites before granting consent.

Whilst there is likely to be some repetition of information between the NCA Screening Report, RIAA, and this Offshore EIAR, the NCA Screening Report and RIAA do not form part of the EIA process and are therefore only mentioned to provide additional context and information. Designated sites, including NCMPAs, etc., are considered within each of the relevant technical assessment chapters of this Offshore EIAR (Chapters 7 to 21).

6.6 References

Highland Wind Ltd (HWL) (2020). Request for Scoping Opinion. Pentland Floating Offshore Wind Farm EIA Scoping Report. A-100671-S00-REPT-001. 16 December 2020. https://marine.gov.scot/data/scoping-request-pentland-floating-offshore-wind-farm [Accessed 12/01/2022].

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