18 INTERACTIONS OF THE FOREGOING AND A SUMMARY OF MITIGATION MEASURES

18.1 INTERACTIONS OF THE FOREGOING

18.1.1 Introduction

The purpose of this Chapter is to identify significant interactions and interdependencies in the existing environment and set out the likely interactions of, and between effects predicted as a result of the Project. Impact interactions and inter-relationships have been considered throughout the EIA process. The foregoing topics in earlier chapters do not exist in isolation from each other and consequently, any impact on one element of the environment may also affect another.

The requirement for the identification of interactions between the various aspects of the environment as detailed throughout the EIAR is set out in Article 3(1) of the amended EIA Directive 2011/92/EU as amended by the Directive 2014/52/EU, which states:
The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on the following factors: a) population and human health; b) biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC; c) land, soil, water, air and climate; d) material assets, cultural heritage and the landscape and e) the interaction between the factors referred to in points (a) to (d)."

18.1.2 Effect Interactions

Where any potential adverse effects have been identified during the assessment process, these effects have been avoided by embedded design mitigation or at a minimum, reduced by the proposed mitigation measures.

18.2 SUMMARY OF MITIGATION MEASURES

This Chapter summarises mitigation measures proposed elsewhere in the EIAR. Chapter 3 to 17 of the EIAR outlines the findings of the assessment of the predicted effects of the Development on a topic by topic basis. The significance of these effects has been assessed using criteria defined in the topic chapters. In the context of The EPA Guidelines (2022), the significance of effects is categorised from imperceptible through to not significant, significant and profound with varying sub-categories.

18.2.1 Embedded Mitigation

Embedded mitigation includes design changes that were made to reduce or eliminate adverse effects, as well as normal good practice measures; these have avoided the majority of potentially significant effects. **Appendix 18.1 Summary of Mitigation Measures** summarises mitigation measures for all technical assessment chapters.

The process of applying the embedded mitigation is set out in **Chapter 2: Development Description** and in various technical chapters. The key design aspects comprising embedded mitigation include:

- No works will occur within a distance of at least 50 m from watercourses (excluding watercourse crossings)
- No works will occur within a distance to land drains of at least 20 m
- No works will occur within a distance to archaeological monuments and structures of at least 50 m.
- Distance from turbines to inhabited houses of at least 540 m.
- Distance of turbines AT01, AT05, AT07, AT08 and AT13 to active bat roosts of 88 m.
- Distance of turbines AT02, AT03, AT04, AT06, AT09, AT10, AT11, AT12, AT14, AT15 to active bat roosts of 94 m.
- Avoidance of ground slopes of greater than approximately 10 – 14%.
- Avoidance of existing telecommunications infrastructure.
- Avoidance of sensitive habitats, e.g. Wet heath, and/or watercourses containing Fresh Pearl Mussel (*Margaritifera margaritifera*)

18.2.2 Specific Mitigation Measures

In addition to mitigation proposed to address significant adverse effects (**Appendix 18.1**), certain chapters have also proposed further measures to reduce effects that were assessed as 'Not Significant' before mitigation.

Table 18.2 outlines interactions between environmental aspects. Technical assessments have assessed pathways, both direct and indirect that can magnify effects through the interaction or accumulation of effects. Effects have been cross-referenced between chapter topics. An outline of potential interactions between chapters/topics is presented in **Table 18.1**.

Table 18.1: Summary matrix of Interactions of Impacts during Construction, Operational and Decommissioning Phases (Source: Adapted from EIAR Guidelines, 2022)

	Planning & Policy		Population & Human Health		Biodiversity		Ornithology		Soils & Geology		Hydrology and Hydrogeology		Air & Climate		Noise		Landscape & Visual		Material Assets		Cultural Heritage		Shadow flicker		Traffic & Transportation		Major Accidents and Natural Disasters	
	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper	Const & Decom	Oper
Planning & Policy																												
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Hydrology and Hydrogeology																												
Air & Climate																												
Noise																												
Landscape & Visual																												
Material Assets																												
Cultural Heritage																												
Shadow flicker																												
Traffic & Transportation																												
Major Accidents & Natural Disasters																												

Note: Const. = Construction phase; Oper = Operational phase Decom. = Decommissioning

Interaction or inter-relationship

No interaction or inter-relationship

Table 18.2: Interactions & Inter-relationships between Environmental Aspects of the Development

Interaction	Description
Population and Human Health & Hydrology and Hydrogeology	Impacts could be observed through contaminated surface runoff, such as suspended sediment, hydrocarbons, cement-based products and wastewater, polluting water supplies and also fish stocks downstream; **Chapter 9: Hydrology and Hydrogeology** considers these aspects.
Population and Human Health & Noise	The noise assessment inherently covers any interaction as the methodology used and limits applied are designed to protect health and amenity.
Population and Human Health & Landscape and Visual	The construction phase of the Proposed Development will see a temporary introduction of machinery and the erection of 21 turbines into a natural but already modified landscape. **Chapter 12: Landscape and Visual Amenity** assessed the landscape effects, the visual effects and the cumulative effects of the Development, including assessment from recreational scenic viewpoints. The interactions between the environmental aspects were carefully considered in the EIAR, particularly in the design of the turbine layout. Detailed zone of theoretical visibility maps (ZTVs), route screening analysis and photomontages were prepared to assess the level of impact. Based on the findings of the collective assessments it is considered that the Proposed Development will not give rise to any significant effects, either singly or in combination. Tourists to Ireland have become accustomed to the vision of turbines on the landscape and given the scenario where more windfarms will be built in Ireland in the future, the most widely held view is that this will not impact their likelihood to visit the area again.
Population and Human Health & Material Assets: 1. Shadow Flicker 2. Air Navigation 3. Telecommunications 4. Socio-economic	1. Shadow flicker could potentially impact on residences. This assessment has identified the potential for shadow flicker to affect 108No. out of 119 No. receptors within the shadow flicker study area. It is proposed that a shadow control system be installed to eliminate the potential for shadow flicker from the Proposed Development. 2. The assessment identified no significant effects, given that shadow flicker is unlikely to cause a nuisance to nearby inhabited dwellings which are greater than ten rotor diameters from the turbines. It also notes that the function to stop the turbine if required to do so, is available. The potential effects of the Proposed Development from shadow flicker are considered to be **Not Significant**. 3. Operating windfarms have the potential to cause a variety of adverse effects on aviation. Rotating wind turbine blades may have an impact on certain aviation operations, particularly those involving radar. The physical height of turbines can cause obstruction to aviation and the overall performance of communications, navigation and surveillance equipment. All structures over 150m in height are required to have lighting to warn aviation traffic. No significant impacts are predicted in terms of human beings and air navigation. In adherence to IAA Safety Regulations and ICAO Annex 15, aeronautical obstacle warning light schemes will be installed as requested by IAA, co-ordinates of ground and tip height elevations at each wind turbine location as constructed delivered, and the identification of the provision of the intention to commence crane operations provided within a minimum of 30 days prior to erection. 4. During operation, wind turbines have the potential to interfere with electromagnetic signals passing above the ground due to the nature and size of the windfarm. During the construction and decommissioning phase activity, signals may be passed below ground via existing infrastructure. Impacts may include overground or underground communication cables, microwave links, telecommunication links, business radio and television reception.

Interaction	Description
	Mitigation measures were undertaken in the design phase through mitigation by avoidance i.e., the known routes of the telecommunication links were plotted and a buffer was applied to them, outside of which the proposed turbines were located. In the operational phase, all electrical components, equipment, apparatus and systems will be required by Irish and European law to comply with the EMC Directive 2014/30/EU. Compliance with this Directive will mean that the electromagnetic emissions from these devices will not cause interference to other equipment. Turbine and substation control electronics will be typical of any circuits used by industry or a conventional generating station. There is no potential for interference with the links from other windfarms in combination with the Development. Based on the remote location of the Development and a distance of 5554 metres to the nearest inhabited residential dwelling (during operation of the Wind Farm), no significant impacts are predicted on telecommunications or radio reception as a result of the Proposed Development. 5. The Proposed Development will provide opportunities for local suppliers to be engaged in the construction phase. This will be a minor beneficial impact. The Developer will seek to secure positive benefits for the local/regional economy by encouraging the use of local labour, manufacture and suppliers where possible.
Population and Human Health & Air and Climate	Impacts on air quality during the construction and decommissioning phase may occur due to dust emissions from construction activities onsite and through increased traffic and associated exhaust emissions from construction traffic. These interactions have been considered as part of the EIAR, without significant effects being predicted and suitable mitigation measures provided to further reduce potential impacts. During the operational phase, the energy generated by the Proposed Development will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a net positive effect on climate. In doing so, there will likely be reduced effects from climate change on human beings. The cumulative effect of the Proposed Development with other Irish renewable generation is considered to be a fundamental change in the climate effects of Ireland's energy supply, which is a **major, positive effect,** that is **Significant** (beneficial) under the EIA Regulations and will contribute to Ireland's binding emission reduction targets.
Population and Human Health & Cultural Heritage	Potential impacts on cultural heritage assets and tourism have been carefully assessed in **Chapter 14: Cultural Heritage.** No predicted significant direct or cumulative effects on the Cultural Heritage resource arising from the Proposed Development have been identified. There is predicted indirect significant effect at operational stage on Carn House (RPS 187) and an archaeological complex subject to a Preservation Order (MA014-061001- to MA014-061005-) in Carn townland, and at Rathfran Abbey (National Monument Ref. 269). These sites, although without any known astronomical alignments inherent to their design layout, are located at prominent elevated or riverine positions within the landscape. There are no mitigation measures to ameliorate these indirect operational stage effects on setting, however it is noted that the duration of same is long-term and the effect is reversible by decommissioning.
Population and Human Health & Traffic and Transport	The construction and decommissioning phase will give rise to traffic movements of abnormal loads and is likely to create some short-term inconvenience for road users. A **Traffic Management Plan** (TMP) will be in place and minimise disruption insofar as possible. Suitable mitigation measures to reduce dust emissions have been outlined in **Chapter 17: Traffic and Transportation.**

Interaction	Description
Population and Human Health & Major Accidents and Natural Disasters	A wind farm is not a recognised source of chemical pollution. Should a major accident or natural disaster occur, the potential sources of pollution onsite during both the construction and operational phases are limited. There is limited potential for significant natural disasters to occur at the Site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to peat-slide, flooding and fire. In the highly unlikely event that the stability of peat is compromised, an Emergency Response Plan has been prepared and can be found in **Appendix 2.1: Construction Environmental Management Plan, Management Plan 1**.
Biodiversity	All interactions for any habitat or species including those associated with Special Protection Areas (SPA) or Special Areas of Conservation (SAC) are considered in the Natura Impact Statement and not considered further here.
Biodiversity & Hydrology and Hydrogeology	Contamination of surface water and groundwater could occur from many elements including wastewater sanitation contamination, hydrocarbon contamination, watercourse crossings construction, entrainment of suspended solids during earth works, increased entrainment of contaminants and other impacts arising due to localised stability issues, amongst other potential sources. Contamination of water quality could impact both flora and fauna including fisheries, otter, lizards and amphibians (loss of breeding ponds) amongst others. The strict mitigation measures which will be enforced to maintain water quality in local drains and watercourses during the Construction, Operational and Decommissioning phases of the Proposed Development (as described in detail in **Chapter 9: Hydrology and Hydrogeology)** will ensure that there will be no significant residual effects on water quality or aquatic habitats or species, including otter and salmonid fish species. As potential effects on European designated sites as a result of the Proposed Development would arise from contaminants carried within watercourses, it follows that there will be no likely significant effects on identified designated sites with hydrological connectivity with the Proposed Development site.
Biodiversity & Soils and Geology	Potential impacts on biodiversity during the construction and decommissioning phase could include disturbance to birds and mammals from loss / changes in habitat. Loss of blanket bog and wet grassland habitat will be mitigated where possible. Excavated peat and subsoil will be removed to the approved deposition area, with no storage of peat or any other materials on the adjoining bog area. The loss of blanket bog will be offset through a **Biodiversity Enhancement and Management Plan (BEMP)** (**Appendix 6.4**).
Biodiversity & Major Accidents & Natural Disasters	Potential impacts on biodiversity during the construction and decommissioning phase could include disturbance to birds and mammals from loss / changes in habitat. The Proposed Development has been designed in accordance with the best practice measures described in detail in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design.
Ornithology & Noise	The ornithology assessment considers general disturbance to sensitive bird species, including that caused by the sources likely to occur during the construction and decommissioning of the Proposed Development. Likely construction related disturbance to breeding sparrowhawk, buzzard, kestrel and snipe. With mitigation in place, comprising the use of work restrictive zones around

Interaction	Description
	identified nests areas, the disturbance effect will be avoided completely or, at most, reduced to level of Not Significant. Likely construction related disturbance to nests of passerine species, including Red-listed meadow pipit, which is rated as a Significant Adverse Effect of Short-term duration. With mitigation by clearance of vegetation outside of breeding season, and ongoing monitoring as required during the construction phase, effect avoided or reduced to Not Significant.
Ornithology & Major Accidents and Natural Disasters	Potential impacts on biodiversity during the construction and decommissioning phase could include disturbance to birds from loss/ changes in habitat. The Proposed Development has been designed in accordance with the best practice measures described in detail in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design.
Soils and Geology & Hydrology and Hydrogeology and Landscape and Visual	During the design phase, the EIA team adopted a "mitigation by avoidance" strategy to minimise potential impacts on the site's hydrogeological balance. This approach focused on optimising the layout of turbines and associated infrastructure to reduce the volume of earth materials requiring excavation. No significant effects to surface water (quality and flows) and groundwater (quality and quantity, and any local groundwater wells) will occur as a result of the Proposed Development provided the proposed mitigation measures are implemented. A Geotechnical Clerk of Works will be employed during the construction phase in order to continuously monitor areas of peat, in particular areas of deep peat and the areas of potential instability highlighted in the PLHRA. Ongoing physical stability checks and calculations will be undertaken in order to verify that safety standards are being met. Providing the mitigation measures are fully implemented and best practice is followed onsite, it is expected that effects on soils and geology associated with the development of the Wind Farm Site will not be significant.
Soils and Geology & Landscape and Visual & Major Accidents and Natural Disasters	The unavoidable residual impacts on the soils and geology environment as a function of the Proposed Development is that there will be a change in ground conditions at the Wind Farm Site with the replacement of natural materials such as peat, subsoil and bedrock by concrete, subgrade and surfacing materials. Stability issues and slope failure arising from vehicular movement could cause significant local or at worst-case scenario landslide issues. Where suitable mitigation measures are applied and proper precautions and planning are executed effectively, the risk of such potential impacts can be significantly reduced or are considered avoidable. No new impacts are anticipated during the operational phase of the Proposed Development.
Soils and Geology, Landscape and Visual & Archaeology and Cultural Heritage	The construction and decommissioning phase pertaining to the Proposed Development will involve significant ground reduction and topsoil removal throughout the design layout footprint. These potential interactions have been thoroughly assessed in **Chapter 14: Cultural Heritage** of the Environmental Impact Assessment Report (EIAR), which informed the turbine layout design and the development of appropriate mitigation measures. While there are no recorded archaeological sites within the Redline Boundary an additional three features of cultural heritage interest were identified within its Redline Boundary during the desktop study and field surveys carried out as part of this assessment. These features are likely to be directly impacted during construction

Interaction	Description
	stage. The Proposed Development is not predicted to result in likely direct Significant effects on the Cultural Heritage resource at construction stage. There is predicted indirect Significant effect at operational stage at Carn House and Carn archaeological complex, and at Rathfran Abbey. It is acknowledged that this indirect significant effect on landscape setting is reversible at decommissioning stage of the Proposed Development. These interactions were considered in the EIAR, both in the design of turbine layout and in the design of mitigation measures. Archaeological monitoring during the construction phase of works will be undertaken by a suitably qualified archaeologist under licence by the National Monuments Service. In the event that any sub-surface archaeological features are identified during archaeological monitoring they will be securely cordoned off, cleaned and recorded in situ. The National Monuments Service will then be notified and consulted to determine further appropriate mitigation measures, which may include preservation in situ (by avoidance) or preservation by record (archaeological excavation). The Proposed Development will result in a range of moderate-significant indirect negative effects on the settings of archaeological monuments located within surrounding lands during the operational phase. These indirect effects will be long term in duration and will be reversible during the decommissioning phase.
Soil and Geology & Major Accidents and Natural Disasters	The Proposed Development has been designed in accordance with the best practice measures described in detail in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design.
Hydrology & Biodiversity	Fisheries may be impacted by a disturbance or contamination of watercourses. Mitigation measures to protect watercourses are outlined in several chapters and include monitoring of site water run-off during all phases of the Proposed Development.
Hydrology and Major Accidents & Natural Disasters	The Proposed Development will use the latest best practice guidance to ensure that flood risk within or downstream of the Wind Farm Site is not increased as a function of the Proposed Development, i.e., a neutral impact at a minimum. The risk of the Wind Farm contributing to downstream flooding is also very low, as the long-term plan for the Wind Farm Site is to retain and slow down drainage water prior to release. Robust drainage measures on the site will include swales, silt traps, check dams, settlement ponds and buffered outfalls. This has been addressed **in Chapter 9: Hydrology and Hydrogeology.**
Noise & Traffic and Transportation	Traffic and transportation will create noise onsite and along the Site Access Roads. Site contractors will be required to employ the best practicable means of reducing noise emissions from plant, machinery and activities, as advocated in BS 5228.
Noise & Major Accidents and Natural Disasters	Alarms (e.g., for security, fire) will be sounded in cases of emergency. The maintenance of these alarms is essential and any faulty alarm causing nuisance alerts will be replaced accordingly. Incidents such as explosions in the substation buildings will have a noise impact. However, proper maintenance and operation will make this risk unlikely.
Landscape and Visual & Material Assets	The Irish Aviation Authority (IAA) has outlined criteria regarding tall structures and the installation of an aeronautical obstacle warning light scheme for the Development. This has been addressed in **Chapter 13: Material Assets and Other Issues** and is not considered further here.

Interaction	Description
Material Assets & Major Accidents and Natural Disasters	The Proposed Development is not connected to or in the vicinity of any site regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations (SEVESO sites), therefore no significant effects associated with major industrial accidents involving dangerous substances are anticipated. Any technical fault at the Proposed Development would not impact the local or national energy supply. The extremely low frequency (ELF) electric and magnetic fields (EMF) associated with the operation of the proposed cables fully comply with the international guidelines for ELF-EMF set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the World Health Organisation, as well as the EU guidelines for human exposure to EMF. Accordingly, there will be no operational impact on properties (residential or other uses), construction staff, operational & maintenance staff or recreational users of the site as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.
Traffic and Transport & Biodiversity: Fisheries	During the construction and decommissioning phase, increased traffic could lead to increased sedimentation/pollution of watercourses. The interactions between these aspects were considered in the EIAR and mitigation has been embedded in the design and recommended for the implementation of the Proposed Development. This assessment has identified no potentially significant residual effects on Fisheries from Traffic & Transportation, from the Proposed Development.
Traffic and Transport & Major Accidents & Natural Disasters	The Proposed Development will utilise the existing road network during the construction phase with some upgrading of Turbine Delivery Route nodes required. Construction related traffic will originate from the delivery of materials to site, removal of surplus excavated material from site and transport of employees to, from and throughout the site. The localised traffic disruptions will be mitigated through the use of industry standard traffic management measures. Please see **Chapter 17: Traffic and Transport** and **Appendix 2.1** for details.