Knockastanna Wind Farm Extension of Operational Life

Chapter 12: Shadow Flicker

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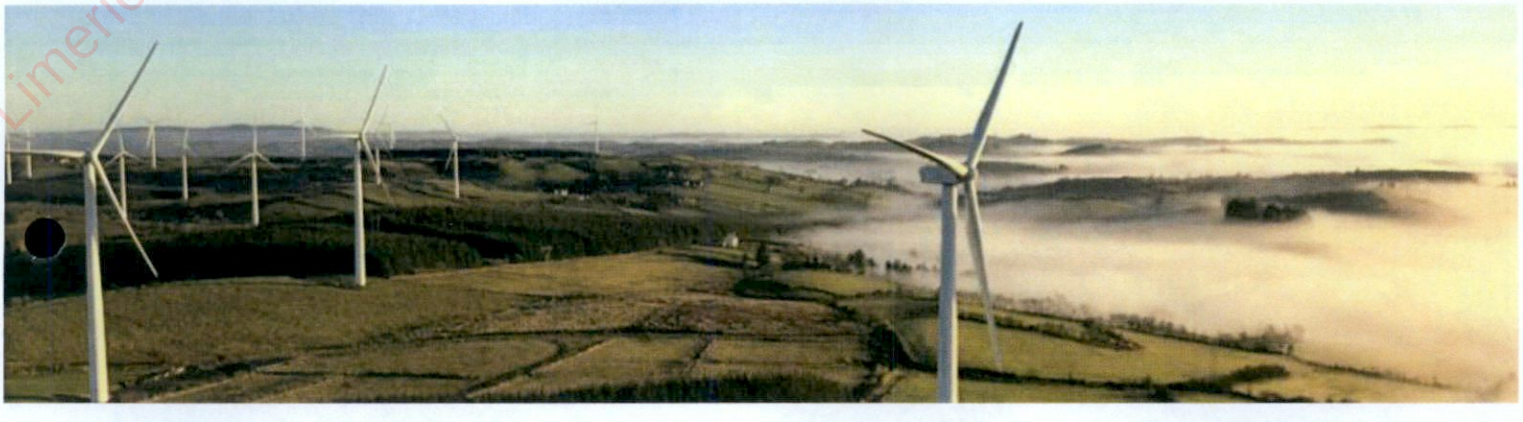

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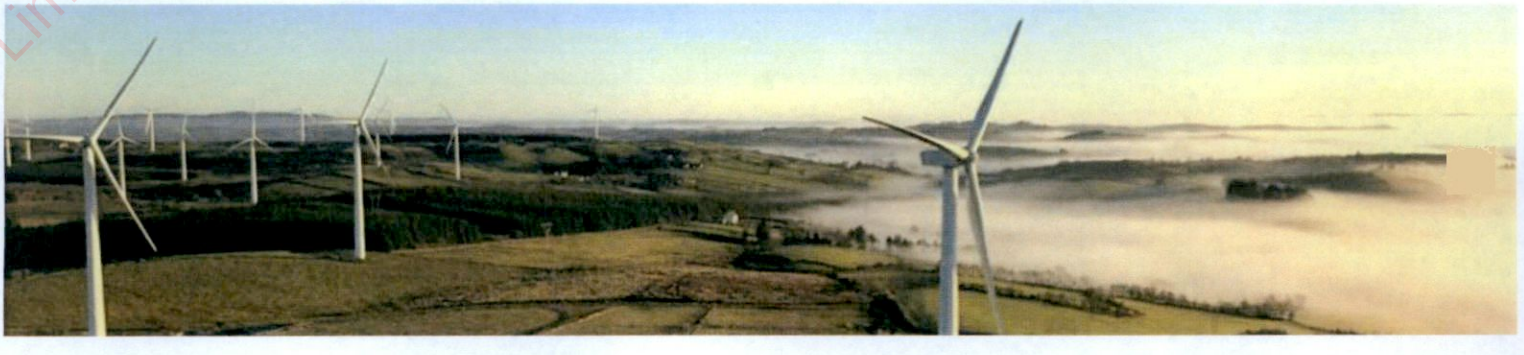


12.1 Introduction

This chapter addresses the likely effects of shadow flicker on nearby properties within the vicinity of the Knockastanna Wind Farm.

As with all tall structures, wind turbines can cast long shadows on neighbouring areas when the sun is low in the sky. During sunny conditions and under certain combinations of geographical position, weather conditions and the time of day, the sun may pass behind the moving wind turbine blades and cause a shadow to flicker on and off of neighbouring properties. This is a phenomenon known as shadow flicker.

Shadow flicker generally lasts only for a short period and happens only in certain specific combinations of weather and geographic conditions such, as follows:-

- The sun is shining and is at a low angle in the sky (after dawn and before sunset);
- The turbine is located directly between the sun and the affected property;
- The wind speed is high enough to move the turbine blades, and
- The turbine blades are orientated such that they are horizontal to the sun.

Given the very low likelihood of such conditions occurring simultaneously, the likelihood of shadow flicker at any receptor is low.

12.1.1 Description of the Proposed Development

In summary, the proposed development comprises the continued operations of the existing wind farm for a further period of 15-years. The existing development, including secondary ancillary developments, consists of the following main components:-

- 4 no. wind turbines;
- Associated turbine foundations and crane hardstandings;
- 1 no. electrical control building with a total footprint of 66 square metres (m^2), including welfare facilities and associated electrical equipment enclosure;
- Underground electrical cabling between each of the existing wind turbines and the electrical control building;
- 1 no. site entrance and 2km of site access tracks; and
- Site drainage infrastructure.

A full description of the proposed development is presented in **Chapter 3**.

12.2 Statement of Authority

This chapter has been prepared by members of the GES Planning & Environment Team, with specialist technical input provided by Joseph Buckley, Technical Services Engineer at GES. Joseph has significant experience of preparing shadow flicker prediction models for existing and permitted wind energy developments, including a number of operational phase shadow flicker monitoring programmes, and has carried out visual inspections to confirm the efficacy of the prediction models and mitigation measures.

12.3 Assessment Methodology

A detailed assessment of the likely effects of shadow flicker was furnished to the Planning Authority as part of the parent planning application for the existing wind farm. An Bord Pleanála, in deciding to grant planning permission, found that here was no likelihood of a significant effect from shadow flicker and that *"...the 'flicker' effect would be very slight..."*[1]. Accordingly, An Bord Pleanála determined that the inclusion

[1] Inspector's Report [p.16] An Bord Pleanála Reference PL13.130938

of a condition of consent limiting the occurrence of shadow flicker was not warranted.

Due to the passage of time since the parent planning application, a further assessment has been undertaken and presented as part of this EIAR. The assessment has been carried out in accordance with all statutory guidelines and uses techniques which are recognised as best practice by the relevant environmental health organisations. The assessment has been prepared in the context of the *Wind Energy Development Guidelines 2006*[2] **('the** 2006 Guidelines') to determine whether the proposed development (i.e. the continued operation of the wind farm for a further 15-years) is likely to result in a significant effect at nearby residential dwellings.

12.3.1 *Wind Energy Development Guidelines for Planning Authorities 2006*

The 2006 Guidelines state:-

> ***"It is recommended that shadow flicker at neighbouring offices and dwellings*** *within 500m should not exceed 30 hours per year or 30 minutes per day. At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Where shadow flicker could be a problem, developers should provide calculations to quantify the effect and where appropriate take measures to prevent or ameliorate the potential effect, such as by turning off a particular* ***turbine at certain times"***

In the first instance, it should be noted that there are no dwellings located within 500m of an existing wind turbine. The 2006 Guidelines state that the likelihood of shadow flicker being experienced at distances greater than 10 no. turbine rotor diameters from a turbine is low. The rotor diameter of the installed wind turbines is 70.5m and, accordingly, all dwellings within 705m of a wind turbine have been included for assessment. A total of 3 no. dwellings are located within this study area; however, it should be noted that only 1 no. of these dwellings is currently occupied. The dwelling identified as H3 is currently unoccupied; however, it is noted that some refurbishment works have been undertaken in recent years. It is unclear as to whether it is proposed for this dwelling to become inhabited; however, for the purposes of this assessment it is assumed that the dwelling may, at some point, be inhabited.

Other elements of the overall development, **including the project's grid connection** infrastructure, are not capable of generating shadow flicker effects and thus have been screened out from further assessment.

12.3.2 *Draft Revised Wind Energy Development Guidelines 2019*

The 2006 Guidelines specify that shadow flicker shall not exceed 30 minutes per day or 30 hours per year at a particular dwelling. In the event that shadow flicker is predicted to exceed either of these thresholds, mitigation measures shall be installed to switch off turbines at times when exceedances are predicted to occur.

The *Draft Revised Wind Energy Development Guidelines 2019* **('the Draft 2019 Guidelines')** propose to fully eliminate the occurrence of shadow flicker at all dwellings, places of work and schools through the installation of automated turbine shut down software. However, as the Draft 2019 Guidelines remain in draft form, and have not been formally adopted, the 2006 Guidelines remain the applicable guidelines under which all wind energy developments must currently be assessed.

[2] The 2006 Guidelines were published subsequent to planning permission having been granted but prior to the construction and commissioning of the Knockastanna Wind Farm.

12.3.3 Passing Frequency

A periodic change in the light produced by the sun occurs at a particular location because of the rotating wind turbine rotor. This is referred to as a pulsating light level. Research[3] has shown that the consequences of the pulsating light level are dependent on the frequency, which is determined by the speed of the rotor blades in the case of wind turbines.

From this research, including research done into the lighting of traffic tunnels, most people tested who experienced frequencies between 5 and 10 Hz (Hertz) were subject to virtually no nuisance. The existing wind turbine model has a typical rotational speed of c. 10rpm (revolutions per minute) and three rotor blades. The maximum passing frequency is, therefore 0.5Hz (30-times per minute), which is well below the accepted level where nuisance is likely to occur. The effects of passing frequencies have, therefore, not been considered in this assessment.

12.3.4 Receptor Survey

The location of all properties within 705m (10-times turbine rotor diameter) of a wind turbine was recorded using Ordnance Survey Ireland (OSI) data, a detailed planning registry search, and a physical survey of the area. A total of 3 no. receptors within 705m of a wind turbine were identified; the locations of which are illustrated at **Annex 12.1**. Again, it should be reiterated that only 1 no. of these dwellings is occupied (H5) with the remaining dwellings (H3 and H4) being unoccupied and/or derelict. It is unclear as to whether it is proposed for dwelling H3 to become inhabited; however, for the purposes of this assessment it is assumed that the dwelling may, at some point, be inhabited.

The topography of the local area, the proposed development site and the elevation of nearby receptors was also modelled using OSI data.

Furthermore, since the commencement of operation of the existing development, the applicant is unaware of any complaints having been received from local residents due to shadow flicker.

12.3.5 Impact Prediction Model & Assumptions

WindPro software, a detailed computer software model which can estimate the likely occurrence of shadow flicker, was used to predict the likely effect of the proposed development. The prediction model assesses the likelihood of shadow flicker occurring at receptor locations relative to the wind turbine locations and with long term average sunshine hours.

It is important to note that shadow flicker is a relatively minor and short-lived phenomenon which only occurs in the very rare instances when a combination of a number of very specific meteorological and physical conditions happen concurrently, as follows:-

- the sun is shining and is at a low angle (after dawn and before sunset);
- there is sufficient direct sunlight to cause shadows (i.e. no cloud, mist, fog);
- the turbine is directly between the sun and the receptor, and within a distance that the shadow has not diminished below perceptible levels;
- there is no screening vegetation or other structures between the turbine and the receptor which would diminish shadow below perceptible levels; and

[3] Department of Energy & Climate Change [Parsons Brinckerhoff] *Update of UK Shadow Flicker Evidence Base Final Report* (2011)

- there is enough wind energy to ensure that the turbine blades are moving.

The concatenation of these conditions to cause shadow flicker at any receptor is highly unusual and even the occasional events that do occur usually go entirely unnoticed.

12.3.5.1 Sunshine Hours & Angle

Shadow flicker cannot occur if the sun is not shining, therefore the probability of sunshine must be considered as part of this assessment. Historical metrological data from the Birr Meteorological Station was used to assess the number of sunshine hours (see **Table 12.1**).

Mean Daily Duration (hours/day)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.57	2.08	2.82	4.36	5.20	4.37	4.15	3.90	3.54	2.68	1.94	1.23

Table 12.1: Average Daily Sunshine Hours between 1981-2010 (Birr)

A simple calculation using the above recorded data shows that the probability of sunshine is approximately 3.15 hours per day when averaged over a 12-month period. The absence of a high mean daily duration of sunshine will result in a significant decrease in the likelihood of shadow flicker effects when the 'worst case' scenario is adjusted to the 'expected' scenario.

There is a great difference in light levels between a shadow at a short distance and a shadow at a long distance. The intensity is greatest at a short distance from the wind turbine since the rotor blade screens the whole of the sun at a short distance. Shadows at a greater distance from the wind turbine have a low intensity since the blades no longer cover the sun completely and, therefore, the light contrast is strongly reduced. If an observer experiences shadow from the sun when it is lower than three degrees above the horizon, the distance to the wind turbine will be of such a length that it is likely that the intensity of the shadow can be ignored. Sunshine is, in Ireland, generally tempered by mist, cloud cover, vegetation growth or buildings in the surrounding area when the position of the sun is lower than three degrees. To account for this, the sun's minimum angle has been set at 3-degrees in the shadow flicker model.

12.3.5.2 Greenhouse Mode

Each receptor is modelled in 'greenhouse mode'. This effectively assumes a conservative 'worst case' impact where each receptor is constructed entirely of glass (windows on all elevations) and that no intervening screening is afforded by walls, vegetation or other opaque objects between the receptor and the wind turbine.

During the site survey, it was noted that H4 and H5 are almost entirely screened from the wind turbines. This screening effect is predominately provided by tall, dense mature trees; while local topography also plays a role in screening the dwellings. While H3 is located on a more 'open' site, topography again plays a role in partially screening the turbines from this dwelling.

Therefore, while each dwelling is modelled in 'greenhouse mode'; this is an extremely conservative approach, presenting worst-case results, and is not assessed as reflecting the actual level of shadow flicker likely to be experienced.

12.3.5.3 Turbine Rotation

The wind turbine model installed at the existing wind farm, a General Electric GE1.5s, has a cut-in wind speed of 4m/s and cut out of 25m/s. According to the Sustainable Energy Authority of Ireland (SEAI) wind atlas, the average adjusted wind speed over the proposed development site is approximately 7.7m/s at 64.7m (i.e. the hub height of the existing turbines). Typically in Ireland, wind speed is between 4m/s and 25m/s for 85% of the time. Therefore, the turbines are likely to be operational for 85% of the year.

The shadow flicker model, however, assumes that the turbine rotors are rotating at all times (i.e. 100% of the time). Therefore, the model is highly conservative, precautionary and does not account for the turbines being non-operational for a variety of reasons including grid unavailability, turbine maintenance and turbine breakdown. The turbine is likely to be non-operational for 15% of the time due to the above factors.

12.3.5.4 Wind Direction & Rotor Orientation

Wind direction plays a crucial role in determining the likelihood of shadow flicker. A wind turbine directs the rotor at right angles to the wind direction (turns the rotors to 'attack' the wind in order to generate power) when there is sufficient wind. The wind direction is, therefore, the critical determining factor for the orientation of the rotor and also for the position of the rotor in relation to the sun.

Given weather variability, it is not possible that that sunshine will always coincide with wind turbines facing parallel to the sun such that the blades are orientated in a horizontal position (directly or indirectly) to cause shadow flicker at any receptor. However, it is assumed for the purposes of the model that, when the sun is shining, wind direction is such that shadow flicker can be caused at all receptors simultaneously.

12.3.5.5 Summary of Assumptions

In summary, the 'worst case' shadow flicker model calculation is based on a number of conservative and highly precautionary assumptions, as follows:-

- When the sun is always shining, there is constant adequate wind speed such that each turbine is always rotating and that the turbine rotor tracks the sun by orientating the turbine exactly as the sun moves, such that shadow flicker is caused at receptors;
- Ordnance Survey Ireland digital data is used as the only topographical reference. Simulations are run on a 'lunar landscape' without allowing for the obscuring effect of any vegetation or other structures between the location of receptors and the position of the sun in the sky;
- Each receptor is constructed entirely of glass (windows on all elevations), all the rooms are occupied and that the curtains or blinds, if present, are always open; and
- There will be no downtime for any of the turbines as a result of a mechanical fault, grid availability or routine maintenance.

12.3.6 'Worst Case' versus 'Expected' Shadow Flicker

The 2006 Guidelines require shadow flicker to be limited to 30-minutes per day and 30-hours per year at sensitive receptors. The guidelines provide that applicants should present calculations to quantify the effect of shadow flicker. As a consequence, and in order to demonstrate compliance with the guidelines, the modelling analysis and

calculations are presented in 'minutes per day' and 'hours per year'. The requirement to present the data in this manner is problematic and can often result in a misunderstanding of the actual impact.

This is due to the fact that the long-run accurate modelling of shadow flicker in 'minutes per day' is not possible as weather conditions on a daily basis are inherently changeable over such a short timeframe and evidently cannot be predicted in advance. For example, over the course of a year, the model can assume that it will be sunny for a percentage of the year (based on historic meteorological data) and the 'worst case' predictions can be adjusted accordingly to find the 'expected' shadow flicker hours. However, over the course of a day, it cannot be assumed that it will only be sunny for a percentage of the day (it may be sunny all day or not at all). As a result, the model significantly overestimates the predicted minutes of shadow flicker which will likely be experienced at any receptor on any given day and the 'minutes per day' criterion is not, therefore, representative of actual shadow flicker which will be experienced. Most dwellings will experience considerably less shadow flicker, if any at all. This approach is in full accordance with the precautionary principle.

On the other hand, modelling over the longer timeframe of 1-year, the 'expected' values ('hours per year') consider the probability of sunshine and predominant wind direction based on historic meteorological data. Modelling over such a longer time span is therefore more accurate and more representative of the actual levels of shadow flicker which are likely to be experienced. However, while more accurate, given the assumptions inherent to the prediction model, as set out at **Section 12.3.5**, even the 'expected hours per year' criterion represents a conservative approach.

Therefore, and as is best practice, the shadow flicker values presented in this chapter are conservative 'worst case' hours per day (in accordance with a precautionary approach) and 'expected' hours per year.

12.4 Description of the Existing Environment

The existing wind farm is located in a rural upland area, within County Limerick, adjacent to the administrative boundary with County Tipperary. Land-use in the environs of the proposed development site is largely confirmed to marginal pastoral agriculture with vast tracks of commercial forestry plantations on higher ground. The relative remoteness of the proposed development site and its environs is evidenced by the fact that the area is relatively sparsely populated with a total of 53 no. dwellings located within 2km of a wind turbine[4].

A total of 3 no. receptors have been identified within 705m (10-times turbine rotor diameter) of an existing wind turbine as illustrated at **Annex 12.1**. As described above, only 1 no. of these dwellings (H5) is inhabited (H3 and H4 are unoccupied and/or derelict); while H4 and H5 are almost entirely screened from the wind turbines by mature intervening vegetation.

12.5 Description of Likely Effects

In the first instance, it is important to reiterate that the proposed development does not provide for any additional wind turbines or alterations to the existing wind turbines. Therefore, the level of shadow flicker experienced at dwellings will remain identical to the current operational phase. As stated at **Section 12.3** above; the Board, in granting

[4] There are 53 no. residential dwellings located within 2km of an existing wind turbine; however, it is also noted that the curtilage of 5 no. additional dwellings are located within the 2km area.

the parent permission, concluded *"...the 'flicker' effect would be very slight..."*. Given that there will be no changes to the wind turbines, it is assessed that this conclusion remains valid in respect of the proposed development.

Notwithstanding the above, it was deemed prudent to undertake a further shadow flicker assessment to quantify the predicted occurrence of shadow flicker at each of the 3 no. dwellings within the study area.

12.5.1 'Do-Nothing' Scenario

If the proposed development is not progressed, the existing wind turbines will be decommissioned and dismantled at the end of their permitted operational period and any instances of shadow flicker will no longer occur.

12.5.2 Construction Phase

All construction activities associated with the existing wind farm have been completed and no additional infrastructure is proposed to be constructed.

12.5.3 Operational Phase

As presented in **Table 12.2** (extracted from **Annex 12.2**), the 'worst case' results indicate that 2 no. receptors (H3 and H4) are predicted to experience shadow flicker in excess of the 30-minutes per day threshold prescribed in the *Wind Energy Development Guidelines for Planning Authorities 2006*.

Dwelling ID	'Worst Case' Shadow Flicker (hours per day [hh:mm])	'Expected' Shadow Flicker (hours per year [hh:mm])
H3	0:47	4:44
H4	0:31	2:28
H5	0:25	2:34

Table 12.2: Shadow Flicker Prediction Model Results

However, it is again reiterated that this calculation is a 'worst case' scenario and is not representative of actual or likely shadow flicker effects. As explained above in **Section 12.3.5**, the 'worst case' scenario can only occur under rare and specific combination of circumstances occurring simultaneously i.e. when the sun is at a certain position in the sky, the sun is shining, the turbines rotor is rotating and rotating parallel (directly or indirectly) to the shadow receptor.

Overall, it is assessed that while the prediction model indicates that the 30-minute per day threshold will be exceeded at H3 (which, as described above, is unoccupied but has recently undergone some refurbishment) and at H4; in reality, the likelihood of the specific circumstances occurring to give rise to such an exceedance is extremely low. Therefore, it is concluded that the 'worst case' shadow flicker effects will not be significant.

The 'expected' results over the course of a year; which, while also being likely to significantly overestimate the actual shadow flicker impact, are a more realistic prediction of likely shadow flicker level and incorporate the adjustments described at **Section 12.3.6**; are also presented in **Table 12.2** (extracted from **Annex 12.2**).

The highest prediction of shadow flicker effects relates to H3, which is predicted to experience 4:44 hours per year. H4 and H5 are predicted to experience shadow flicker effect of 2:28 and 2.34 hours respectively over the course of a year. The level of

predicted shadow flicker is substantially below the 30-hours per year threshold prescribed in the 2006 Guidelines and, again, confirms that significant effects will not arise.

It is, therefore, concluded that the proposed development will result in a slight effect at each dwelling located within the study area, which accords with the conclusion of An Bord Pléanala in respect of the parent permission, and will not result in a significant effect on any receptor.

12.5.4 Decommissioning Phase

As the wind turbines will not be operational during the decommissioning phase, shadow flicker will not occur.

12.5.5 Cumulative Effects

Prior to undertaking the impact assessment modelling presented in this chapter, an appraisal of the wider area was undertaken to determine if any cumulative effects could arise with other wind farm developments. While there are a number of wind energy developments to the east and southeast of the Knockastanna Wind Farm; due to the intervening separation distances, there is no likelihood of cumulative effects arising.

12.6 Mitigation & Monitoring Measures

12.6.1 Construction Phase

As there are no construction works to be undertaken, no mitigation are required or proposed.

12.6.2 Operational Phase

The above assessment has concluded that the proposed development will not result in likely significant shadow flicker effects. The predicted effects have been assessed **to be 'slight'**; particularly given the extremely low predicted annual-levels of shadow flicker.

Therefore, given that 2 no. of the affected receptors are currently unoccupied and/or derelict, the remaining receptor is heavily screened from the wind turbines by mature **vegetation, and in the context of the low levels of 'expected' shadow flicker; it is** assessed that no mitigation measures are warranted, and none are proposed.

It should also be noted that no mitigation measures are currently being implemented in respect of the existing wind farm and we refer to the fact that the Applicant is unaware of any shadow flicker complaints having been received since the commencement of operations. This serves to further confirm that significant effects are not being experienced; and, given that no modifications are proposed to the wind turbines, significant future effects are not assessed as likely.

Notwithstanding the above, in the event that a complaint is received and subsequent investigation identifies significant levels (i.e. in excess of the limits prescribed in the 2006 Guidelines) of shadow flicker being experienced at a receptor, appropriate mitigation measures will be implemented.

Should mitigation be required, technological solutions are available, and widely implemented, on wind farm developments where shadow flicker levels are proven to be causing a significant effect. These mitigation measures effectively limit (curtail) the operation of turbines during the infrequent and rare periods when shadow flicker occurs. In short, if a particular turbine is creating shadow flicker effects at a particular

receptor, then the operation of that turbine may be temporarily curtailed. This is usually achieved by turning off the turbines at predetermined times, as predicted by the shadow flicker model, when shadow flicker is proven to occur.

It is important to once again reiterate that mitigation measures are not assessed as likely to be required given the results of the assessment undertaken at **Section 12.5** above.

12.6.3 Decommissioning Phase

As there is no likelihood of shadow flicker effects arising during the decommissioning phase, no mitigation measures or monitoring proposals are required, or proposed.

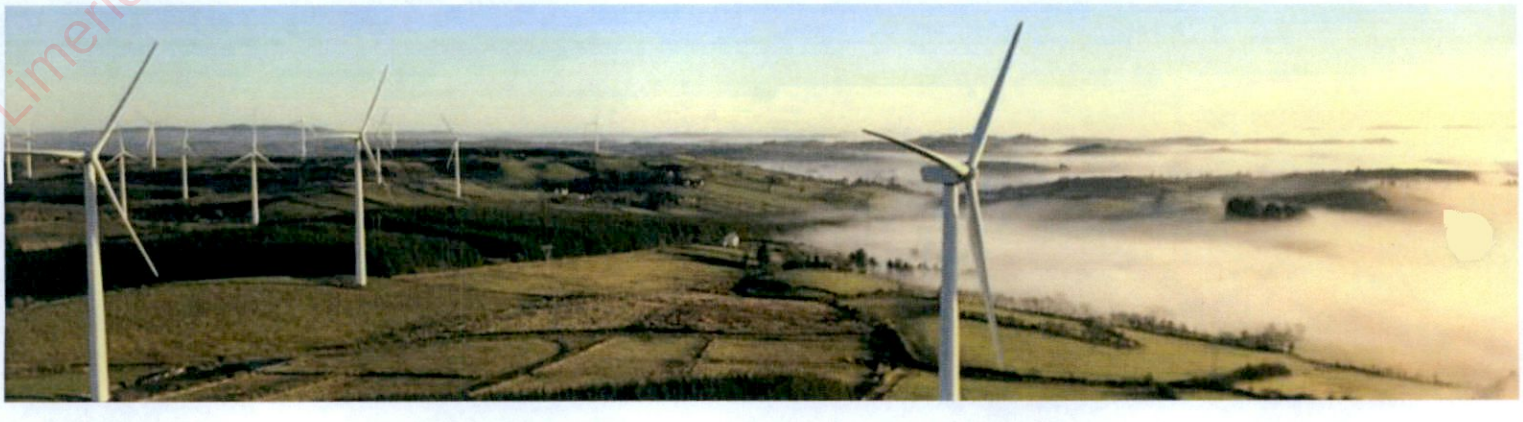
12.7 Residual Effects

As no mitigation measures are proposed, the residual effects will remain as described at **Section 12.5**; and will be **'slight'.** It can be confirmed that no receptor will experience likely significant shadow flicker effects.

12.8 Summary

This chapter has assessed the likelihood of shadow flicker effects at all dwellings (3 no.) located within 10-times the wind turbine rotor diameter (705m) of the existing wind turbines using a shadow flicker model. Shadow flicker is a rare phenomenon and can only occur during the infrequent coincidence of a number of specific, variable meteorological and geographic factors. The shadow flicker model is also based on a number of precautionary assumptions which significantly overestimate the likely shadow flicker impact at any receptor.

While it is predicted that all 3 no. dwellings will experience shadow flicker; it is assessed that no dwelling will experience a significant effect. Over the course of a year, **'expected' shadow flicker levels are extremely low; while local topography and** intervening vegetation will serve to reduce the level of shadow flicker at each dwelling yet further.



Knockastanna Wind Farm Extension of Operational Life

Chapter 13: Material Assets

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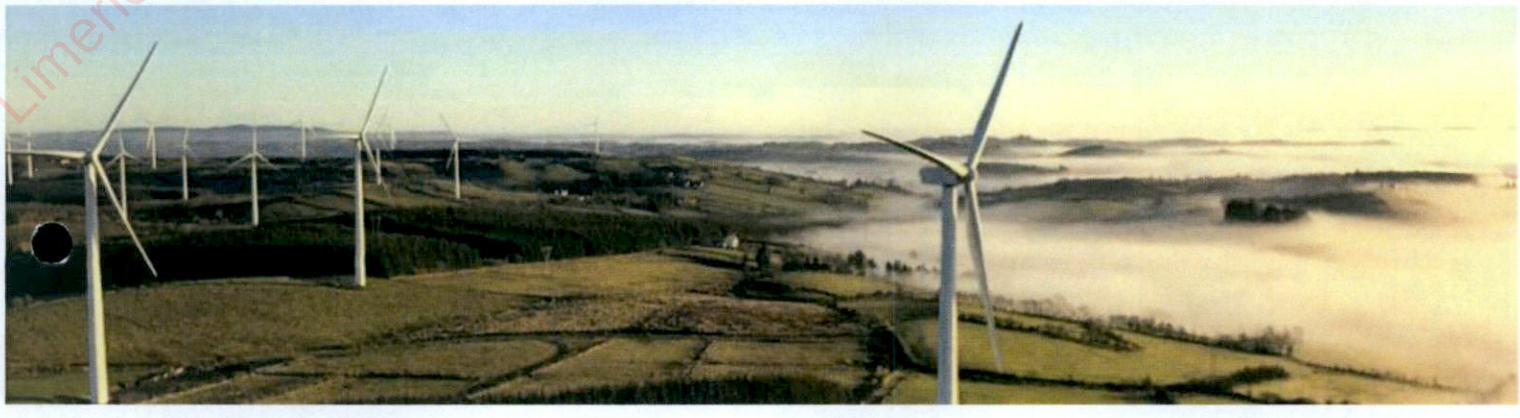

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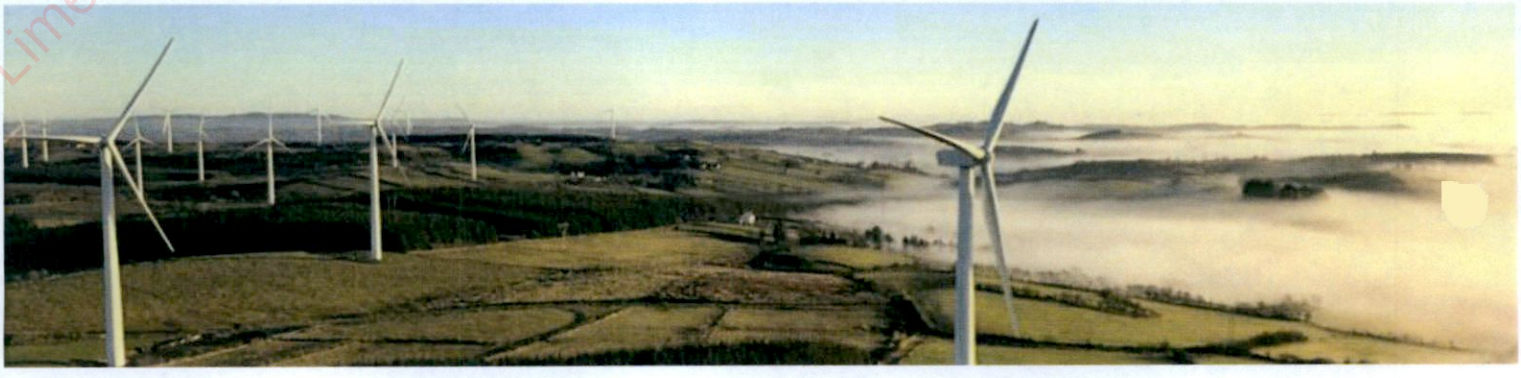

13.0 Introduction

Material assets are *"resources that are valued and that are intrinsic to specific places"* which can be of human or natural origin[1]. While the meaning is less clear than other factors, Material Assets are taken to mean *"built services and infrastructure"*[2]. The majority of assets of natural origin are assessed elsewhere within this EIAR such as biodiversity, water quality, air quality and landscape. This chapter addresses, therefore, assets which are of human origin, including transport, access, aviation, telecommunications, and resources & utility infrastructure. Another material asset of human origin, archaeology and cultural heritage, is addressed in **Chapter 10**.

13.0.1 Description of the Proposed Development

In summary, the proposed development comprises the continued operations of the Knockastanna Wind Farm for a further period of 15-years. The existing development, including secondary ancillary developments, consists of the following main components:-

- 4 no. wind turbines;
- Associated turbine foundations and crane hardstandings;
- 1 no. electrical control building with a total footprint of 66 square metres (m^2), including welfare facilities and associated electrical equipment enclosure;
- Underground electrical cabling between each of the existing wind turbines and the electrical control building;
- 1 no. site entrance and 2km of site access tracks; and
- Site drainage infrastructure.

A full description of the proposed development is presented in **Chapter 3**.

13.1 Transport & Access

13.1.1 Introduction

13.1.1.1 Background and Objectives

This section comprises an assessment of the likely significant effects on transport and access resulting from the continued operation, and decommissioning, of the proposed development. This chapter provides an assessment of the local road network for operational and decommissioning traffic.

13.1.1.2 Statement of Authority

This section has been prepared by members of the GES Environment & Planning Team. GES has substantial experience having prepared Material Asset (Transport & Access) chapters for multiple wind energy EIAR developments.

13.1.2 Methodology

13.1.2.1 Assessment Methodology

This assessment used the following method, further details of which are provided in the following sections:-

- Legislation and guidance review;
- Desk study of the local road network, including review of available maps and published information;

[1] *Draft Advice Notes for preparing Environmental Impact Statements* (EPA, 2015)

[2] *Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (EPA, 2022)

- Evaluation of likely effects;
- Evaluation of the significance of these effects; and
- Identification of measures to avoid and mitigate any likely effects.

13.1.2.2 Planning Policy & Guidelines

This assessment has been prepared and carried out in accordance with guidance contained in the following published documents:-

- Environmental Protection Agency (May 2022): *Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*;
- Environmental Protection Agency (August 2017): *Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*;
- Environmental Protection Agency (September 2015): *Draft Advice Notes on Current Practice in the preparation on Environmental Impact Statements*;
- Environmental Protection Agency (2003): *Advice Notes on Current Practice in the Preparation on Environmental Impact Statements*;
- *Limerick County Development Plan 2010-2016*[3] ('the Limerick CDP');
- *Draft Limerick City & County Development Plan 2022-2028* ('the Draft Limerick CDP');
- *Design Manual for Urban Roads and Streets* ('DMURS')[4];
- *Design Manual for Roads and Bridges* ('DMRB') published by Transport Infrastructure Ireland ('TII'); and
- *Traffic and Transport Assessment Guidelines*[5].

Limerick County Development Plan 2010-2016

An assessment of the relevant transport policies of the Limerick CDP are set out in **Table 13.1** below.

Planning Policy	Assessed	Comment
Policy IN P1: Integration of transport with land use. The Council shall seek to develop a robust evidence-based framework of decision making in infrastructure and development management, to ensure the efficient and timely provision of suitable facilities for access when and where needed. The Council shall also require that the facilities and the land uses they would serve are mutually integrated so as to make optimum use of investment in transport infrastructure. To this end the Council shall seek in particular to implement the provisions of the emerging Mid-Western Area Strategic Plan (MWASP) once fully assessed and adopted.	No	Not considered relevant to the proposed development.
Policy IN P2: Suitability of Facilities. It is policy of the Council to ensure that quality facilities are provided, designed and	No	Not considered relevant to the proposed development.

[3] The lifetime of the Limerick CDP has been extended in accordance with Section 11A of the Planning & Development Act 2000 (as amended).

[4] https://www.gov.ie/en/publication/c808c-design-manual-for-urban-roads-and-streets-2019-low-res/

[5] https://www.tiipublications.ie/library/PE-PDV-02045-01.pdf

Planning Policy	Assessed	Comment
retained for access suitable for all to serve the social, economic and recreational needs of the community, in a manner that is sustainable, of good quality design and safe. The following values shall be paramount: a) Maximisation of sustainable travel patterns b) Promotion of modal shift away from private road transport c) Inclusive access d) Public safety and security e) Minimisation of environmental impact directly and indirectly. f) Cost-effectiveness in the delivery and appropriateness of the infrastructure to purpose.		
Policy IN P3: Land Use planning and accessibility. It is policy of the Council to ensure that considerations of accessibility and mobility are properly incorporated into the assessment and planning of land uses and services, and that land uses are connected to good quality transportation infrastructure.	No	Not considered relevant to the proposed development.
Policy IN P4: Promotion of sustainable patterns of transport use. It is policy of the Council to seek to implement in a positive manner, in cooperation with other Authorities and agencies, the policies of the Mid-Western Regional Planning Guidelines, and the Department of Transport Policy 'Smarter Travel, A Sustainable Transport Future 2009-2020' to encourage more sustainable patterns of travel, and greater use of sustainable forms of transport, including public transport, cycling, and walking.	No	Not considered relevant to the proposed development.
Policy IN P5: Socially Inclusive Access. It is policy of the Council to ensure that in the design and planning of infrastructure and the integration of land use, infrastructure and transport modes that the widest spectrum of needs, including pedestrians, cyclists and those with diverse cognitive, mobility and sensory abilities and impairments, are taken into account.	No	Not considered relevant to the proposed development.
Policy IN P6: Protection of public transport assets and facilitation of public transport. It is Council policy to protect strategic public transport assets; to facilitate accessibility by public transport in development layouts; and to support the enhancement of public transport infrastructure and use through initiatives such as park and ride. To this end	No	Not considered relevant to the proposed development.

Planning Policy	Assessed	Comment
the Council shall seek, in particular, to implement the provisions of the emerging Mid-Western Area Strategic Plan (MWASP) once fully assessed and adopted.		
Policy IN P7: Road Safety and Capacity. To seek the improvement of road safety and capacity throughout the County, through minimising existing traffic hazards, preventing the creation of additional or new traffic hazards in the road network and securing appropriate signage.	Yes	The maintenance of road safety during the period related to the proposed development is assessed at **Section 13.1.4.3**.
Policy IN P8 Strategic Regional Road Network. It shall be the policy of the Council to protect the investment in the Strategic Regional Road Network, prevent the premature obsolescence of this network and maintain and improve road safety and capacity.	No	Not considered relevant to the proposed development.
Policy IN P9 Safeguard the Capacity of National Roads. It is Council policy to safeguard the capacity of the national road network and road safety standards in accordance with the NRAs (National Road Authority) Policy Statement on Development Management and Access to National Roads (May 2006), and subsequent amendments to or replacements of this, including the forthcoming Government guidance on spatial planning and national roads when adopted and the 'Sustainable Rural Housing Development Guidelines' (DEHLG, 2005).	No	Not considered relevant to the proposed development.
Policy IN P10 Protection of Corridors and Route Alignments. The Council will continue to work with the NRA in protecting corridors and route alignments identified for national roads projects from prejudicial development, in accordance with the Mid-West Regional Planning Guidelines, Transport 21 and the National Development Plan.	No	Not considered relevant to the proposed development.

Table 13.1: Limerick County Development Plan 2010-2016 Transport Policies

Given the nature and characteristics of the proposed development, it is likely that there will be an extremely limited interaction with the road network in County Limerick. It is noted, however, that theR505, located c. 6km south of the proposed development is listed as a 'Strategic Regional Route'.

Draft Limerick City & County Development Plan 2022-2028

The Draft Limerick CDP was put on public display in 2021, and is due to be adopted in 2022. **Table 13.2**, below, contains the transport policies contained within the Draft Limerick CDP.

Planning Policy	Assessed	Comment
Policy TR P1 Integration of Land Use and Transport Policies. It is a policy of the Council to support and facilitate the integration of land use and transportation policies, to ensure the delivery of sustainable compact settlements, which are served by sustainable modes of transport.	No	Not considered relevant to the proposed development.
Policy TR P2 Promotion of Sustainable Patterns of Transport Use. It is a policy of the Council to seek to implement in a positive manner, in cooperation with other relevant authorities and agencies, the policies of the NPF, RSES and the Department of Transport's Smarter Travel, A Sustainable Transport Future 2009 – 2020, to encourage more sustainable patterns of travel and greater use of sustainable forms of transport, including public transport, cycling and walking.	No	Not considered relevant to the proposed development.
Policy TR P3 Sustainable Mobility and Regional Accessibility. It is a policy of the Council to support sustainable mobility, enhanced regional accessibility and connectivity within Limerick, in accordance with the National Strategic Outcomes of the National Planning Framework and the Regional Spatial and Economic Strategy for the Southern Region.	No	Not considered relevant to the proposed development.
Policy TR P4 Delivery of Transport Infrastructure in line with National Policy. It is a policy of the Council to support the delivery of transport infrastructure identified within the National Planning Framework, National Development Plan, 2018 – 2027 (and any update) and the Regional Spatial and Economic Strategy for the Southern Region and to support enhanced connectivity within Limerick and inter-urban connectivity within the regions.	No	Not considered relevant to the proposed development.
Policy TR P5 Sustainable Travel and Transport. It is a policy of the Council to support, facilitate and co-operate with relevant agencies to secure sustainable travel within Limerick and seek to implement the 10 minute city/town concept, promote compact growth and reduce the need for long distance travel,	No	Not considered relevant to this development.

Planning Policy	Assessed	Comment
as a means to reduce the impact of climate change.		
Policy TR P6 Local Transport Plans. It is a policy of the Council to prepare a Local Transport Plan (LTP), Mobility and Public Realm Plan for the Key Town of Newcastle West, in consultation with the National Transport Authority, Transport Infrastructure Ireland and other relevant stakeholders, as part of the of the Local Area Plan process and for other settlements as deemed necessary.	No	Not considered relevant to this development.
Policy TR P7 Road Safety and Carrying Capacity of the Road Network. It is a policy of the Council to seek improvements to road safety and enhance the carrying capacity of the road network throughout Limerick, through minimising existing traffic hazards, preventing the creation of additional or new traffic hazards in the road network.	Yes	The maintenance of road safety during the period related to the proposed development is assessed at **Section 13.1.4.3**.
Policy TR P8 Safeguard the Capacity of National Roads. It is a policy of the Council to: a) Protect the capacity of the national road network, having regard to all relevant Government guidance, including DoECLG Spatial Planning and National Roads Guidelines (DoECLG, 2012) in the carrying out of Local Authority functions and; b) Ensure development does not prejudice the future development, or impair the capacity of, the planned national roads, which includes the N/ M20 Cork to Limerick Scheme and Foynes to Limerick Road (including Adare Bypass) projects and other schemes referenced in Section 6.4.	No	Not considered relevant to this development.
Policy TR P9 Strategic Regional Road Network. It is a policy of the Council to protect the investment in the strategic regional road network and maintain and improve road safety and capacity.	No	Not considered relevant to this development.
Policy TR P10 Sustainable Transport in Rural Areas. It is a policy of the Council to support the objectives contained in Our Rural Future: Government's Blueprint to Transport Rural Ireland, including investment in public transport and high-quality walking and cycling infrastructure specifically targeted at towns and villages.	No	Not considered relevant to this development.
Policy TR P11 Rural Transport. It is a policy of the Council to continue to support the	No	Not considered relevant to this development.

Planning Policy	Assessed	Comment
'Local Link' rural transport service and to encourage operators to improve the service to meet the social and economic needs of the rural communities in Limerick.		

Table 13.2: Draft Limerick City & County Development Plan 2022-2028 Transport Policies

13.1.2.3 Desk Study

A desk study of the proposed development site and the road network in surrounding area was undertaken. The sources of information included documentary sources, such as those outlined at **Section 13.1.2.2** and an evaluation of aerial imagery and visualisations (e.g. Google Maps and Streetview) to assess the nature and condition of the local road network.

13.1.2.4 Evaluation of Likely Effects

Following the assessment of the current/existing environment, the available data was used to identify and categorise the effects likely to affect the local road network used for the turbine delivery route and construction materials haul route.

The criteria for the assessment of effects require that likely effects are described with respect to their magnitude, nature (i.e. negative, positive or neutral), transboundary nature (if applicable), intensity and complexity, probability, duration, frequency, reversibility, cumulation and possibility of reducing the effects. The descriptors used in this chapter are those set out in EPA (2022).

Impacts may be categorised as follows:-

- Direct: where the existing traffic and transport environment in proximity to the proposed development is altered, in whole or in part;
- Indirect: where the traffic and transport environment beyond the proposed development is altered by activities related to the construction or operation of the proposed development; and
- No Impact: Where the proposed development has neither negative nor a positive impact upon the traffic and transport environment.

Sensitivity

The sensitivity of the local transport infrastructure has been identified using the criteria outlined within the TII Guidance. These criteria are outlined in **Table 13.3** below.

Importance	Criteria
Very High	Attribute has a high quality, significance or value on a regional or national scale.
High	Attribute has a high quality, significance or value on a local scale.
Medium	Attribute has a medium quality, significance or value on a local scale.
Low	Attribute has a low quality, significance or value on a local scale.

Table 13.3: Criteria for Rating Site Attributes

Magnitude

The magnitude of likely effects has been defined in accordance with the criteria

provided in the 2022 EPA publication *Guidelines on the information to be contained in Environmental Impact Assessment Reports* as outlined within **Table 13.4** below.

Magnitude of Impact	Description
Imperceptible	An effect capable of measurement but without significant consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends
Significant	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound	An effect which obliterates sensitive characteristics

Table 13.4: Impact Assessment Criteria

Significance Criteria

The significance of the likely effects of the proposed development have been classified by taking into account the sensitivity of receptors and the magnitude of the effects on them, combined with the likelihood of an event occurring as defined in **Table 13.5**.

	Magnitude of Impact				
Importance of Attribute		Negligible	Small	Moderate	Large
	Extremely High	Imperceptible	Significant	Profound	Profound
	Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
	High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Severe/ Significant
	Medium	Imperceptible	Slight	Moderate	Significant
	Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

Table 13.5: Rating of Significant Environmental Impacts

13.1.3 Description of Existing Environment

13.1.3.1 Site Location & Context

The proposed development is located entirely within the townland of Curraghfoil, Co. Limerick. The townland abuts the jurisdictional boundary between counties Limerick and Tipperary. The proposed development site and surrounding environment is typical of an upland landscape with extensive tracts of commercial forestry plantations dominating the surrounding, undulating, landscape. Other agricultural activities in the

wider environs of the proposed development site tend to be extensive (i.e. non-intensive) cattle and sheep enterprises.

13.1.3.2 Local Road Network

The road network in the vicinity of the proposed development generally comprises regional and local roads. The N24 National Secondary Road is located approximately 13km to the southwest of the proposed development site

The R505 Regional Road is located approximately 7km south of the proposed development site. The R505 is classified as a 'Strategic Regional Route' in both the Limerick CDP and the Draft Limerick CDP due to the volumes of traffic which it typically carries.

Additionally, the R503 Regional Road is located c. 1.5km northeast of the proposed development site in Co. Tipperary. This road does not enjoy any specific classification within the *North Tipperary County Development Plan 2010-2016* or the *Draft Tipperary County Development Plan 2022-2028*.

The proposed development site is accessed by the L-5029-419 local road which is a single-carriageway road adjoined by grass verges. The road is located on the lower slopes of Knockastanna Hill and generally follows the local topography as it encircles Knockastanna Hill. The carriageways appears to be well maintained; however, due to the low density of residential dwellings along the route and nature of other land-uses, it is likely that the route experiences low daily traffic volumes.

13.1.3.3 Access to the Proposed Development Site

Access to the existing development is provided by a site entrance from the L-5029-419. The existing site entrance will continue to be utilised during the proposed additional period of operations and, other than ongoing standard maintenance, no specific works are required. Ongoing works may include verge trimming to maintain sight visibility splays and maintenance of the access track and/or associated drainage infrastructure.

13.1.4 Description of Likely Effects

13.1.4.1 'Do-Nothing' Scenario

If the proposed development is not progressed, the existing development will be dismantled at the end of its permitted operational period and the low volumes of associated traffic will be removed from the local road network.

13.1.4.2 Construction Phase

All construction activities associated with the existing wind farm have been completed and no additional infrastructure is proposed to be constructed. Any works to be undertaken, including the reinstatement of turbine T05 (as described at **Chapter 3**), will comprise routine maintenance works undertaken in the normal management of an operational wind farm. Therefore, no construction phase effects on transport and access will arise.

13.1.4.3 Operational Phase

As is the case during the current operations of the wind farm; during the proposed period of additional operations, the development will generally be unmanned. Operational and remote monitoring activities will be carried out on an ongoing basis. However, regular visits to the site will be undertaken for routine inspections and maintenance. Under normal circumstances, the operation of the current

development requires an average of 1-2 no. visits to the site per week by maintenance personnel and it is predicted that this rate of attendance at the site will continue.

Therefore, it is assessed that the proposed development will not result in any particular intensification of vehicular movements additional to that currently experienced which could adversely affect the road network or local road users such that a deterioration in road safety could arise. During specific maintenance works; for example, the reinstatement of turbine T05 and maintenance works to access tracks or site drainage infrastructure; there may be a minor increase in traffic volumes; however, the duration of these works will be short-term.

Parking is, and will continue to be, provided at the on-site electrical control building or at the turbine hardstands during maintenance visits.

Overall, it is assessed that the volume of traffic likely to be generated during the period of additional operations is very low and will not notably affect the local road network or interact with third party access or use of the local road network. Therefore, it is concluded that the effect on transport and access will be indirect, imperceptible, negative, and of a long-term duration.

13.1.4.4 Decommissioning Phase

Abnormally-sized loads are (as described at **Chapter 3**) unlikely during the decommissioning phase; and, therefore, direct effects on transport, access or the local road network, such as upgrade works or carriageway damage, are not assessed as likely.

In terms of indirect effects, the total volume of traffic will be increased when compared to the operational phase. The decommissioning of the wind farm will require the removal of all structures by heavy-goods vehicles (HGVs); while the volume of personnel attending the site, using light-goods vehicles (LGVs) or vans, will also increase.

However, this phase is predicted to last approximately 3-months and is, therefore, of an extremely short duration. Overall, therefore, the effect of the decommissioning phase is assessed to be indirect, slight, negative, and of a short-term duration.

13.1.4.5 Cumulative Effects

Given that the proposed development is not assessed as likely to generate significant volumes of vehicular traffic, it is further assessed that there is no likelihood of significant cumulative effects arising with other existing, permitted or proposed developments; including the associated grid connection infrastructure.

13.1.5 Mitigation & Monitoring Measures

13.1.5.1 Mitigation

Given that the proposed development is not assessed as likely to generate significant volumes of vehicular traffic, specific mitigation measures are not deemed to be necessary. However, in order to ensure that road safety is maintained throughout the proposed period of operations, the following mitigation measures will be implemented:-

- Adequate signage shall be provided at entrances providing access, safety and warning information;

- Speed limit compliance; particularly along the L-5029-419; will be emphasised to all staff and contractors access the proposed development site;
- The hours of maintenance works (and associated traffic movements) will, where possible, be limited to avoid unsociable hours. Activities shall generally be restricted to between 07:00hrs and 19:00hrs Monday to Friday and between 07:00hrs and 13:00hrs on Saturdays, with no activities on Sundays or public holidays unless in the event of an emergency; and
- The site shall be closed, and strictly secured, to the public during the period of additional operations.

13.1.6 Residual Effects

13.1.6.1 'Do-Nothing' Scenario

If the proposed development is not progressed, the existing wind farm will be dismantled at the end of its permitted operational period and the low volumes of operational phase traffic will be removed from the local road network.

13.1.6.2 Construction Phase

All construction activities associated with the development have been completed and no additional infrastructure is proposed to be constructed. Therefore, no construction phase traffic or access effects will arise.

13.1.6.3 Operational Phase

There will be no significant residual effects during the operational phase as only occasional light vehicles are generally envisaged to visit the site during operation for routine checking and maintenance. Where more notable works are required, the short term duration of such works will ensure that there are no lasting significant effects on transport and access.

13.1.6.4 Decommissioning Phase

Due to the short term duration of the decommissioning phase, significant effects are not assessed as likely. Following the completion of the decommissioning works, all wind farm-related traffic volumes will be removed from the local road network.

13.1.7 Summary

This section has assessed the likelihood of significant effects arising from the proposed development on transport and access. The proposed development has generally been assessed as having the likelihood to result in effects of a negative, imperceptible/slight, direct, long-term (operational phase), and short-term (decommissioning effects). After mitigation, the likely residual effects have been assessed as imperceptible, negative, long-term (operational phase), and short-term (decommissioning phase) in nature.

Likely cumulative effects, with other developments in the vicinity, have not been assessed as being significant.

Overall, this assessment has identified no likelihood of significant effects on transport and access which could arise as a result of the proposed development either individually or in combination with other existing, permitted or proposed developments.

13.2 Aviation

13.2.1 Introduction

This section assesses the likelihood of effects on aviation arising from the continued operation and decommissioning of the Knockastanna Wind Farm. The requirement for an assessment of the likely effects on aviation is set in the *Wind Energy Development Guidelines for Planning Authorities 2006* which state:-

> *"The siting of wind turbines may have implications for the operations of communications, navigation and surveillance systems used for Air Traffic Control for the separation and safety of aircraft. Wind turbine siting may also have implications for the flight paths of aircraft."*

13.2.2 Methodology

The assessment involved consultation with various stakeholders including the Irish Aviation Authority (IAA) and Department of Defence. In addition, publications issued by the IAA and the Department were reviewed to determine if the proposed development site was assessed as being of significance or if significant effects were likely. A desktop study was also undertaken to determine the presence of aerodromes or airstrips within 20km of the subject site.

This assessment has also had regard to the *Draft Air Corps Wind Farm/Tall Structures Position Paper* (August 2014) (**Annex 13.1**) which sets out the Air Corps position on the appropriate siting and management of wind farms and tall structures. This assessment includes a detailed review of this position paper, a comparison of the proposed development site with identified 'Danger Areas', 'Restricted Areas' and 'Low Level Flying Areas'.

13.2.3 Consultation

Consultation was undertaken with the IAA and Department of Defence to establish if any effects on aviation were likely. A consultation letter was issued to both in June 2021 (see **Chapter 1**), which included a Scoping Report, a general description of the proposed development and site location drawings.

Correspondence received from the IAA (see **Annex 1.4**) requested that in the event of additional turbines being proposed at the subject site, details should be provided to the IAA ANSP department.

At the time of writing, a response has not been received from the Department of Defence.

13.2.4 Description of Existing Environment

There are no major airports in the vicinity of the proposed development and the site is therefore assessed as being unconstrained. The proposed development site is located c. 47km east of Shannon Airport.

According to the IAA, the nearest aerodrome is at Erinagh in County Tipperary at an approximate distance of 16km; while Abbeyfeale Aerodrome is located c. 80km to the southwest. The Killenaule Airfield is located approximately 37km to the southeast of the proposed development site.

The proposed development site is not located within any 'Danger', 'Restricted' or 'Military Operating' area as identified at Annex A, B or C of the *Draft Air Corps Wind Farm/Tall Structures Position Paper*. Similarly, the subject site is not located within 3 no. nautical miles of any critical low level route identified at para. 2(2)(c) and illustrated

at Annex D of the Paper.

Air traffic control radar is of two types. Primary Surveillance Radar (PSR) equipment sends out pulses of electromagnetic energy which will reflect off objects in their path. The radar's receiver antenna detects the returning 'echoes' and these are displayed on the radar screen. The time taken for the pulse to travel out to the target and back gives an indication of the range of the object from the radar

Secondary Surveillance Radar (SSR) is the second type of radar equipment used for air traffic control. Like primary radar, SSR relies on an antenna rotating continuously through 360°. However the radar does not transmit raw pulses of energy; it transmits an interrogation signal. The signal is received at the SSR antenna, decoded, and the height and location of nearby aircraft are presented on the radar screen. This enables controllers to positively identify radar returns on their screens and (after verbal confirmation from the pilot) to confirm the aircraft's height.

Rotating wind turbine blades within radar range can impart a Doppler shift to any radar energy reflecting off the blades. The radar's processor could detect this as a non-static target and therefore display the turbines as objects on the radar screen.

13.2.5 Description of Likely Effects

13.2.5.1 'Do-Nothing' Scenario

In the 'Do-Nothing' Scenario, the existing wind turbines will be removed from site upon the expiry of their planning permission which will result in a reduction in the number of tall structures at this location.

13.2.5.2 Construction Phase

All construction activities associated with the wind farm have been completed and no additional infrastructure is proposed to be constructed.

13.2.5.3 Operational Phase

The continued operation of the existing development is not assessed as likely to give rise to any additional effects on aviation. The presence of the existing turbines is known to the IAA, by virtue of engagement undertaken as part of the parent permission, and there will be no increase in the overall height of the turbines such that an additional interaction with aviation could occur. Furthermore, during consultation regarding the proposed development, the IAA has not raised any concerns regarding the continued operation of the existing development.

It is also noted that the proposed development site is not located within any low flying areas, restricted areas, danger areas, military operating areas or low level routes identified within the *Draft Air Corps Wind Farm/Tall Structures Position Paper*. It is concluded, therefore, that the operation of the proposed development will not result in any likely significant effect on the Air Corps or associated activities.

A crane (or cranes) will be erected at the site during the reinstatement of turbine T05. In accordance with the consultation response of the IAA (see **Annex 1.4**), as the crane will exceed 45m in height, the IAA shall be notified a minimum of 30-days prior to the erection of the crane.

Overall, therefore, it is assessed that there will be no adverse effect on aviation.

13.2.5.4 Decommissioning Phase

During the decommissioning phase, crane operations will be required to dismantle the

wind turbines. As above, the IAA shall be notified a minimum of 30-days prior to the erection of the crane.

13.2.6 Cumulative Effects

Given that the proposed development is not assessed as likely to result in any adverse effects on aviation, it is assessed that there is no likelihood of cumulative effects. While it is noted that there are other tall structures (wind turbines) in the wider landscape, this assessment concludes that there is no likelihood of in-combination effects.

13.2.7 Mitigation & Monitoring Measures

13.2.7.1 Construction Phase

As there are no construction works to be undertaken, no mitigation measures are required or proposed.

13.2.7.2 Operational Phase

The existing wind turbines have, as agreed with the IAA and Planning Authority as part of the discharge of planning conditions associated with the parent permission, been fitted with aviation warning lighting. This lighting will be maintained and shall continue to operate during the proposed additional period of operations.

In the event that the obstacle warning lighting fails or if there are plans to withdraw them from use for a period of time, the IAA will be contacted, via AISOPs@iaa.ie, as a matter of urgency, to request that a NOTAM (Notice to Airmen) is issued concerning the absence of obstacle lights. The following information will be provided to the IAA:-

- Obstacle ID;
- Obstacle type;
- Obstacle Position;
- Elevation; and
- Colour of Light.

The Department of Defence shall also be notified in the event of a failure of the installed warning lights.

As described above, the IAA shall receive prior notification of intended crane operations associated with the reinstatement of turbine T05.

13.2.7.3 Decommissioning Phase

As described above, during crane operations associated with the decommissioning of the wind turbines, the IAA shall receive prior notification and the crane shall be fitted with an aviation warning light.

13.2.8 Residual Effects

No significant residual effects are assessed as likely to occur.

13.2.9 Summary

This assessment concludes that the proposed development is unlikely to result in any significant effect on aviation. The proposed development site is not located within an area identified as being of particular sensitivity or importance in the *Draft Air Corps Wind Farm/Tall Structures Position Paper* on military aviation or located close to any civilian aerodrome, airfield or airport. Accordingly, with the continued maintenance of aviation warning lighting and appropriate management of any crane operations, no significant effects are assessed as likely to occur. Therefore, it is assessed that

significant effects on aviation are unlikely to arise as a result of the proposed development, either individually or in combination with other existing, permitted or proposed developments.

13.3 Telecommunications

13.3.1 Introduction

As noted in the *Wind Energy Development Guidelines for Planning Authorities 2006*, wind turbines, like all electrical equipment, produce electromagnetic radiation, and this can interfere with broadcast communications. This section considers the likely effects of the proposed development upon a range of communications infrastructure, including telecommunications networks, broadcast radio and television and fixed infrastructure such as telecommunication masts. In theory, interference could affect all electromagnetic communications including:-

- Satellite Communications;
- Cellular Radio Communications; and
- Television Broadcasting Signalling.

13.3.2 Methodology

The methodology employed in assessing the likelihood for significant effects on telecommunication networks consisted of desk based research and consultation with various telecommunication companies and relevant authorities. Desk based research was undertaken to identify:-

- Locations of known telecommunications facilities;
- Known telecommunication fixed links; and
- Known television broadcast and re-broadcast facilities;

During the EIAR scoping process (see **Chapter 1**), the following telecommunication service providers and authorities were consulted with;-

- Airspeed Telecom;
- Ajisko Limited;
- An Garda Síochana;
- Broadcasting Authority of Ireland;
- BT Communications Ireland;
- Commission for Communications Regulation;
- Eir Limited;
- Enet Telecommunications Networks Limited;
- Imagine Group;
- Irish Aviation Authority;
- JFK Communications Limited;
- Mosaic Net;
- National Ambulance Service;
- Open Eir;
- Radio Services & Building Limited;
- Ripplecom;
- 2rn (RTE Transmission Network Ireland);
- Tetra Ireland Communications Ltd;
- Three (3) Ireland;
- Towercom;
- Viatel Ireland Limited;
- Virgin Media Ireland; and
- Vodafone Ireland Ltd.

The responses received from these organisations are summarised at **Chapter 1** and can be viewed at **Annex 1.4**.

Consultation responses received from service providers confirmed that, as it was not proposed to increase the number of turbines at the site, there would be no impact whatsoever on the telecommunications network in the area of the proposed development.

13.3.3 Description of Existing Environment

The consultations undertaken illustrate that the proposed development site is not a significant location for telecommunication links. While there are telecommunication masts located within the wider environs of the subject site[6], on the basis of the consultations undertaken, there are no telecommunication links located within the proposed development site which are likely to be affected by the proposed development.

It should also be noted that, since the commencement of operations at the wind farm, we are unaware of the Applicant having received any formal complaints, from a service provider or members of the public, regarding telecommunications interference. During the community consultation process (described at **Chapter 1**), 1 no. local resident suggested that the existing wind farm was affecting phone signal and broadband (WIFI) signals. However, given that no service provider has identified any risk to telecommunications arising from the development, it is assessed that the issues experienced are unrelated to the operation of the Knockastanna Wind Farm.

13.3.4 Description of Likely Effects

13.3.4.1 'Do-Nothing' Scenario

In the 'Do-Nothing' Scenario, the existing wind turbines will be removed from site upon the expiry of their planning permission which will result in a reduction in the number of structures at this location which could, in theory, adversely affect telecommunication signals.

13.3.4.2 Construction Phase

All construction activities associated with the development have been completed and no additional infrastructure is proposed to be constructed.

13.3.4.3 Operational Phase

Interference of Wind Turbines with Electromagnetic Transmissions

The operation of wind turbines can affect electromagnetic transmissions in two ways: by blocking or deflecting **line of sight radio or microwave links or by 'scattering'** transmission signals.

Analogue and Digital Television Signals

The **United Kingdom's** Office of Communications (OFCOM) document ***"Tall structures and their impact on broadcast and other wireless services"***[7] provides an overview for developers and planning authorities on how tall structures such as wind turbines may affect reception of wireless services.

There are two potential problems that can occur due to interference from tall structures: (1) signal blocking, and (2) reflection. Signal blocking can occur when a tall structure is situated between the transmitter and receiver. This causes a shadow

[6] http://siteviewer.comreg.ie/#explore

[7] OFCOM: Tall structures and their impact on broadcast and other wireless services, August 2009, http://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/tall_structures.pdf

behind the structure that can reduce signal levels. The severity of the reduced signal can vary depending on a number of factors such as the height of the structure.

Signal reflection can occur when wireless signals are reflected from the sides of structures. In the case of wind turbines, because the blades are rotating, the reflections can fluctuate and be quite complex. Reflections from turbines can also vary depending on the speed at which the blades are rotating and the angles of the blades. According to OFCOM, digital television signals are much better at coping with signal reflections, and pictures do no experience ghosting.

As analogue television has been phased out in Ireland, problems with ghosting and signal reflection due to interference from turbines will be reduced. The digital television signal is much better at coping with signal reflection. Since the digital switchover, the power of transmitters emitting the digital signal has been increased to deal with the demand. This higher output is likely to overcome any signal interference and is not likely to effect the reception received on televisions. Overall, the likely extent of any potential problems is much less significant with digital television than with analogue television.

Furthermore, 2rn have not identified any risk of interference to local digital terrestrial television viewers in the vicinity of the proposed development.

Mobile Phone & Broadband Signals

Notwithstanding the presence of a number of telecommunication (mobile phone & broadband) masts in the wider area, the consultation process has not identified the likelihood of significant interference occurring and no service provider has raised any concerns. While a local resident has suggested that the existing wind farm may be at fault for issues experienced, there is no evidence to confirm the cause and significant effects on mobile phone or broadband signals are not assessed as likely.

13.3.4.4 Decommissioning Phase

No significant effects are assessed as likely to occur during the decommissioning phase.

13.3.5 Cumulative Effects

Given that the proposed development is not assessed as likely to give rise to significant adverse effects on telecommunications, it is assessed that there is no likelihood for the proposed development to act in combination with other existing, permitted or proposed developments.

13.3.6 Mitigation & Monitoring Measures

13.3.6.1 Construction Phase

As there are no construction works to be undertaken, no mitigation are required or proposed.

13.3.6.2 Operational Phase

Extensive consultation with telecommunications providers has confirmed that significant adverse effects on existing telecommunication links are unlikely to arise from the operation of the proposed development.

While assessed to be unlikely, should significant signal interference in any form be identified and assessed as being directly attributable to the proposed development, appropriate remedial measures will immediately be undertaken. A range of technical

measures are available to mitigate any instances of interference including signal amplifiers, active deflectors and relay transmitters, repeater stations, booster units, realignment of domestic aerials, installation of higher quality aerials and the installation of suppression equipment. Remedial works will be promptly undertaken to ensure uninterrupted telecommunication, broadcasting and mobile phone service provision.

13.3.6.3 Decommissioning Phase

As no significant effects are assessed as likely to occur during the decommissioning phase, no specific mitigation measures are proposed or required.

13.3.7 Residual Effects

No likely significant residual effects are assessed as likely to occur.

13.3.8 Summary

It can be concluded that, on the basis of this desktop assessment and extensive consultation with stakeholders, the proposed development will not result in likely significant effects on the telecommunications network. The implementation of mitigation measures will ensure that, while highly unlikely, any effects on telecommunication signals or links are appropriately managed and mitigated.

13.4 Resources & Utility Infrastructure

13.4.1 Introduction

This section provides details of the likelihood of significant effects on or interactions with existing renewable and non-renewable resources and existing utility infrastructure. Within the wider environs of the proposed development site there is notable evidence of renewable energy developments; particularly the presence of other wind farms to the east and southeast.

There is also the presence of utility infrastructure, with overhead electricity lines connecting to the majority of dwellings, medium and high voltage electricity lines traversing the landscape and telecommunication lines located adjacent to the majority of local roads.

13.4.2 Description of Existing Environment

13.4.2.1 Renewable Resources

The Knockastanna Wind Farm was constructed at the subject site and became operational in 2009. There are also a number of existing and permitted wind energy developments in the surrounding landscape including the Garracummer Wind Farm, Mienvee Wind Turbine, Hollyford Wind Farm, Glenough Wind Farm, Glencarbry Wind Farm, Cappawhite A Wind Farm, Cappawhite B Wind Farm, Castlewaller Wind Farm, Upperchurch Wind Farm, and the Turraheen Upper Wind Turbine (see **Annex 1.5** (**Volume II**).

In addition, the local landscape is heavily characterised by tracts of commercial conifer plantations.

13.4.2.2 Non-Renewable Resources

There are a number of extant quarrying activities within the environs of the proposed development site. The nearest quarry, Rearcross Quarries, is located c. 2km northwest; while Lackamore Quarry is located c. 2.5km west.

13.4.2.3 Utilities Infrastructure

The electricity transmission network in County Limerick predominately comprises 38kV and 110kV electricity transmission lines; with lower voltage distribution lines connecting individual properties to the distribution network. The network, however, is weaker in more eastern areas of the county. The existing electricity transmission network in the wider region of the proposed development site is illustrated at **Annex 13.2**.

EirGrid is the transmission system operator (TSO) responsible for both the planning and **operation of Ireland's high voltage national grid (≥110kV)** while ESB Networks are responsible **for the development of medium and low voltage lines (≤38kV)**. The existing wind farm is connected to the national electricity grid by a c. 11km of 20kV overhead electricity line. The overhead electricity line comprises electrical cables suspended from wooden pole sets.

In addition to the microwave telecommunications network discussed at **Section 13.3** above, there is an extensive physical telecommunications network in the wider environs of the proposed development site with poles and wires running along the majority of local and regional roads; while local services such as water schemes and local authority roadside drainage infrastructure is also present along local roads.

13.4.3 Description of Likely Effects

13.4.3.1 Construction Phase

All construction activities associated with the existing development have been completed and no additional infrastructure is proposed to be constructed.

13.4.3.2 Operational Phase

The continued operation of the existing wind farm will not result in any likely effect on existing utility infrastructure or renewable or non-renewable resources.

It may be necessary to occasionally import aggregates to the site during operations, including during the reinstatement of turbine T05 and to maintain access for service vehicles; however, materials will be sourced from authorised quarries with full planning permission and no likely significant effects will occur.

The proposed development will have no likely effects on existing renewable resources. It is assessed that the proposed development will have a likely overall positive effect in terms of carbon reduction and climate change (see **Chapter 8**). It is assessed, therefore, that significant effects on the environment are unlikely to occur in respect of resources and utility infrastructure during the continued operation of the existing wind farm, either individually or in combination with other existing, permitted or proposed developments.

13.4.3.3 Decommissioning Phase

No significant effects are assessed as likely to occur during the decommissioning phase in respect of resources and utility infrastructure.

13.4.3.4 Cumulative Effects

The proposed development is not assessed as likely to result in any cumulative effects on resources or utility infrastructure, either individually or in combination with other existing, permitted or proposed developments.

13.4.4 Mitigation & Monitoring Measures

13.4.4.1 Construction Phase

As there are no construction works to be undertaken, no mitigation are required or proposed.

13.4.4.2 Operational Phase

No specific mitigation measures are proposed or required during the operational phase.

13.4.4.3 Decommissioning Phase

No specific mitigation measures are proposed or required during the decommissioning phase.

13.4.5 Residual Effects

No likely significant residual effects are assessed as likely to occur.

13.4.6 Summary

This assessment concludes that the proposed development is unlikely to result in any significant adverse effect on renewable and non-renewable resources or on utilities infrastructure. The continued operation of the existing development will bring about a benefit in terms of electricity generated from renewable sources. This assessment

similarly concludes that the proposed development is unlikely to result in any significant adverse cumulative effects in combination with existing, permitted or proposed developments.

Knockastanna Wind Farm Extension of Operational Life

Chapter 14: Interaction of the Foregoing

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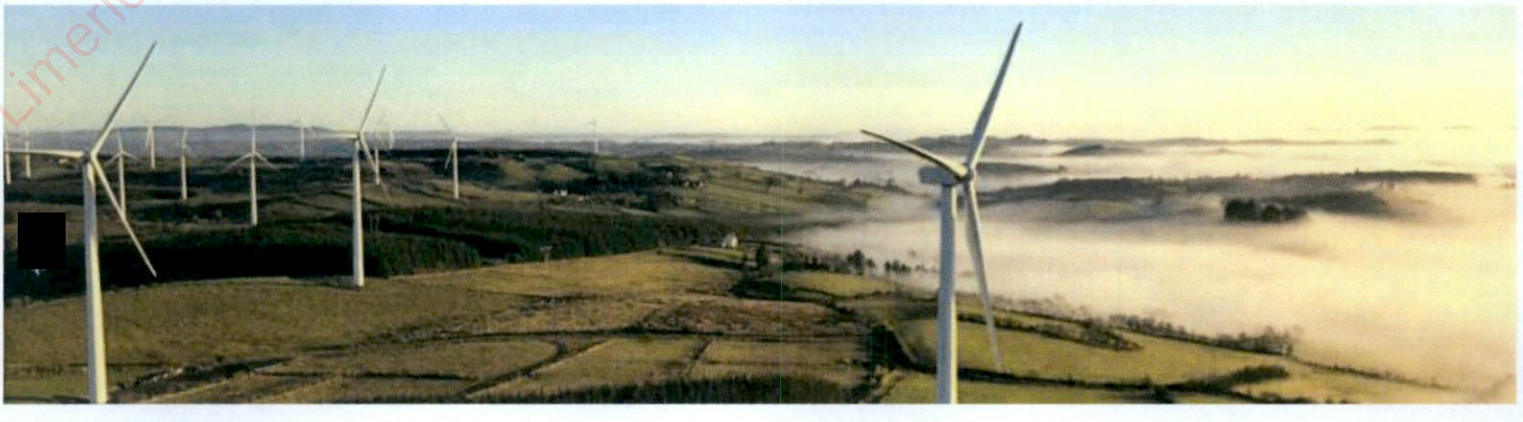

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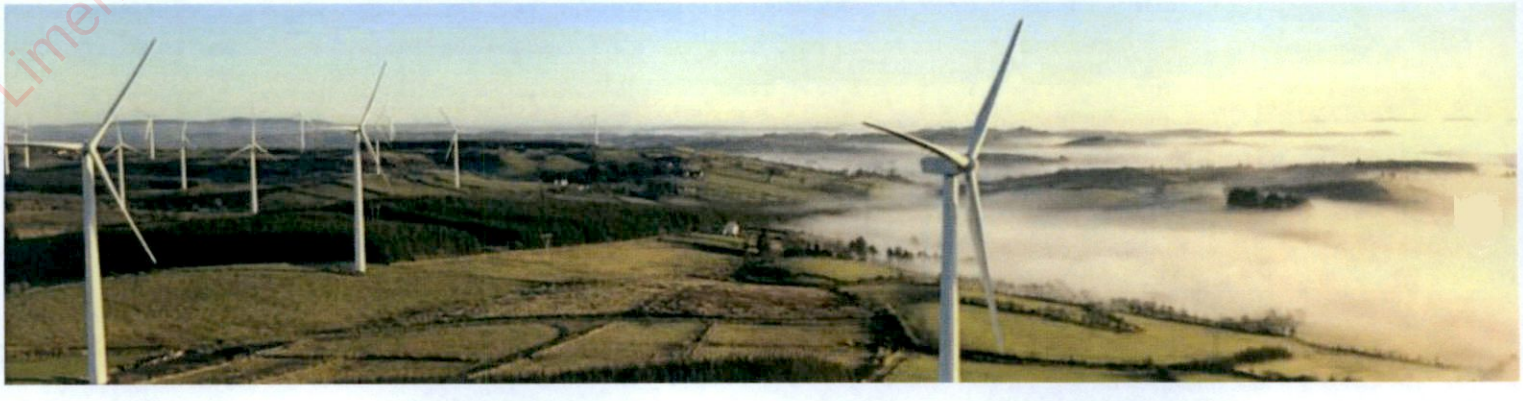

14.1 Introduction

This chapter summarises the critical results and conclusions of each individual chapter of this EIAR and identifies interactions between issues arising under separate factors which might otherwise not be noticed but which need to be assessed to ensure all likely significant effects are identified and assessed.

The interactions between effects on different environmental factors are also addressed, as relevant, throughout this EIAR by ensuring that effects are cross-referenced between topics, thus reducing the need to duplicate coverage of such topics. Close co-ordination and management within the EIA project team, and careful read-across editing, ensured that assessors were vigilant for complex interactions (direct, indirect, secondary and cumulative) and, where they are likely to arise, they are adequately identified and assessed. This included interactions between effects, and possible cumulative effects, arising from the mitigation measures proposed that could magnify effects through the interaction or accumulation of effects.

Reference should also be made to **Chapter 2** which provides an evaluation of reasonable project alternatives and **Chapter 3** which provides a detailed description of the proposed development.

14.2 Interactions

It is general practice that interactions are shown by a means of a matrix, as set out in **Table 14.1** below, examining each aspect of the receiving environment which is considered in detail in the respective chapters of this EIAR, and cross-tabulated against all other aspects that have also been considered. This is accompanied by a brief text describing the interactions, including during the operational and decommissioning phases.

Where an interaction is considered to be both likely and significant, it is given a reference number in the matrix and detail of the interaction is discussed below, including whether it is weak or strong, or whether the interaction is positive or negative. Where there is no number indicated in the matrix, it is assessed there is no likelihood for any significant effects by way of interaction between the environmental factors.

Interactions	Population and Human Health	Biodiversity	Land and Soils	Water	Air Quality & Climate	Landscape	Cultural Heritage	Noise & Vibration	Shadow Flicker	Material Assets
Population and Human Health						1		2	3	4
Biodiversity										
Land and Soils										
Water										
Air Quality & Climate										5
Landscape	1						6			
Cultural Heritage						6				
Noise & Vibration	2									
Shadow Flicker	3									
Material Assets	4				5					

Table 14.1: Matrix of Interactions

14.2.1 Interaction 1: Population & Human Health and Landscape

The likely effects of the proposed development on landscape, and the interaction with population and human health, have been discussed in **Chapter 4** and **Chapter 9** of this EIAR. The proposed development has been assessed having regard to the sensitivity of the landscape, the degree of intrusion or dominance created by it and the degree to which is it visible in the landscape. Views from key prospects and receptors were identified and a detailed analysis of each, accompanied by photography, is provided at **Chapter 9**. Overall, it is concluded that while the proposed development is, and will remain, visible in the landscape, it is not assessed as likely to result in significant impacts on, or interactions with, population & human health.

14.2.2 Interaction 2: Population & Human Health and Noise & Vibration

The noise levels at a set of representative noise-sensitive locations in the vicinity of the Knockastanna Wind Farm have been quantified by an appropriate survey of operational phase noise levels (**Chapter 11**). Using the recorded results, it has been confirmed that operational phase noise levels are below the appropriate criteria set out by An Bord Pleanála for the existing development. Therefore, it is concluded that

the continued operation of the Knockastanna Wind Farm will not result in a significant interaction with population & human health additional to that of the existing development.

14.2.3 Interaction 3: Population & Human Health and Shadow Flicker

In the first instance, the continued operation of the existing development will not result in an increased level of shadow flicker experienced by residential dwellings in the local landscape. Consequently therefore, and on the basis of the assessment undertaken within this EIAR (**Chapter 12**), the proposed development will not result in a significant impact on, or interact with, population and human health due to shadow flicker.

14.2.4 Interaction 4: Population & Human Health and Material Assets

As described at **Chapter 13**, the proposed development will not give rise to a noticeable increase in traffic movements compared to the existing development. Given the low volumes of predicted vehicular movements, including during the decommissioning phase; a significant effect on, or interaction with, population & human health could arise.

The proposed development is not assessed as likely to result in any significant effects on telecommunications such that would be likely to interact with local communities.

14.2.5 Interaction 5: Air Quality & Climate and Materials Assets

As the likely traffic volumes associated with the continued operation of the wind farm will be very low; overall, it is assessed that there will be no likely significant interaction between Air Quality & Climate (**Chapter 8**) and Material Assets (Transport and Access; **Chapter 13**).

14.2.6 Interaction 6: Landscape & Cultural Heritage

Overall, due to the absence of additional infrastructure of alterations to the existing infrastructure, it is assessed that there is no likelihood of significant landscape or visual effects (**Chapter 9**). Similarly, it is assessed at **Chapter 10** that the proposed development will not exert a significant visual effect on features of cultural heritage; and following decommissioning, all effects will be entirely reversed. Therefore, it is concluded that there will be no significant interaction between landscape and cultural heritage.

14.3 Summary of Interactions & Effects

All environmental factors are interrelated to some degree and the assessment of these interactions is an important requirement of the EIAR process. Having assessed the interaction of likely effects during the operational and decommissioning phases; the interaction of effects is not assessed as likely to result in any impacts that could magnify environmental effects through interaction or accumulation. All interactions are assessed and have been fully considered in the relevant chapters of this EIAR.

During the proposed operational phase, the development will result in a long term positive effect on both air quality and climate and, in turn, on human health. The generation of electricity from the proposed development will lead to a net saving in terms of greenhouse gas emissions.

Overall, it is concluded that the impact of the proposed development on the receiving environment is not likely to be significant. Likely effects from the proposed development vary in significance but are generally in the minor to negligible range.

A number of positive impacts have also been identified such as community benefits; a reduction in the use of fossil fuels; and a significant contribution towards achieving **Ireland's** national and European targets for energy production from renewable sources.

The likely effects which have been identified in this EIAR demonstrate that the proposed development will not result in any likely significant negative impact on the environment, and will result in a positive impact by continuing the production of energy from a renewable source at an appropriate location.