

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED LITTLETON WIND FARM, CO. TIPPERARY

Volume 2 - Main EIAR Chapter 16 - Interaction of Effects

Prepared for:
Littleton Wind Farm DAC



Date: June 2026

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TABLE OF CONTENTS

16.	INTERACTION OF EFFECTS	1
16.1	Introduction.....	1
16.1.1	Statement of Authority	2
16.2	Assessment of Potential Interactions	2
16.3	Conclusion	10

LIST OF TABLES

	<u>Page</u>
Table 16-1: Summary of the Interactions between Key Environmental Aspects	3
Table 16-2: Description of Interactions between Key Environmental Aspects.....	4



16. INTERACTION OF EFFECTS

16.1 Introduction

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 EIA Directive 2011/92/EU as amended by the Directive 2014/52/EU, which states the following:

“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;*
- e) the interaction between the factors referred to in points (a) to (d).”*

In the preparation of this chapter, regard was had to the Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact interactions (European Commission, 1999)¹, the EPA’s Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (2017)², and the European Commission’s Guidance on the Preparation of the Environmental Impact Assessment Report (2017)³

This Chapter considers the potential for interactions and inter-relationships between each aspect of the environment assessed throughout this EIAR which can result in an impact being either positive or negative, as well as having varying significance. The chapter considers potential significant environmental effects that may occur in terms of the interaction and inter-relationships of Air Quality & Climate, Noise & Vibration, Biodiversity, Ornithology, Land, Soils, & Geology, Hydrology, Hydrogeology & Water Quality, Population & Human Health, Material Assets, Shadow Flicker, Archaeological, Architectural & Cultural heritage, and Landscape & Visual Impact, as a result of the Proposed Development as described in Chapter 4 of this EIAR.

Direct, indirect, cumulative, and interactive impacts were considered during the siting of the proposed turbines and associated infrastructure in order to minimise impacts on the environmental aspects mentioned above. The interactions and inter-relationships of the potential impacts as set out throughout this EIAR are detailed in this Chapter.

¹ European Commission (1999), Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions. Office for Official Publications of the European Communities, May 1999

² Environmental Protection Agency (2017), Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. EPA

³ European Commission (2017), Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report. Publications Office of the European Union



16.1.1 Statement of Authority

This chapter has been prepared by Ida Wulff, and reviewed and approved by Trevor Byrne, both of Fehily Timoney and Company.

Ida Wulff is a Graduate Planner with Fehily Timoney and Company and holds a Masters' degree in Planning and Sustainable Development, and a Bachelor's degree in International Development from University College Cork. Ida has one years' experience preparing EIAR chapter for a range of development types.

Trevor is an Associate Director at Fehily Timoney and a chartered member of Engineers Ireland with over 15 years of industry experience and over 10 years' experience in the preparation of EIAR's for large scale renewable energy projects. Trevor holds a Master's degree in Sustainable Energy Systems and a first-class honours degree in Civil and Environmental Engineering. Trevor also holds an Advanced Diploma in Planning and Environmental Law from the Honourable Society of Kings Inns. Throughout his career to date, Trevor has provided technical advisory services through all stages of project delivery from feasibility assessment, impact assessment, design, expert witness, contract administration and construction.

16.2 Assessment of Potential Interactions

Table 16-1 herein provides a matrix detailing the key interactions and inter-relationships between the key environmental aspects of the Proposed Development, including the wind farm, grid connection route (GC), turbine delivery route (TDR) and biodiversity enhancement management plan lands (BEMP lands) during the construction, operation and decommissioning phases of the Proposed Development. The green squares represent an interaction between environmental aspects.

Table 16-2 provides further details and examples of the diverse range of interaction and inter-relationships between the key environmental aspects.

Each individual chapter of the EIAR has had regard to interactions between different potential impacts. For example, Hydrology, Hydrogeology and Water Quality has had regard to potential impacts on Biodiversity; and Land, Soils and Geology has had regard to potential impacts on both Biodiversity, Hydrology, Hydrogeology and Water Quality and Traffic & Transportation.

The project is made up of four distinct elements as listed below and referred to throughout this Chapter.

- The 'Proposed Wind Farm' (also referred to in this EIAR as the '**Site**');
- The 'Proposed Grid Connection' (also referred to in this EIAR as the '**GC**');
- The 'Turbine Delivery Route' (also referred to in this EIAR as the '**TDR**');
- The 'Biodiversity Enhancement and Management Plan Lands' (also referred to in this EIAR as the '**BEMP Lands**');



Table 16-1: Summary of the Interactions between Key Environmental Aspects

	Air Quality & Climate	Noise & Vibration	Biodiversity	Ornithology	Land, Soils, and Geology	Hydrology, Hydrogeology, and Water Quality	Population and Human Health	Shadow Flicker	Material Assets	Archaeological, Architectural & Cultural Heritage	Landscape and Visual Impact
Air Quality & Climate											
Noise & Vibration											
Biodiversity											
Ornithology											
Land, Soils, and Geology											
Hydrology, Hydrogeology, and Water Quality											
Population and Human Health											
Shadow Flicker											
Material Assets											
Archaeological, Architectural & Cultural Heritage											
Landscape and Visual Impact											



Table 16-2: Description of Interactions between Key Environmental Aspects

Interaction	Description
Air Quality & Climate - Noise & Vibration - Biodiversity - Ornithology - Land, Soils, and Geology - Population and Human Health - Material Assets	The operational phase of the Proposed Development will result in the production of clean sustainable electricity which will offset the burning of fossil fuels and carbon emissions, resulting in positive benefit to air quality. This will result in an overall benefit to human health, as well as improved conditions for biodiversity and ornithology. The renewable electricity generated will provide greater energy security to the national grid, reducing the nation's dependency on fossil fuel and reducing the costs associated with fossil fuel importation. The Proposed Development will have a positive effect on both material assets and a positive effect on air quality, displacing approximately 79,638 tonnes of CO₂ per annum which would otherwise be released to the atmosphere as a result of the burning of fossil fuels. This will also benefit in reducing climate change.
Noise & Vibration - Air Quality & Climate - Biodiversity - Ornithology - Land, Soils, and Geology - Population and Human Health - Material Assets - Landscape and Visual Impact	The operation phase of the Proposed Development has potential to effect on residential amenity and human health as a result of a combination of noise, visual impact and the potential effects of shadow flicker on nearby residential receptors. These effects have been considered in Chapter 11: Noise & Vibration, Chapter 5: Population and Human Health, Chapter 6: Biodiversity, Chapter 7: Ornithology, Chapter 8: Land, Soils and Geology, Chapter 12: Shadow Flicker, Chapter 13: Landscape & Visual Impact and Chapter 15: Material Assets. Mitigation has been set out in each chapter. The predicted noise levels will fall within the guideline noise limits at the Site as described in Chapter 11. With mitigation measures, cumulative operational noise levels of the proposed wind farm and adjacent wind farms will meet the daytime and night-time noise limit derived using the Wind Energy Development Guidelines 2006 and current best practice guidance as set out in Chapter 11: Noise & Vibration.
Biodiversity - Air Quality & Climate - Noise & Vibration - Ornithology - Land, Soils, and Geology - Hydrology, Hydrogeology, and Water Quality - Population and Human Health - Material Assets	During the construction and decommissioning phase of the Proposed Development there is potential for negative effects on biodiversity due to vegetation effects (saturation of vegetation from dust) and soiling effects as a result of construction activity. Vegetation effects can occur up to 15m from sources and soiling effects can occur up to 50m from sources. This is likely to occur as a result of excavation and the migration of dust, which can be exacerbated by increased traffic movements. This can impact on air quality, plant species and habitat. Mitigation has been set out in Chapter 10: Air Quality & Climate, Chapter 6: Biodiversity, Chapter 8: Land, Soils and Geology and Chapter 15: Material Assets in order to reduce potential soiling and vegetation affects including the covering of loads to minimise the potential for fugitive emissions during transport. Use of designated haul routes and appropriate storage of soils in accordance with the soils management plan will be utilised to control this potential impact. During the construction phase there is also potential for effects on biodiversity including bird species as a result of vegetation clearance and movement of soil and the operation of machinery.



Interaction	Description
	These activities will generate noise with potential to displace species and effect foraging and nesting habitats at the Site, GC and TDR. Secondary habitat degradation may occur through a deterioration in water quality as a result of earthworks. With mitigation measures outlined in Chapter 6: Biodiversity and Chapter 7: Ornithology, no effect significance greater than short-term moderate and long-term slight as per EPA (2022) criteria was identified for any residual effect. Mitigation measures have been set out in Chapter 8: Land, Soils and Geology and Chapter 9: Hydrology, Hydrogeology and Water Quality in order to avoid effects on water quality and aquatic species and habitat. Mitigation measures have been set out in Chapter 6: Biodiversity to avoid effects on species and habitats including mammals during construction. During the construction and decommissioning phases of the Proposed Development, sanitary waste and material waste accumulated at the Site has potential to impact on water quality and biodiversity if mishandled or disposed of inappropriately. As set out in the Construction Environmental Management Plan (CEMP) included in Volume III, Appendix 4.1, all on-site waste will be stored appropriately and disposed of at a licenced waste facility. As a part of the Proposed Development, BEMP lands are proposed located wholly within the site boundary, in Littleton Bog. The measures set out in the BEMP include those designed to protect and enhance existing habitats. Higher value habitats will be actively managed to maintain and improve their value and lower value habitats will see specific interventions designed to improve their attractiveness for a range of species. Appropriate planting will increase the available feeding, roosting and nesting cover for wildlife. The implementation of the proposed BEMP measures is expected to have a positive effect on both biodiversity and land-use. This is further detailed in the Biodiversity Enhancement Management Plan (Appendix 6.1).
Ornithology • Air Quality & Climate • Noise & Vibration • Biodiversity • Land, Soils, and Geology • Hydrology, Hydrogeology, and Water Quality • Population and Human Health • Material Assets	The construction phase of the development might also have effects on local bird populations, as laid out in Chapter 7: Ornithology. These relate to disturbance and / or displacement and habitat loss / alteration. A Project Ecologist/Ecological Clerk of Works (ECOW) with appropriate experience and expertise (in implementing ecological mitigation measure for wind farm developments) will be employed for the duration of the construction phase to ensure that all the mitigation measures outlined in relation to the environment are implemented. A buffer zone between turbines and treelines has been applied to minimize risk to bat populations. Pre-construction monitoring surveys will be undertaken, and an Ecological Clerk of Works will be present to oversee the construction works and vegetation clearing. Mitigation measures have been set out in Chapter 11: Noise & Vibration to reduce noise where possible during the construction phase of the project. Following implementation of mitigation measures, the potential effects to species and habitat as a result of this potential interaction is considered slight negative and temporary in duration.



Interaction	Description
Land, Soils, and Geology • Air Quality & Climate • Noise & Vibration • Biodiversity • Ornithology • Hydrology, Hydrogeology, and Water Quality • Population and Human Health • Material Assets • Archaeological, Architectural & Cultural Heritage	The activities associated with the construction and decommissioning of the Proposed Development has potential to result in soil compaction due to use of heavy machinery and construction traffic at the Site. Soil compaction can reduce the infiltration of runoff and may result in areas of standing water which pose potential health and safety issues to construction workers and the general public. There is potential for silt to be carried from the construction site to the public road on the wheels of construction traffic which can cause the soiling of the public road, reducing skid resistance and causing a potential traffic hazard. Mitigation measures have been set out in Chapter 8: Land, Soils & Geology, Chapter 9: Hydrology, Hydrogeology and Water Quality, Chapter 5: Population and Human Health and Chapter 15: Material Assets in order to reduce the potential for the migration of soil to the public road, reduce potential for soil compaction, reduce the occurrence of standing water and maintain best practice health and safety standards on-site and off-site during construction.
Hydrology, Hydrogeology, and Water Quality • Biodiversity • Ornithology • Land, Soils, and Geology • Material Assets • Archaeological, Architectural & Cultural Heritage	The construction phase of the Proposed Development has potential to impact on water quality, aquatic biodiversity and habitats as a result of excavation and vegetation removal. This can result in the deterioration of water quality due to sediment and nutrient release to watercourses and has the potential to impact on European sites which are hydrologically connected to the project, including the Site, GC and TDR. Furthermore, the potential for spillage of hydrocarbons from refuelling or from malfunctioning machinery also has potential to impact on water quality and aquatic biodiversity. Excavation works associated with the installation of the GC may result in suspended solids reaching watercourses, affecting water quality and biodiversity. Suspended solids also have the potential to reach watercourses by being transported from the construction site to the public road on the wheels of construction traffic. This has potential to migrate to roadside drains. Mitigation measures have been set out in Chapter 6: Biodiversity, Chapter 8: Land, Soils & Geology, Chapter 9: Hydrology, Hydrogeology and Water Quality and Chapter 15: Material Assets, in order to reduce potential impact on watercourses and biodiversity. This includes the use of silt traps, silt fencing, swales, settlement ponds, the avoidance of excavations in adverse weather conditions and the use of bunded hydrocarbon stores and refuelling areas. Mitigation by design has also been included in the project. The setback of proposed works from watercourses will reduce the potential for sediment reaching water courses. The re-use of existing culverts for on-site watercourse crossings and the use of horizontal directional drilling on the public road along the GC will avoid instream works and reduce potential for the deterioration of water quality during the construction phase. Construction activities associated with the Proposed Development have potential to result in the erosion of exposed soil which can lead to sediment and nutrient concentrations in surface water run-off. This has potential to impact on ground water and the water of the aquifer beneath the Site and GC area.



Interaction	Description
	Similarly, the potential for spillage of hydrocarbons used on site has potential to impact on ground water quality. This has potential to impact on drinking water of nearby wells which can impact on human health. Mitigation measures are set out in Chapter 8: Land, Soils and Geology and Chapter 9: Hydrology, Hydrogeology and Water Quality to avoid potential impact on ground water. It is assumed that all dwellings within 1km of the Site have groundwater wells, with the closest dwelling located approximately 800m from the nearest proposed turbine. There are no recorded or assumed groundwater supply wells in proximity to the turbine locations where potential for impact to ground water is highest. Excavations associated with the substations, tracks, compound and grid connection will not extend into the underlying bedrock aquifer.
Population and Human Health • Air Quality & Climate • Noise & Vibration • Biodiversity • Ornithology • Land, Soils, and Geology • Shadow Flicker • Material Assets • Archaeological, Architectural & Cultural Heritage • Landscape and Visual Impact	During the construction phase of the Proposed Development there is potential for impact to human health as a result of construction activities. Dust arising from earthworks, vegetation removal, trench excavation along the GC, construction of the new and upgrade of existing access tracks, the temporary storage of excavated materials, the movement of construction vehicles, loading and unloading of aggregates/materials and the movement of material can lead to the migration of dust. Dust emissions arise when particulate matter becomes airborne making it available to be carried downwind from the source. Dust emissions can lead to elevated PM10 and PM2.5 concentrations impacting air quality and potentially impacting human health at nearby dwellings. This is further exacerbated by the increase in traffic movements associated with the construction phase which can spread dust, particularly during dry spells of weather. This potential impact is unlikely to occur at the Site due to the setback of the proposed construction site from nearby dwellings. There is greater potential for this impact to occur along the GC where installation works will be located in close proximity to dwellings. Due to the rolling nature of the proposed grid route works, this will have a short-term, temporary and slight impact on nearby dwellings. Mitigation measures have been set out in Chapter 10: Air Quality & Climate, Chapter 8: Land, Soils & Geology, Chapter 9: Hydrology, Hydrogeology and Water Quality and Chapter 15: Material Assets to avoid the impact of dust on nearby residential properties. Mitigation measures include the use of specific haul routes, diversions and speed limits to limit the spread of dust and the implementation of a dust control plan where construction works will be in proximity to residential properties. The potential susceptibility of the Proposed Development to major accidents and natural disasters is considered in Chapter 5: Population and Human Health. This assessment considers the potential effect of landslides/slope failure, forest fire and flooding.



Interaction	Description
	These events have potential to effect soils and geology, hydrological regimes, water quality, human health and safety of construction workers and the general public, material assets including property and renewable energy projects, roads, infrastructure and natural resources, biodiversity and archaeological monuments. Slope stability has been considered in Chapter 8: Land, Soils and Geology and turbines have been sited to avoid steep slopes and areas of overly deep peat. The magnitude of the potential effects, prior to mitigation, is considered to be negligible and no slope stability issues are anticipated across the site. Flood risk is considered in Chapter 9: Hydrology, Hydrogeology and Water Quality and has regard to the potential effect flooding might have on slope stability. The flood risk assessment concludes that the Proposed Development will have a negligible effect on flood risk around the substation area. This was also assessed with a 20% increase predicted run-off flow to account for potential future climate change. Safety measures have been built into the design of the proposed development to avoid potential for fire and avoid potential for the spreading of fire as set out in Chapter 5: Population and Human Health, including significant setback between infrastructure and treelines, and significant setback of the proposed wind farm from nearby residential and agricultural structures. An Emergency Response Plan has been prepared as part of the EIAR which can be found in the Construction and Environmental Management Plan, Volume 3, Appendix 4.1.
Shadow Flicker - Population and Human Health - Landscape and Visual Impact	Shadow flicker control modules, consisting of light sensors and specialised software, will be installed on the turbines to ensure that mitigation is implemented to reduce shadow flicker occurrence at any receptor. The locations and dimensions of the turbines and shadow flicker receptors can be input into the turbine control software, and when the theoretically optimal on-site conditions for shadow flicker are met (i.e. the light intensity is sufficient and shadow flicker might occur) during operation, then individual turbines would cease operation until the on-site conditions change, or the theoretical period has passed. A setback distance has been applied between the proposed turbines and nearby residential dwellings. The closest residential receptor to a turbine is 851 m south-west of Proposed Turbine T11, and the closest residential receptor to the on site substation is approximately 540 m to the north of the substation. These provisions will provide adequate setback in order to maintain residential amenity at nearby dwellings. The setback will also reduce noise and potential occurrences of shadow flicker impact, reducing potential for this interaction to occur.
Material Assets - Air Quality & Climate - Noise & Vibration - Biodiversity - Ornithology	During the construction phase of the Proposed Development the construction works in combination with the projected increase in traffic has the potential to impact on human health and residential amenity by causing noise nuisance and dust emissions at nearby dwellings. The project's design includes a minimum setback of 800m between nearby dwellings and the proposed turbines. Therefore, the project noise levels at the Site will not exceed guideline limits and the setback distance from the Site to nearby



Interaction	Description
- Land, Soils, and Geology - Hydrology, Hydrogeology, and Water Quality - Population and Human Health	dwelling will reduce potential dust migration and avoid impact from soiling effects. Noise barriers shall also be implemented to mitigate noise emissions from excavation works at the proposed borrow pit. The use of designated haul routes will control the spread of dust and noise as a result of the increased traffic movements. The proposed GC works will result in elevated noise levels at nearby dwellings which may be above the guideline limits for short periods of time in some instances. Mitigation measures include the use of temporary barrier or screen to reduce noise impact and the use of a dust control plan to mitigate against the dispersal of dust. Vehicles and machinery in proximity to dwellings will not wait outside residential properties when idle to reduce impact of noise. Due to the rolling nature of these works, the impact is expected to be moderate short term impact. Potential impacts along the turbine delivery route (TDR) may occur due to the construction of temporary accommodation works to facilitate the delivery of large turbine components.
Archaeological, Architectural & Cultural Heritage - Land, Soils, and Geology - Hydrology, Hydrogeology, and Water Quality - Population and Human Health - Landscape and Visual Impact	There are 37 no. recorded archaeological sites located within the boundary of the Proposed Development Site, and a further there are 101 no. examples located within the surrounding 2km study area. The design of the proposed wind farm has considered the cultural heritage assets and the alignments of nearby monuments. Separation distances have been applied to avoid potential effect. Therefore, there are no expected significant, adverse effects to recreation, amenity and tourism or archaeological, architectural and cultural heritage assets in the area of the proposed wind farm.
Landscape and Visual Impact - Noise & Vibration - Population and Human Health - Shadow Flicker - Archaeological, Architectural & Cultural Heritage	The operational phase of the proposed development has potential to effect landscape and cultural heritage which may have an effect on tourism in the area. As outlined in Chapter 5, there are no major tourism attractions in proximity to the Site. The most significant recreation activity/attractions at the proposed Littleton Wind Farm site is the Littleton Labyrinth which is an existing amenity route developed by Tipperary County Council which provides a shared walking and cycling route connecting the village of Horse and Jockey to Lough Derryvilla. A further walking and cycling route The Midlands Trail Network proposed by Fáilte Ireland and BnM was granted permission in August 2025. The proposed trails link with the Littleton Labyrinth and creates two new stretches of shared walking and cycling routes through the BnM peatlands, namely, between the Former Bord na Mona Factory, Lanespark and the L2111 road towards Littleton and between Lough Derryvilla



Interaction	Description
	and the L2111 towards New Birmingham. These routes are generally outside the proposed Wind Farm Site with the exception of a very short stretch. As part of the Proposed Development, 4.0 km of a new recreational amenity in the form of walking/cycling trails within the Wind Farm Site is being proposed. This will positively interact with landscape and visual impact, as well as population and human health. These proposed trails are further detailed in Chapter 4: Project Description. There are no significant recreation, amenity and tourism attractions located in proximity to the proposed Littleton Wind Farm site and TDR, and as such, the construction, operation and decommissioning phases of the Proposed Development are not expected to have a cumulative effects on major tourism attractions, tourism numbers or tourism revenue. Any identified effects to local recreation and amenity during construction, operation and decommissioning are mitigated against by implementing a number of mitigation measures such as the implementing of a Traffic Management Plan during construction. As further outlined in Chapter 5: Population and Human Health, wind farm development does not have a significant bearing on Tourism. Therefore, the effects associated with landscape and visuals during the operational phase of the proposed development will not have a significant effect on Population and Human Health (Recreation, Amenity & Tourism) and Archaeological, Architectural & Cultural Heritage. A residual permanent significant, positive effect on recreation, amenity and tourism is expected as a result of the provision of new and improved recreation facilities at the proposed wind farm site which will interact with cultural heritage assets, providing public access to stone circles and other monuments at the wind farm site.

16.3 Conclusion

The proposed Littleton Wind Farm project has potential to effect on various environmental aspects as detailed throughout this EIAR. As outlined in this Chapter, there are interactions and inter-relationships between these aspects as described above. The EIAR has considered these interactions and inter-relationships throughout the assessment, firstly through the design of the Site, GC, TDR and the location of BEMP Lands, to avoid effects where possible and also in the definition of suitable mitigation measures to minimise potential effects. It is therefore considered that the potential significant effects associated with the interactions of environmental effects outlined in this chapter will be avoided due to the implementation of mitigation measures as detailed throughout this EIAR.



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