5. POPULATION AND HUMAN HEALTH

5.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses the potential effects of the Proposed Development on population and human health and has been completed in accordance with the EIA guidance and legislation set out in Chapter 1: Introduction. The full description of the Proposed Development is provided in Chapter 4 of this EIAR.

As detailed in Section 1.1.1 in Chapter 1, for the purposes of this EIAR, the various project components are described and assessed using the following references: 'Proposed Development', 'the Site', 'Wind Farm Site' and 'Grid Connection'.

One of the principal concerns in the development process is that human beings, as individuals or communities, should experience no significant diminution in their quality of life from the direct, indirect or cumulative effects arising from the construction, operation and decommissioning of a development. Ultimately, all the impacts of a development impinge on human beings, directly and indirectly, positively and negatively. The key issues examined in this chapter of the EIAR include population, human health, employment and economic activity, land-use, residential amenity, community facilities and services, tourism, property values and health and safety.

5.1.1 Statement of Authority

This section of the EIAR has been prepared by Ellen Costello and Tom Madden and reviewed by Michael Watson, all of MKO. Ellen is a Project Environmental Scientist with over three years of consultancy experience with MKO and has been involved in a number of wind energy EIAR applications including the compilation of numerous chapters including chapters on Population and Human Health. Ellen holds a BSc. in Earth Science and a MSc. in Climate Change: Integrated Environmental and Social Science Aspects. Tom is an Environmental Scientist with over 4 years' experience in professional environmental consultancies. Tom holds a BSc (Hons) in Environmental Science from the University of Limerick. Prior to joining MKO, Tom worked with environmental consultancies in Dublin and Carlow where he gained experience from working on a wide range of different projects. Michael is a project director and head of the Environmental Team in MKO. Michael has over 20 years' experience in the environmental sector and has been working with MKO since 2014. Michael's professional experience includes managing Environmental Impact Assessments, EPA licence applications, environmental due diligence and general environmental assessment on behalf of clients in the wind farm, waste management public sector, and commercial and industrial sectors nationally.

5.2 Population

5.2.1 Receiving Environment

This socio-economic study of the receiving environment included an examination of the population and employment characteristics of the area. Information regarding population and general socio-economic data were sourced from the Central Statistics Office (CSO), the Westmeath County Development Plan 2021 – 2027, Offaly County Development Plan 2021-2027, Fáilte Ireland and any other literature pertinent to the area. The study included an examination of the population and employment characteristics of the area. This information was sourced from the Census of Ireland 2016, which is the most recent census for which a complete dataset is available, also the Census of Ireland 2011, the Census of Agriculture 2010 and from the CSO website (www.cso.ie). Census information is divided into State, Provincial, County, Major Town and District Electoral Division (DED) level.

Preliminary data for the State is available from the Census of Ireland 2022; however, at the time of writing this report, the full dataset of results with regards to Provincial, County, Major Town and Electoral Divisions has not been published and is due for publication in April 2023.

The Wind Farm Site is located approximately 2 kilometres southwest of Ballymore, Co. Westmeath, 6.6 kilometres to the north of Moate, Co Westmeath and 12.2 kilometres northeast of Athlone, Co. Westmeath. It is proposed to access the Wind Farm Site via an existing access track off the L5363 Local road to the northwest of the Wind Farm Site. The Wind Farm Site is served by a number of existing agricultural roads and tracks. Please refer to Figure 1-1 of Chapter 1: Introduction, for the site location.

The Grid Connection includes a proposed onsite 110kV substation within the Wind Farm Site and underground 110kV cabling connecting to the existing Thornsberry 110kV substation in the townland of Derrynagall or Ballydaly, County Offaly. The underground electrical cabling route, measuring approximately 31 km in length, is primarily located within the public road corridor.

Current land-use on the Wind Farm Site comprises coniferous forestry, and agriculture. Current land-use along the Grid Connection comprises public road corridor, public open space, discontinuous urban fabric and agriculture. Land-use in the wider landscape of the Site comprises a mix of agriculture, peat cutting, quarrying, low density residential and commercial forestry.

In order to assess the population in the vicinity of the Wind Farm Site, the Population Study Area for the Population section of this EIAR was defined in terms of the District Electoral Divisions (DEDs) where the Wind Farm Site is located, and where relevant, nearby DEDs which may be affected by the Wind Farm Site. The Wind Farm Site lies within three DEDs: Drumraney, Ballymore and Umma, as shown in Figure 5-1. All three of these DEDs will collectively be referred to hereafter as the Population Study Area for this chapter. The Population Study Area has a population of 1,279 persons, as of 2016 and comprises a total land area of 54.3 km^2 (Source: CSO Census of the Population 2016).

There are 41 properties located within 1 kilometre of the proposed turbine locations with 8 of those properties belonging to the landowners who form part of the Proposed Development. The closest inhabitable dwelling is located approximately 757 metres from the nearest proposed turbine location (T1). There is a derelict property that is located approximately 571m from the nearest proposed turbine location (T4). Of the 41 no. properties located within 1 kilometres of the proposed turbines, 40 are inhabitable dwellings and 1 is derelict. There is an existing derelict property located within the Wind Farm Site which was historically Umma House (as detailed in Section 13.3.2.10.1 in Chapter 13 of this EIAR), and it will not be occupied should the Proposed Development be granted planning permission. Therefore, the property is not considered any further in this assessment.

For the shadow flicker assessment which is further detailed in Section 5.7 below, the Shadow Flicker Study Area is defined as ten times rotor diameter from each turbine as set out in the '*Wind Energy Development Guidelines for Planning Authorities 2006'* (DoEHLG) (referred to as the Guidelines). The Shadow Flicker Study Area for this assessment is 1.62 kilometres based on a rotor diameter of 162 metres, and is further detailed in Section 5.7.5.2 below.

In order to assess the population in the vicinity of the Grid Connection, a review of properties and planning applications in the vicinity of the onsite substation, temporary construction compound and underground electrical cabling route was carried out. There are approximately 302 properties located within 100m of the Grid Connection. As detailed above, properties have been identified within the proximity of the Wind Farm Site, and such, there is an overlap of those properties identified within 100m of the Grid Connection infrastructure located in or in close proximity to the Wind Farm Site.

The active construction area for the underground electrical cabling route will be small, ranging from 150 to 300 metres in length at any one time, and it will be transient in nature as it moves along the route. Should separate crews be used during the construction phase they will generally be separated by one to two kilometres.

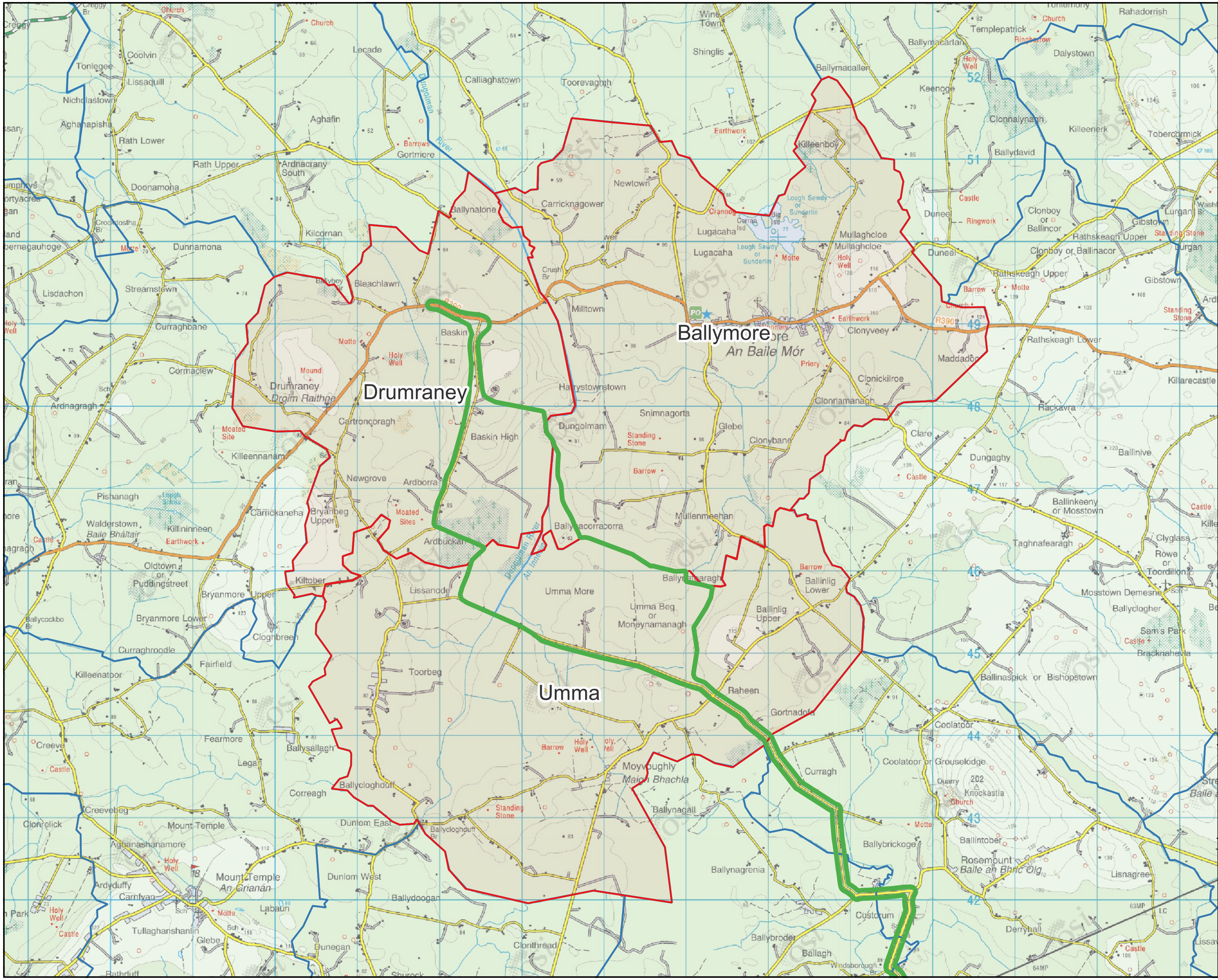
5.2.2 Population Trends

In the period between the 2011 and the 2016 Census, the population of Ireland increased by 3.8%. During this time, the population of County Westmeath grew by 3.0% to 88,770 persons. Other population statistics for the State, County Westmeath and the Population Study Area have been obtained from the Central Statistics Office (CSO) and are presented in Table 5-1.

Table 5-1 Population 2011 – 2016 (Source: CSO)

Area	Population Change		% Population Change
	2011	2016	2011 - 2016
State	4,588,252	4,761,865	3.8%
County Westmeath	86,164	88,770	3.0%
Population Study Area	1,207	1,279	6.0%

The data presented in Table 5-1 shows that the population of the Population Study Area increased by 6.0% between 2011 and 2016. There is a small increase in population growth for the Population Study Area and the population growth rate is higher than that of the County. When the population data is examined in closer detail, it shows that the rate of population increase within the Population Study Area is unevenly spread through the DEDs. Ballymore DED witnessed a population increase of 9.9% whereas the population in Umma DED only increased by 2.3%. The population in Drumraney DED remained unchanged from the 2011 census. Ballymore DED has a significantly larger population in comparison to both Umma DED and Drumraney DED with a total of 734 persons residing here in 2016. In 2016, Drumraney DED and Umma DED had populations of 273 and 272 persons respectively. The preliminary results from the 2022 Census shows an increase in the population of the State by 7.6%, from 4,761,865 in 2016, to 5,123,536 in 2022. At the time of writing this report, the Census 2022 Summary Report has not been published and is due for publication in April 2023.



Map Legend

- EIAR Site Boundary
- Population Study Area
- District Electorial Divisions

Drawing Title	Population Study Area
Project Title	Umma More Renewable Energy Development
Drawn By: BT	Checked By: EC
Project No.: 201050	Drawing No.: Figure 5-1
Scale: 1:60,000	Date: 2023-02-01

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5.2.3 Population Density

The population densities recorded within the State, County Westmeath and the Population Study Area during the 2011 and 2016 Census are shown in Table 5-2.

Table 5-2 Population Density in 2011 and 2016 (Source: CSO)

Area	Population Density (Persons per square kilometre)	
	2011	2016
State	67.49	70.05
County Westmeath	47.0	48.5
Population Study Area	22.14	23.46

The population density of the Population Study Area recorded during the 2016 Census was 23.46 persons per km^2. This figure is significantly lower than the national population density of 70.05 persons per km^2 and the county population density of 48.23 persons per km^2. These findings indicate that the Population Study Area has a low population density.

Similar to the trends observed in Section 5.2.2 above, the population density recorded across the Population Study Area varies between DEDs. Umma DED has the lowest population density, at 13.15 persons per km^2, Drumraney DED has a population density of 21.03 persons per km^2, and Ballymore DED has the highest population density, at 35.65 persons per km^2.

5.2.4 Household Statistics

The number of households and average household size recorded within the State, County Westmeath and the Population Study Area during the 2011 and 2016 Censuses are shown in Table 5-3.

Table 5-3 Number of Household and Average Household Size 2011 – 2016 (Source: CSO)

Area	2011		2016	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
State	1,654,208	2.77	1,702,289	2.75
County Westmeath	31,739	2.74	33,162	2.74
Population Study Area	424	2.84	446	2.86

In general, the figures in Table 5-3 show that the number of households within the State and County has increased from 2011 to 2016. The number of households in the Population Study Area has also increased slightly, along with the average size of the household from 2011 to 2016 within the Population Study Area. Average household size recorded within the Population Study Area during the 2016 Census is slightly above both the County and State level. Similar to the trends observed above, the average household size recorded across the Population Study Area varies between DEDs. Drumraney DED had the highest, with 3.13 persons per household recorded in 2016, while Umma DED was lower with an average of 2.83 persons per household in 2016, and Ballymore DED was the lowest with 2.79 persons per household in 2016.

5.2.5 Age Structure

Table 5-4 presents the population percentages of the State, County Westmeath and Population Study Area within different age groups as defined by the Central Statistics Office during the 2016 Census. This data is also displayed in Figure 5-2.

Table 5-4 Population per Age Category in 2016 (Source: CSO)

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
State	21.1%	12.1%	29.5%	23.8%	13.4%
County Westmeath	22.3%	12.4%	28.3%	24.2%	12.8%
Population Study Area	23.8%	12.0%	26.2%	25.6%	12.4%

The proportion of the Population Study Area population is broadly similar to those recorded at national and county level for most categories. For the Population Study Area, the highest population percentage occurs within the 25-44 age category.

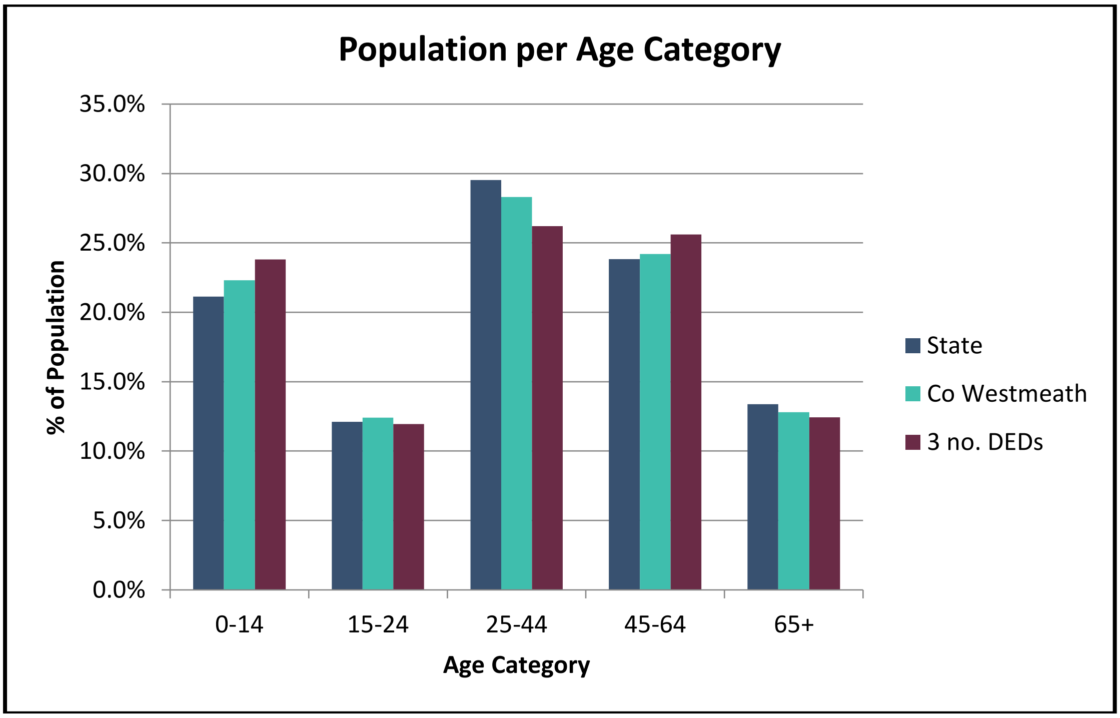


Figure 5-2 Population per Age Category in 2016 (Source: CSO)

5.2.6 Employment and Economic Activity

5.2.6.1 Economic Status of the Population Study Area

The labour force consists of those who are able to work, i.e. those who are aged 15+, out of full-time education and not performing duties that prevent them from working. In 2016, there were 2,304,037 persons in the labour force in the State. Table 5-5 shows the percentage of the total population aged 15+

who were in the labour force during the 2016 Census. This figure is further broken down into the percentages that were at work or unemployed. It also shows the percentage of the total population aged 15+ who were not in the labour force, i.e. those who were students, retired, unable to work or performing home duties.

Table 5-5 Economic Status of the Total Population Aged 15+ in 2016 (Source: CSO)

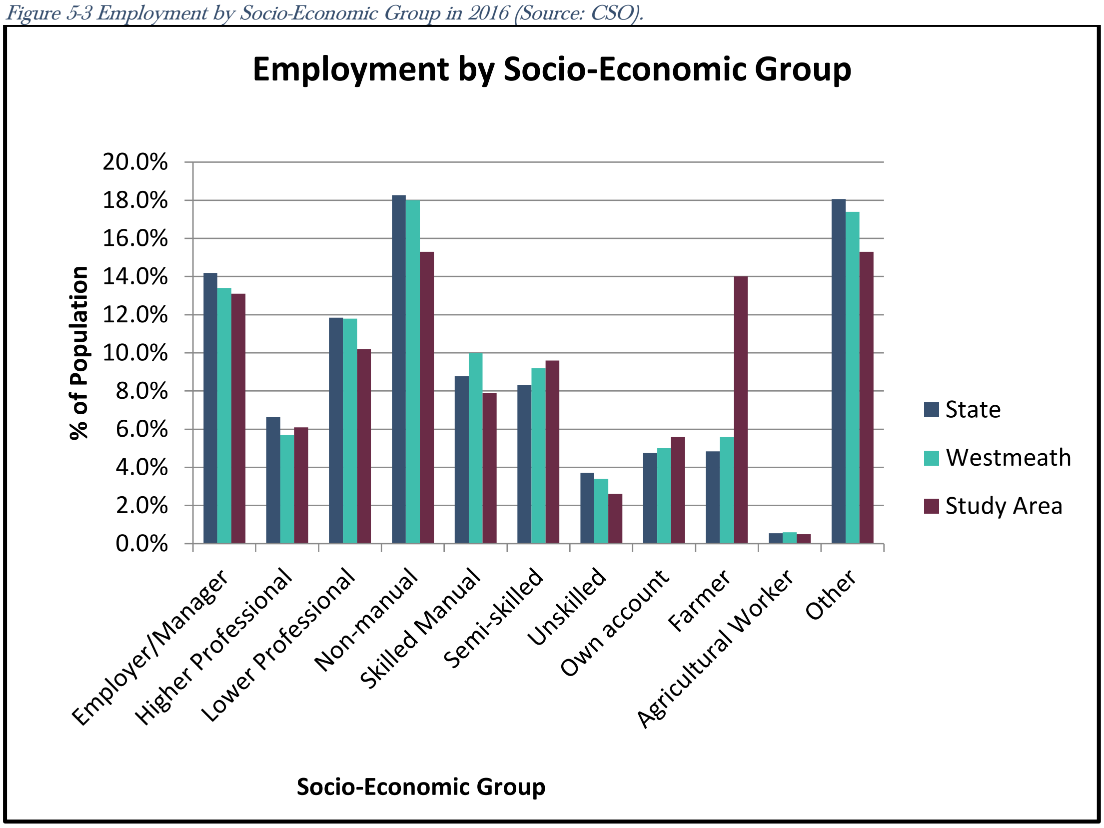
Status		State	County Westmeath	Population Study Area
% of population aged 15+ who are in the labour force		**61.4%**	**60.8%**	**62.5%**
% of which are:	At work	87.1%	84.1%	87.7%
	First time job seeker	1.4%	1.7%	2.0%
	Unemployed	11.5%	14.2%	10.3%
% of population aged 15+ who are not in the labour force		**38.6%**	**39.2%**	**37.5%**
% of which are:	Student	29.4%	29.0%	29.3%
	Home duties	21.1%	22.5%	27.4%
	Retired	37.6%	35.5%	29.9%
	Unable to work	10.9%	11.4%	13.2%
	Other	1.0%	1.6%	0.3%

Overall, the principal economic status of those living in the Population Study Area is broadly similar to that recorded at State and County level. During the 2016 Census, the percentage of people over the age of 15 who were in the labour force was similar at both state and county level, but slightly higher within the Population Study Area with 62.5% in the labour force. Of those who were not in the labour force during the 2016 Census, the highest percentage of the Population Study Area population were 'Retired' individuals, similar to state and county populations.

5.2.6.2 Employment by Socio-Economic Group

Socio-economic grouping divides the population into categories depending on the level of skill or educational attainment required. The 'Higher Professional' category includes scientists, engineers, solicitors, town planners and psychologists. The 'Lower Professional' category includes teachers, lab technicians, nurses, journalists, actors and driving instructors. Skilled occupations are divided into manual skilled such as bricklayers and building contractors; semi-skilled such as roofers and gardeners; and unskilled, which includes construction labourers, refuse collectors and window cleaners. Figure 5-3 shows the percentages of those employed in each socio-economic group in the State, County Westmeath and the Population Study Area during 2016.

Figure 5-3 Employment by Socio-Economic Group in 2016 (Source: CSO).



The highest level of employment within the Population Study Area was recorded in the Non-Manual category. The levels of employment within the Employer/Manager, Lower Professional, Non-Manual, Skilled Manual, Un-skilled, and Other categories in the Population Study Area were lower than those recorded for the State and County Westmeath, while those recorded within the Semi-Skilled, Own Account, and Farmer, categories were higher. The level of employment in the Agricultural Worker category were lower than those recorded for the County and the same as those recorded for the State. The level of employment for Higher Professionals category were slightly lower than those recorded for the state but higher than those recorded throughout County Westmeath.

The CSO employment figures grouped by socio-economic status includes the entire population for the Population Study Area, County and State in their respective categories. As such, the socio-economic category of 'Other' is skewed to include those who are not in the labour force.

5.2.6.3 Employment and Investment Potential in the Irish Wind Energy Industry

5.2.6.3.1 *Background*

A report entitled '*Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy*' was published in 2009 by Deloitte, in conjunction with the Irish Wind Energy Association (IWEA). This report focused on the ability of the Irish wind energy industry to create investment and jobs. In terms of the overall economic benefit to be obtained from wind energy, the report states in its introduction:

> *"Ireland is fortunate to enjoy one of the best wind resources in the world. Developing this resource will reduce and stabilise energy prices in Ireland and boost our long-term competitiveness as an economy. It will also significantly reduce our dependence on imported fossil fuels."*

More recently, a report published in 2014 by Siemens entitled '*An Enterprising Wind - An economic analysis of the job creation potential of the wind sector in Ireland*', also in conjunction with the Irish Wind Energy Association (IWEA), concluded that, *'a major programme of investment in wind could have a sizeable positive effect on the labour market, resulting in substantial growth in employment.'*

The report considers the three potential types of direct employment created, as a result of increased investment in wind energy, to be:

- Wind Energy Industry Employment:
  - Installation
  - Development
  - Planning
  - Operation and Maintenance
  - Investor activity
- Electricity Grid Network Employment
- Potential Wind Turbine Manufacturing Employment

5.2.6.3.2 Energy Targets

The Climate Action Plan 2023 (CAP) was published on the 21st December 2023 by the Department of Communications, Climate Action and Environment. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Ireland's environment, society, economic and natural resources. The CAP includes a commitment that 80% of Ireland's electricity needs will come from renewable sources by 2030 and a target of 9 GW from onshore wind, 8 GW from solar, and at least 5 GW of offshore wind energy by 2030. It is envisaged that wind energy will provide the largest source of renewable energy in achieving this target.

5.2.6.3.3 Employment Potential

The 2014 report "*An Enterprising Wind: An economic analysis of the job creation potential of the wind sector in Ireland*" published by the Irish Wind Energy Association (IWEA) predicted that the wind energy sector in Ireland would result in 6,659 direct jobs in a scenario where 4GW capacity is achieved by 2020. This figure of 6,659 is broken down further; 5,596 of these jobs are associated directly with the construction and installation of windfarms, while the remaining 1,063 jobs are associated with the national grid. Under this scenario this contributes 1.66 direct jobs per Megawatt (MW) of wind capacity throughout the various stages of installation. According to Wind Energy Ireland, the installed wind capacity in Ireland is over 4.2GW as of February 2021, which would support employment during the last decade. Ireland needs to achieve a total of 8.2GW of onshore wind by 2030 which will further support further employment.

The Sustainable Energy Authority of Ireland estimates, in their '*Wind Energy Roadmap 2011-2050*', note that '*Onshore and offshore wind could create 20,000 direct installation and O&M jobs by 2040*'. Furthermore, '*wind energy resource represents a significant value to Ireland by 2050. This value is presented in terms of its ability to contribute to our indigenous energy needs, the benefits of enhanced employment creation and investment potential, and the ability to significantly abate carbon emissions to 2050*'.

The 2014 report '*The Value of Wind Energy to Ireland*', published by Pőyry, stated that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. If Ireland instead chooses to not develop any more wind, then by 2030 the country will be reliant on natural gas for most of our electricity generation, at a cost of €671 million per annum in fuel import costs.

Internationally, a report issued by WindEurope in September 2017, entitled '*Wind energy in Europe: Scenarios for 2030'* details various scenarios in Europe in respect to the EU target for renewable energy. According to WindEurope's High Scenario, which assumes favourable market and policy conditions including the achievement of a 35% EU renewable energy target (slightly higher than the 32% EU target for renewables), '*397 GW of wind energy capacity would be installed in the EU by 2030, 298.5 GW onshore and 99 GW offshore. In this scenario, the wind energy industry would invest €351bn by 2030, and it would create 716,000 jobs'.*

A more recent report which was issued by WindEurope in February 2022, titled '*Wind Energy in Europe: 2021 Statistics and the Outlook for 2022-2026'* details various scenarios in Europe in respect to the EU target for renewable energy. According to WindEurope's report, '*Europe installed 17GW (11 GW in the EU-27) of new wind capacity in 2021. This is not even half of what the EU should be building to be on track to deliver its 2030 Climate Energy Goals.* The report continued on to state that *'We expect Europe to install 116 GW of new wind farms over the period from 2022-2026. Three quarters of these new capacity additions will be onshore wind.'* The report also states that '*The European Commission modelling shows that we need at least 79 GW offshore wind but National Government have pledged to build at least 92 GW offshore wind capacity by 2030.'*

As of December 2022, there were over 5,585 Megawatts (MW) of wind energy capacity installed on the island of Ireland. Of this, 4,332.5 MW was installed in the Republic of Ireland, with 1,276 MW installed in Northern Ireland. The majority of the Republic of Ireland's installed wind energy capacity is located in Counties Mayo, Galway, Cork and Kerry.

5.2.6.3.4 Economic Value

A 2009 Deloitte report in conjunction with the Irish Wind Energy Association (now Wind Energy Ireland, WEI) titled 'Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy'[1] states that the construction and development of wind energy projects across the island of Ireland would involve approximately €14.75 billion of investment from 2009 up to 2020, €5.1 billion of which would be retained in the Irish economy (€4.3 billion invested in the Republic of Ireland and €0.8 billion in Northern Ireland).

The report also states that increasing the share of our energy from renewable sources will deliver significant benefits for the electricity customer, the local economy and society. It estimates that between 25 and 30% of capital investment is retained in the local economy. This typically flows to companies in construction, legal, finance and other professional services. The report states:

> *".. the framework acknowledges the need to put the energy/climate change agenda at the heart of Ireland's economic renewal. Every new wind farm development provides a substantial contribution to the local and national economy through job creation, authority rates, land rents and increased demand for local support services. More wind on the system will also result in lower and more stable energy prices for consumers while helping us achieve our energy and emissions targets."*

A 2019 report by Baringa, '*Wind for a Euro: Cost-benefit analysis of wind energy in Ireland 2000-2020'*, has analysed the financial impact for end consumers of the deployment of wind generation in Ireland over the period 2000-2020. The report calculates how the costs and benefits for consumers would have differed if no wind farms had been built. The analysis indicated that the deployment of 4.1 GW of wind generation capacity in Ireland between 2000 and 2020 (2018-2020 results being projective) will result in a total net cost to consumers, over 20 years, of €0.1bn (€63 million to be exact), which equates to a cost of less than €1 per person per year since 2000. Further cost benefit analysis noted that wind energy has delivered €2.3 billion in savings in the wholesale electricity market. As such, the economic benefit of renewable energy to consumers is greater than what would have been if Ireland did not invest in wind

[1] *Deloitte, Irish Wind Energy Association 2009 Jobs and Investment in Irish Wind Energy Powering Ireland's Economy. Available at: https://windenergyireland.com/images/files/9660bd5e72bcac538f47d1b02cc6658c97d41f.pdf*

power. This tallies with the Deloitte report which indicated that more wind energy feeding into the national grid would result in lower and more stable energy costs for consumers.

The Proposed Development will, if consent is granted, contribute to the economic value that renewable energy brings to Ireland by reducing the reliance of fossil fuels in Ireland and assist in meeting our renewable energy targets as set out by the EU.

5.2.7 Land-Use

Current land use on the Wind Farm Site comprises coniferous forestry and agriculture. Current use along the Grid Connection underground electrical cabling route comprises of public road corridor, public open space, discontinuous urban fabric and agriculture. Land use in the wider landscape of the Site comprises a mix of agriculture, peat cutting, quarrying, low density residential and commercial forestry.

The total area of farmland within the Population Study Area measures approximately 4,539 hectares, comprising approximately 83.3% of the Population Study Area, according to the CSO Census of Agriculture 2010. There are 115 farms located within the Population Study Area, with an average farm size of 39.5 hectares. This is smaller than the 61.7-hectare average farm size for Co. Westmeath.

Within the Population Study Area, farming employs 227 people, and the majority of farms are family-owned and run. Table 5-6 shows the breakdown of farmed lands within the Population Study Area. Pasture accounts for the largest proportion of farmland, which is followed by silage, crops and hay. There are no lands farmed for potatoes within the Population Study Area.

Table 5-6 Farm Size and Classification within the Population Study Area in 2010 (Source: CSO)

Characteristic	Value
Size of Population Study Area	5,451 hectares
Total Area Farmed within Population Study Area	4,539 hectares
Farmland as % of Population Study Area	83.3%
Breakdown of Farmed Land	**Area (hectares)**
Total Pasture	3,025 ha
Total Silage	1,000 ha
Total Crops	162 ha
Total Hay	141 ha
Total Cereals	127 ha
Grazing	111 ha
Total Potatoes	0 ha

5.2.7.1 Equine Industry

No stud farms or equestrian facilities were identified within 10km of the Wind Farm Site. The closest such facility is Athlone Equestrian Centre which is located approximately 10.6km to the southwest of the Wind Farm Site.

There have been no known studies carried out in Ireland on the impacts of wind farms on the equine industry. In 2014 Marshall Day Acoustics published a document entitled *'Summary of research of noise effects on Animals'*. The Marshall Day study specifically assessed the impacts of varying levels of noise on horses in three differing behavioural settings. The three behavioural settings studied included horses in stables, breeding mares and racing horses.

Horses in Stables

The study by Marshall Day Acoustics found that horses, stabled at the Flemington Racecourse Australia at the same time as a music concert on the site, when exposed to $L_{Aeq,15min}$ of 54-70 dB showed little response to the music noise unless the noise was particularly impulsive. The horses stabled at Flemington Racecourse were thoroughbreds, and stables were located 200 metres from the concert.

Breeding Mares

A study by Le Blanc et al (1991) and summarised by Marshall Day studied the effects of simulated aircraft noise over 100 dB and visual stimuli on pregnant mares. The study focused on pregnancy success, behaviour, cardiac function, hormonal production and rate of habitation. Le Blanc concluded the following:

> *Le Blanc et al (1991) found that birth success of pregnant mares was not affected by F-14 jet aircraft noise. While the 'fright-flight' reaction was initially observed, the mares did adapt to the noise.*

Racehorses

Marshall Day Acoustics concluded the following in relation to their study on the impacts of noise on racehorses:

> *Marshall Day Acoustics have observed horses grazing in paddocks directly under the main approach path of the Christchurch International Airport where noise levels are in excess of 90 dB (LAmax) during an aircraft flyover. Although these horses are arguably "used to" the noise, there was generally little recognition by them of an aircraft passing, let alone any sign of disturbance. This tends to support the conclusions by Le Blanc et al (1991).*

5.2.7.1.2 *Guidance*

In the absence of national policy or guidance in relation of the development of wind farms near stud farms/equestrian centres, MKO have reviewed the British Horse Society's *'Advice on Wind Turbines and Horses – Guidance for Planners and Developers'*. A copy of the guidance document is included in Appendix 5-1 of this EIAR.

The British Horse Society policy statement states the following in relating to the siting of wind turbines in the vicinity of equine businesses:

> *The BHS strongly recommends that the views and concerns of local equestrians should be recognised and taken into account when determining separation distances and that normally a minimum separation distance of 200m or three times blade tip height (whichever is greater) will be required between a turbine and any route used by horses or a business with horses.*

On a precautionary basis, working on the assumption that every inhabitable dwelling owns a horse or horses on a precautionary basis, the closest inhabitable dwelling is located approximately 757 metres from the nearest proposed turbine location. As mentioned previously, the closest stud farm/equestrian facility is located approximately 10.6km from the Wind Farm Site. In both instances, the proposed turbines are at a distance beyond that of the British Horse Society's recommended minimum separation distance of 200 metres as noted above. In both instances, the minimum separation distance from proposed turbines exceeds the 555 metres separation distance (based on three times the turbine blade tip height of 185 metres) between a turbine and any business with horses.

5.2.8 Services

The Wind Farm Site is located approximately 12.2 kilometres north-east of Athlone, Co. Westmeath and approximately 6.6 kilometres to the north of Moate, Co. Westmeath. It is proposed to access the Wind Farm Site via an existing track off the L5363 Local road to the north-west of the Wind Farm Site. The Wind Farm Site is served by a number of existing agricultural roads and tracks.

Tullamore town centre is located approximately 2.2 kilometres to the south-west of the Grid Connection underground electrical cabling route terminus at Thornsberry 110kV Substation. The underground electrical cabling route also passes through the outskirts of Kilbeggan, Co. Westmeath.

The main services for the Population Study Area are located within Athlone, 12.2 kilometres south-west of the Wind Farm Site, which is classified as a county town, and in Moate, 6.6 kilometres south of the Wind Farm Site which is classified as a service town. Other settlement centres in the wider region which provide retail, recreational, educational, and religious services include Ballymore, 2 kilometres to the east of the Wind Farm Site, and Mount Temple, 4.7 kilometres to the southwest of the Wind Farm Site.

5.2.8.1 Education

The nearest school to the Wind Farm Site is Drumraney Mixed National School, located approximately 1.4 kilometres to the west of the Wind Farm Site at its closest point. Naomh Clar National School is located approximately 1.8 kilometres to the west of the Wind Farm Site at its closest point. The closest secondary school is Moate Community School which is located approximately 6.7 kilometres to the south-west. The closest third-level institute to the site is the Technological University of the Shannon (TUS): Midlands Midwest Athlone Campus which is located approximately 12.8km to the south-west of the Wind Farm Site.

The primary school located closest to the Grid Connection is Rosemount National School which is located adjacent to the underground electrical cabling route along the local L6021 road. The closest Secondary School to the Grid Connection is the Mercy Secondary School in Kilbeggan which is approximately 962 metres to the east of the underground electrical cabling route at its closest point. Technological University of the Shannon (TUS): Midlands Midwest Athlone Campus is the closest third level institution to the underground electrical cabling route, located 12.8km to the south-west.

5.2.8.2 Access and Public Transport

The Wind Farm Site is accessed via an existing access track off the L5363 to the north-west of the Wind Farm Site. The Wind Farm Site itself is served by a number of existing forestry and agricultural roads and tracks. The nearest bus routes from which several daily connections are available, can be accessed in Moate, approximately 6.6km to the south of the Wind Farm Site.

The Grid Connection underground electrical cabling route is approximately 31km in length. The underground electrical cabling route can be accessed from a number of roads which it runs adjacent to such as the L5336, L1305, L6021, R436, and N52. Bus routes which would service the Grid Connection underground electrical cabling route are located in Moate, Kilbeggan and Tullamore.

5.2.8.3 Amenities and Community Facilities

There are a number of amenities and community facilities, including sports clubs, youth clubs, recreational areas, retail and personal services located in the nearby villages of Ballymore, Mount Temple and Rosemount. The towns of Athlone and Moate also offer a large selection of amenities and community facilities. There are a number of GAA clubs in the areas surrounding the Wind Farm Site and Grid Connection, some of which are the Maryland GAA Club, Cauldry GAA Club, Rosemount GAA Club (Located adjacent to the underground electrical cabling route in Rosemount village) and Fr Daltons GAA Club.

The varied environment of this area of County Westmeath provides many opportunities for walking, cycling and playing golf. Ballymore Pitch and Putt is located approximately 1.9 kilometres to the east of the Wind Farm Site at its closest point.

The Old Rail Trail, which caters for walkers and cyclists stretches from Mullingar to Athlone. This trail passes through the town of Moate and is at its closest to the Wind Farm Site approximately 4.6 kilometres to the south-east. The Grid Connection underground electrical cabling route passes under the Old Rail Trail on the local road 1.6km south-west of Rosemount.

Community Benefit proposals, which would enhance local amenities and community facilities are described in Chapter 4: Description of the Proposed Development.

5.3 Tourism

5.3.1 Tourism Numbers and Revenue

Tourism is one of the major contributors to the national economy and is a significant source of full time and seasonal employment. During 2019, total tourism revenue generated in Ireland was approximately €9.5 billion, an increase on the €9.4 billion revenue recorded in 2018. Overseas tourist visits to Ireland in 2019 grew by 0.7% to 9.7 million ('*Tourism Facts 2019*, Fáilte Ireland, March 2021).

Ireland is divided into seven tourism regions. Table 5-7 shows the total revenue and breakdown of overseas tourist numbers to each region in Ireland during 2019 ('*Tourism Facts 2019*, Fáilte Ireland, March 2021).

Table 5-7 Overseas Tourists Revenue and Numbers 2019 (Source: Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
Dublin	€2,210m	6,644
Mid-East/Midlands	**€348m**	**954**
South-East	€261m	945
South-West	€970m	2,335
Mid-West	€472 m	1,432
West	€653m	1,943
Border	€259m	768
Total	**€5,174 m**	**15,021**

The Wind Farm Site and Grid Connection are located within the Mid-East/Midlands. According to '*Regional tourism performance in 2019'* (Fáilte Ireland, March 2021) the Mid-East/Midlands Region which comprises Counties Kildare, Louth, Laois, Longford, Meath, Offaly, Westmeath and Wicklow, benefited from approximately 15.7% of the total number of overseas tourists to the country and approximately 14.86% of the associated tourism income generated in Ireland in 2019.

Although the data for 2019 is not available, Table 5-8 presents the most recent breakdown of overseas tourist numbers and revenue to the Mid-East/ Midlands region during 2017 ('*2017 Topline Tourism Performance by Region,* Fáilte Ireland, August 2018). As can be observed in Table 5-8, County Westmeath had 103,000 overseas tourists visiting the Region during 2017 and had tourism revenue at €46 million.

Table 5-8 Overseas Tourism to Mid-East/Midlands Region during 2017 (Source: Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
Kildare	91	211
Louth	55	172
Laois	14	43
Longford	10	24
Meath	44	162
Offaly	16	52
Westmeath	**46**	**103**
Wicklow	73	275

5.3.2 Tourist Attractions

There are no key identified tourist attractions pertaining specifically to the site of the Proposed Development, however the Grid Connection underground electrical cabling route will be located within the public road network which passes under the Old Rail Trail tourist attraction on the local road 1.6km south-west of Rosemount.

Key tourist attractions within County Westmeath include Athlone Castle, Kilbeggan Distillery, The Hill of Uisneach, The Old Rail Trail Greenway, Tullynally Castle and the Royal Canal Greenway.

Many additional tourist attractions are found in Athlone, Moate and Kilbeggan along with towns in adjacent counties such as Ballymahon in County Longford and Clara in County Offaly.

The Discover Ireland website (www.discoverireland.ie) lists the following attractions with relation to the Wind Farm Site:

- Athlone Castle, located approximately 15 kilometres to the south-west of the Wind Farm Site
- The Old Rail Trail also passes through Athlone. This greenway stretches from Athlone to Mullingar and is at its closest to the Wind Farm Site approximately 4.6 kilometres to the south-east.

- Dún na Sí Amenity & Heritage Park is located approximately 6.6 kilometres to the south of the Wind Farm Site, on the northern outskirts of the town of Moate. The Old Rail Trail also passes through this town.
- The Kilbeggan Distillery is approximately 15 kilometres to the south-east of the Wind Farm Site. This distillery is one of the largest tourist attractions in County Westmeath.
- Kilbeggan Racecourse is located approximately 14 kilometres to the south-east of the Wind Farm Site.
- Center Parcs Longford is located to the east of the town of Ballymahon and is approximately 8 kilometres to the north of the Wind Farm Site.

Further recreational walking routes which are located within 25km of the Wind Farm Site as listed in Chapter 12 are as follows:

- Newcastle Wood Church Walk
- National Famine Way
- Royal Canal Greenway
- Mullingar Cycle and Walking Hub Loop 2
- The Pilgrims Road to Clonmacnoise Cycle Route
- Westmeath Way
- Clara Esker Forest Loop Walk
- Clara Esker Ballinlough Doorey Loop
- Clara Bog Boardwalk
- Rinn Duin Loop Walks
- Green Heartlands Cycle Route
- Offaly Way

5.3.3 Tourist Attitudes to Wind Farms

5.3.3.1 Scottish Tourism Survey 2016

BiGGAR Economics undertook an independent study in 2016, entitled '*Wind Farms and Tourism Trends in Scotland*', to understand the relationship, if any, that exists between the development of onshore wind energy and the sustainable tourism sector in Scotland. In recent years, the onshore wind sector and sustainable tourism sector have grown significantly in Scotland. However, it could be argued that if there was any relationship between the growth of onshore wind energy and tourism, it would be at a more local level. This study therefore considered the evidence at a local authority level and in the immediate vicinity of constructed wind farms.

Eight local authorities had seen a faster increase in wind energy deployment than the Scottish average. Of these, five also saw a larger increase in sustainable tourism employment than the Scottish average, while only three saw less growth than the Scottish average. The analysis presented in this report shows that, at the Local Authority level, the development of onshore wind energy does not have a detrimental impact on the tourism sector. It was found that in the majority of cases (66%) sustainable tourism employment performed better in areas surrounding wind farms than in the wider local authority area. There was no pattern emerging that would suggest that onshore wind farm development has had a detrimental impact on the tourism sector, even at the very local level.

Overall, the conclusion of this study is that published national statistics on employment in sustainable tourism, demonstrate that there is no relationship between the development of onshore wind farms and tourism employment at the level of the Scottish economy, at local authority level, nor in the areas immediately surrounding wind farm development. However the report also concluded that *'Although this study does not suggest that there is any direct relationship between tourism sector growth and wind farm development, it does show that wind farms do not cause a decrease in tourism employment either at a local or a national level.'*

5.3.3.2 Fáilte Ireland Surveys 2007 and 2012

In 2007, Fáilte Ireland in association with the Northern Ireland Tourist Board carried out a survey of domestic and overseas holidaymakers to Ireland in order to determine their attitudes to wind farms. The purpose of the survey was to assess whether the development of wind farms impacts on the enjoyment of the Irish scenery by holidaymakers. The survey involved face-to-face interviews with 1,300 tourists (25% domestic and 75% overseas). The results of the survey are presented in the Fáilte Ireland Newsletter 2008/No.3 entitled 'Visitor Attitudes on the Environment: Wind Farms'.

The Fáilte Ireland survey results indicate that most visitors are broadly positive towards the idea of building wind farms in Ireland. There exists a sizeable minority (one in seven) however who are negative towards wind farms in any context. In terms of awareness of wind farms, the findings of the survey include the following:

- Almost half of those surveyed had seen at least one wind farm on their holiday to Ireland. Of these, two thirds had seen up to two wind farms during their holiday.
- Typically, wind farms are encountered in the landscape while driving or being driven (74%), while few have experienced a wind farm up close.
- Of the wind farms viewed, most contained less than ten turbines and 15% had less than five turbines.

Regarding the perceived impact of wind farms on sightseeing, the Fáilte Ireland report states:

> *"Despite the fact that almost half of the tourists interviewed had seen at least one wind farm on their holiday, most felt that their presence did not detract from the quality of their sightseeing, with the largest proportion (45%) saying that the presence of the wind farm had a positive impact on their enjoyment of sightseeing, with 15% claiming that they had a negative impact."*

In assessing the perceived impact of wind farms on beauty, visitors were asked to rate the beauty of five different landscapes types: Coastal, Mountain, Farmland, Bogland and Urban Industrial, and then rate on a scale of 1-5 the potential impact of a wind farm being sited in each landscape. The survey found that each potential wind farm must be assessed on its own merits. Overall however, in looking at wind farm developments in different landscape types, the numbers claiming a positive impact on the landscape due to wind farms were greater than those claiming a negative impact, in all cases.

Regarding the perceived impact of wind farms on future visits to the area, the Fáilte Ireland survey states:

> *"Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland. Of those who feel that a potentially greater number of wind farms would positively impact on their likelihood to visit, the key driver is their support for renewable energy and potential decreased carbon emissions."*

The report goes on to state that while there is a generally positive disposition among tourists towards wind development in Ireland, it is important also to take account of the views of the one in seven tourists who are negatively disposed towards wind farms. This requires good planning on the part of the wind farm developer as well as the Local Authority. Good planning has been an integral component of the Proposed Development throughout the site design and assessment processes. Reference has been made to the '*Planning Guidelines on Wind Energy Development 2006*' and the '*Draft Revised Wind Energy Development Guidelines December 2019*' in addition to WEI (previously IWEA) best practice guidance, throughout all stages, including pre-planning consultation and scoping.

The 2007 survey findings are further upheld by a more recent report carried out by Fáilte Ireland on tourism attitudes to wind farms in 2012. The results of the updated study were published in the 'Fáilte Ireland Newsletter 2012/No.1 entitled 'Visitor Attitudes on the Environment: Wind Farms – Update on

2007 Research'. The updated survey found that of 1,000 domestic and foreign tourists who holidayed in Ireland during 2012, over half of tourists said that they had seen a wind turbine while travelling around the country. Of this number of tourists, 21% claimed wind turbines had a negative impact on the landscape. However, 32% said that it enhanced the surrounding landscape, while 47% said that it made no difference to the landscape. Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland.

Further details regarding the general public perception of wind energy, including those living in the vicinity of a wind farm, are presented in Section 5.4 below.

5.4 Public Perception of Wind Energy

5.4.1 Sustainable Energy Ireland Survey 2003

5.4.1.1 Background

The results of a national survey entitled *'Attitudes Towards the Development of Wind Farms in Ireland'* were published by the Sustainable Energy Authority of Ireland (SEAI) in 2003. A catchment area survey was also carried out by SEAI (formerly SEI) in order to focus specifically on people living with a wind farm in their locality or in areas where wind farms are planned.

5.4.1.2 Findings

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents rating it positively or very positively. One percent rates it negatively and 14% had no opinion either way. Approximately two thirds of respondents (67%) were found to be positively disposed to having a wind farm in their locality. Where negative attitudes were voiced towards wind farms, the visual impact of the turbines on the landscape was the strongest influence. The report also notes however that the findings obtained within wind farm catchment areas showed that impact on the landscape is not a major concern for those living near an existing wind farm.

With regards to the economic and environmental impacts of wind farm development, the national survey reveals that attitudes towards wind energy are influenced by a perception that wind is an attractive source of energy:

> *"Over 8 in 10 recognise wind as a non-polluting source of energy, while a similar number believe it can make a significant contribution to Ireland's energy requirements."*

The study reveals uncertainty among respondents with regards to the issues of noise levels, local benefits and the reliability or otherwise of wind power as an energy source. It goes on to state however that the finding that people who have seen wind farms rate these economic and environmental factors more favourably is a further indication that some experience of the structures tends to translate into positive attitudes towards wind energy.

Similar to the national survey, the surveys of those living within the vicinity of a wind farm also found that the findings are generally positive towards wind farms. Perceptions of the impact of the development on the locality were generally positive, with some three-quarters of interviewees believing it had impacted positively.

In areas where a wind farm development had been granted planning permission but was not yet under construction, three quarters of the interviewees expressed themselves in favour of the wind farm being built in their area. Four per cent were against the development. The reasons cited by those who expressed themselves in favour of the wind farm included the fact that wind energy is clean (78%), it would provide local jobs (44%), it would help develop the area (32%) and that it would add to the landscape (13%). Those with direct experience of a wind farm in the locality are generally impressed with it as an additional feature in the landscape. The report states:

> *"It is particularly encouraging that those with experience of wind turbines are most favourable to their development and that wind farms are not solely seen as good in theory, but are also seen as beneficial when they are actually built."*

Few of those living in proximity either to an existing wind farm or one for which permission has been granted believe that the development damages the locality, either in terms of damage to tourism potential or to wildlife. The survey found that there is a clear preference for larger turbines in smaller numbers over smaller turbines in larger numbers.

5.4.1.3 Survey Update 2017

Additionally, a survey carried out by Interactions in October 2017, published by the SEAI, show 47% of Irish adults polled said they were strongly in favour of wind power in Ireland while a further 38% favour it. Overall, this is a 4% increase in favourable attitudes towards wind power compared with similar research in 2013.

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents in favour of the use of wind energy in Ireland. Approximately two thirds of respondents (70%) would prefer to power their home with renewable energy over fossil fuels, and 45% would be in favour of a wind farm development in their area.

The survey also captured the perceived benefits of wind power among the public. Of those surveyed three quarters selected good for the environment and reduced Carbon Dioxide emissions while fewer people, just over two in three, cited cheaper electricity.

5.4.1.4 Conclusions

The main findings of the SEAI survey indicate that the overall attitude to wind farms is "almost entirely positive". The study highlights that two-thirds of Irish adults are either very favourable or fairly favourable to having a wind farm built in their locality, with little evidence of a "Not In My Back Yard" (NIMBY) effect. The final section of the 2017 report states:

> *"The overwhelming indication from this study is that wind energy enjoys great support and, more specifically, that the development of wind farms is supported and welcomed. The single most powerful indicator of this is to be found among those living in proximity to an existing wind farm: over 60% would be in favour of a second wind farm or an extension of the existing one. This represents a strong vote in favour of wind farm developments – especially important since it is voiced by those who know from direct experience about the impact of such developments on their communities."*

5.4.2 Public Perceptions of Wind Power in Scotland and Ireland Survey 2005

5.4.2.1 Background

A survey of the public perception of wind power in Scotland and Ireland was carried out in 2003/2004 by researchers at the School of Geography & Geosciences, University of St. Andrews, Fife and The Macaulay Institute, Aberdeen ('*Green on Green: Public Perceptions of Wind Power in Scotland and Ireland*', Journal of Environmental Planning and Management, November 2005). The aims of the study were to ascertain the extent to which people support or oppose wind power, to investigate the reasons for these attitudes and to establish how public attitudes relate to factors such as personal experience of operational wind farms and their proximity to them.

5.4.2.2 Study Area

Surveys were carried out at two localities in the Scottish Borders region, one surrounding an existing wind farm and one around a site at which a wind farm had received planning permission but had not yet been built. Surveys were also carried out in Ireland, at two sites in Counties Cork and Kerry, each of which has two wind farms in proximity.

5.4.2.3 Findings

The survey of public attitudes at both the Scottish and Irish study sites concluded that large majorities of people are strongly in favour of their local wind farm, their personal experience having engendered positive attitudes. Attitudes towards the concept of wind energy were described as "overwhelmingly positive" at both study sites in Scotland, while the Irish survey results showed almost full support for renewable energy and 92% support for the development of wind energy in Ireland.

The results of the survey were found to agree with the findings of previous research, which show that positive attitudes to wind power increase through time and with proximity to wind farms. With regards to the NIMBY effect, the report states that where NIMBY-ism does occur, it is much more pronounced in relation to proposed wind farms than actual wind farms. The Scottish survey found that while positive attitudes towards wind power were observed among those living in proximity to both the proposed and existing wind farm sites, people around the proposed site were less convinced than those living in proximity to the existing site. Retrospective questioning regarding pre- and post-construction attitudes at the existing site found that attitudes remained unchanged for 65% of respondents. Of the 24% of people who altered their attitudes following experience of the wind farm, all but one became more positive. The report states:

> *"These results support earlier work which has found that opposition to wind farms arises in part from exaggerated perceptions of likely impact, and that the experience of living near a wind farm frequently dispels these fears. Prior to construction, locals typically expect the landscape impacts to be negative, whereas, once in operation, may people regard them as an attractive addition."*

The reasons that people gave for their positive attitude to the local wind farm were predominantly of a global kind, i.e. environmental protection and the promotion of renewable energy, together with opposition to a reliance on fossil fuels and nuclear power. Problems that are often cited as negative impacts of wind farms, such as interference with telecommunications and shadow flicker were not mentioned at either site. With regards to those who changed to a more positive attitude following construction of the wind farm, the reasons given were that the wind farm is *"not unattractive (62%), that there was no noise (15%), that community funding had been forthcoming (15%) and that it could be a tourist attraction (8%)".*

The findings of the Irish survey reinforce those obtained at the Scottish sites with regards to the increase in positive attitudes to wind power through time and proximity to wind farms. The survey of public attitudes at the sites in Cork and Kerry found that the highest levels of support for wind power were recorded in the innermost study zone (0 – 5 kilometres from a point in between the pair of wind farms). The data also suggests that *"those who see the wind farms most often are most accepting of the visual impact".* The report also states that a previous Irish survey found that most of those with direct experience of wind farms do not consider that they have had any adverse impact on the scenic beauty of the area, or on wildlife, tourism or property values. Overall, the study data reveals *"a clear pattern of public attitudes becoming significantly more positive following personal experience of operational wind farms".*

With regards to wind farm size, the report notes that it is evident from this and previous research that wind farms with small numbers of large turbines are generally preferred to those with large numbers of smaller turbines.

5.4.2.4 Conclusions

The overall conclusions drawn from the survey findings and from the authors' review of previous studies show that local people become more favourable towards wind farms after construction, that the degree of acceptance increases with proximity to them, and that the NIMBY-ism effect does not adequately explain variations in public attitudes due to the degree of subjectivity involved.

5.4.3 IWEA Interactions Opinion Poll on Wind Energy

Published in January 2020, IWEA undertook a national opinion poll on Wind Energy November 2019 with the objective to "*measure and track public perceptions and attitudes around wind energy amongst Irish adults*." Between November 20th – 30th 2019, a nationally represented sample of 1,019 adults and a booster sample of 200 rural residents participated in an online survey. The 2019 results indicate that 79% of both the nationally represented sample and rural sample strongly favour or favour wind power while 16% of both samples neither favour or oppose it. Amongst those in favour of wind power, the majority cited environmental and climate concerns as their main reasons for supporting such developments. Other reasons cited for supporting wind energy developments include: "economic benefits," "reliable/efficient," "positive experience with wind energy" and recognise it as a "safe resource." When questioned about wind developments in their local area, 55% of nationally represented sample favour or tend to favour such proposals and 51% of the rural population reported the same. Reasons cited for supporting wind developments in their local area include: "good for the environment," "social responsibility," "create jobs," "good for the community." In the same survey, 30 to 31% neither favour/opposed, 6 to 7% tended to oppose and 9 to 11% strongly opposed.

The IWEA November 2019 survey follows previous national opinion polls asking the same questions on wind energy undertaken in October 2017 and November 2018. The 2019 survey results are consistent with the 2017 and 2018 figures and thus indicate that approximately 4 out of 5 Irish adults have continued to support wind energy in recent years.

5.5 Health Impacts of Wind Farms

5.5.1 Health Impact Studies

While there are anecdotal reports of negative health effects on people who live very close to wind turbines, peer-reviewed research largely does not support these statements. There is currently no published credible scientific evidence to positively link wind turbines with adverse health effects. The main publications supporting the view that there is no evidence of any direct link between wind turbines and health are summarised below.

1. ***'Wind Turbine Sound and Health Effects – An Expert Panel Review', American Wind Energy Association and Canadian Wind Energy Association, December 2009***

This expert panel undertook extensive review, analysis and discussion of the large body of peer-reviewed literature on sound and health effects in general, and on sound produced by wind turbines in particular. The panel assessed the plausible biological effects of exposure to wind turbine sound. Following review, analysis, and discussion of current knowledge, the panel reached consensus on the following conclusions:

- *"There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.*

- *The ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans.*
- *The sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences."*

The report found, amongst other things, that:

- *"Wind Turbine Syndrome" symptoms are the same as those seen in the general population due to stresses of daily life. They include headaches, insomnia, anxiety, dizziness, etc.*
- *Low frequency and very low-frequency 'infrasound' produced by wind turbines are the same as those produced by vehicular traffic and home appliances, even by the beating of people's hearts. Such 'infrasounds' are not special and convey no risk factors;*
- *The power of suggestion, as conveyed by news media coverage of perceived 'wind-turbine sickness', might have triggered 'anticipatory fear' in those close to turbine installations."*

2. ***'Wind Turbine Syndrome – An independent review of the state of knowledge about the alleged health condition', Expert Panel on behalf of Renewable UK, July 2010***

This report consists of three reviews carried out by independent experts to update and understand the available knowledge of the science relating to infrasound generated by wind turbines. This report was prepared following the publication of a book entitled '*Wind Turbine Syndrome'*, in 2009 by Dr. Pierpont, which received significant media attention at the time. The report discusses the methodology and assessment carried out in the 2009 publication and assessed the impact of low-frequency noise from wind turbines on humans. The independent review found that:

- *"The scientific and epidemiological methodology and conclusions drawn (in the 2009 book) are fundamentally flawed;*
- *The scientific and audiological assumptions presented by Dr Pierpont relating infrasound to WTD are wrong; and*
- *Noise from Wind Turbines cannot contribute to the symptoms reported by Dr. Pierpont's respondents by the mechanisms proposed."*

Accordingly, the consistent and scientifically robust conclusion remains that there is no evidence to demonstrate any significant health effects in humans arising from noise at the levels of that generated by wind turbines.

3. ***'A Rapid Review of the Evidence', Australian Government National Health and Medical Research Council (NHMRC) Wind Turbines & Health, July 2010***

The purpose of this paper was to review evidence from current literature on the issue of wind turbines and potential impacts on human health and to validate the finding of the *'Wind Turbine Sound and Health Effects - An Expert Panel Review'* (see Item 2 above) that:

- *"There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*
- *There is currently no published scientific evidence to positively link wind turbines with adverse health effects.*
- *'This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*

4. *'Position Statement on Health and Wind Turbines', Climate and Health Alliance, February 2012*

The Climate and Health Alliance (CAHA) was established in August 2010 and is a coalition of health care stakeholders who wish to see the threat to human health from climate change and ecological degradation addressed through prompt policy action. In its Position Statement in February 2012, CAHA states that:

> *"To date, there is no credible peer reviewed scientific evidence that demonstrates a direct causal link between wind turbines and adverse health impacts in people living in proximity to them. There is no evidence for any adverse health effects from wind turbine shadow flicker or electromagnetic frequency. There is no evidence in the peer reviewed published scientific literature that suggests that there are any adverse health effects from infrasound (a component of low frequency sound) at the low levels that may be emitted by wind turbines."*

The Position Statement explores human perceptions of wind energy and notes that some people may be predisposed to some form of negative perception that itself may cause annoyance. It states that:

> *"Fear and anxious anticipation of potential negative impacts of wind farms can also contribute to stress responses, and result in physical and psychological stress symptoms... Local concerns about wind farms can be related to perceived threats from changes to their place and can be considered a form of "place-protection action", recognised in psychological research about the importance of place and people's sense of identity."*

CAHA notes the existence of *"misinformation about wind power"* and, in particular, states that:

> *"Some of the anxiety and concern in the community stems originally from a self-published book by an anti-wind farm activist in the United States which invented a syndrome, the so-called "wind turbine syndrome". This is not a recognised medical syndrome in any international index of disease, nor has this publication been subjected to peer review."*

CAHA notes that:

> *"Large scale commercial wind farms however have been in operation internationally for many decades, often in close proximity to thousands of people, and there has been no evidence of any significant rise in disease rates."*

This, it states, contrasts with the health impacts of fossil fuel energy generation.

5. *'Wind Turbine Health Impact Study -Report of Independent Expert Panel' – Massachusetts Departments of Environmental Protection and Public Health (2012)*

An expert panel was established with the objective to, inter alia, evaluate information from peer-reviewed scientific studies, other reports, popular media and public comments and to assess the magnitude and frequency of any potential impacts and risks to human health associated with the design and operation of wind energy turbines. In its final report, the expert panel set out its conclusions under several headings, including noise and shadow flicker.

In relation to noise, the panel concluded that there was limited or no evidence to indicate any causal link between noise from wind turbines and health effects, including the following conclusions:

> *"There is no evidence for a set of health effects, from exposure to wind turbines that could be characterized as a "Wind Turbine Syndrome."*
>
> *The strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental health problems. There*

were two smaller, weaker, studies: one did note an association, one did not. Therefore, we conclude the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems.

None of the limited epidemiological evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine."

In relation to shadow flicker, the expert panel found the following:

"Scientific evidence suggests that shadow flicker does not pose a risk for eliciting seizures as a result of photic stimulation.

There is limited scientific evidence of an association between annoyance from prolonged shadow flicker (exceeding 30 minutes per day) and potential transitory cognitive and physical health effects."

6. ***Wind Turbines and Health, A Critical Review of the Scientific Literature, Massachusetts Institute of Technology (Journal of Occupational and Environmental Medicine Vol. 56, Number 11, November 2014)***

This review assessed the peer-reviewed literature regarding evaluations of potential health effects among people living in the vicinity of wind turbines. The review posed a number of questions around the effect of turbines on human health, with the aim of determining if stress, annoyance or sleep disturbance occur as a result of living in proximity to wind turbines, and whether specific aspects of wind turbine noise have unique potential health effects. The review concluded the following with regard to the above questions:

- Measurements of low-frequency sound, infrasound, tonal sound emission, and amplitude-modulated sound show that infrasound is emitted by wind turbines. The levels of infrasound at customary distances to homes are typically well below audibility thresholds.
- No cohort or case–control studies were located in this updated review of the peer-reviewed literature. Nevertheless, among the cross-sectional studies of better quality, no clear or consistent association is seen between wind turbine noise and any reported disease or other indicator of harm to human health.
- Components of wind turbine sound, including infrasound and low frequency sound, have not been shown to present unique health risks to people living near wind turbines.
- Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.

A further 25 reviews of the scientific evidence that universally conclude that exposure to wind farms and the sound emanating from wind farms does not trigger adverse health effects, were compiled in September 2015 by Professor Simon Chapman, of the School of Public Health and Sydney University Medical School, Australia, and is included as Appendix 5-2 of this EIAR. Another recent publication by Chapman and Crichton (2017) entitled '*Wind turbine syndrome; A communicated disease'* critically discusses why certain health impacts might often be incorrectly attributed to wind turbines.

7. ***Position Paper on Wind Turbines and Public Health: HSE Public Health Medicine Environment and Health Group, February 2017***

The Health Service Executive (HSE) position paper on wind turbines and public health was published in February 2017 to address the rise in wind farm development and concerns regarding potential impacts on public health. The paper discusses previous observations and case studies which describe a broad range of health effects that are associated with wind turbine noise, shadow flicker and electromagnetic radiation.

A number of comprehensive reviews conducted in recent years to examine whether these health effects are proven has highlighted the lack of published and high-quality scientific evidence to support adverse effects of wind turbines on health.

The HSE position paper determines that current scientific evidence on adverse impacts of wind farms on health is weak or absent. Further research and investigative processes are required at a larger scale in order to be more informative for identifying potential health effects of exposure to wind turbine effects. They advise developers on making use of the draft Guidelines, as a means of setting noise limits and set back distances from the nearest dwellings.

8. ***Environmental Noise Guidelines for the European Region: World Health Organisation Regional Office for Europe, 2018.***

The WHO *Environmental Noise Guidelines for the European Region* (2018) provide guidance on protecting human health from exposure to environmental noise. They set health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise. Recommendations are rated as either 'strong' or 'conditional'. A strong recommendation, "*can be adopted as policy in most situations*" whereas a conditional recommendation, "*requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply*".

The objective of the World Health Organisation (WHO) Environmental Noise Guidelines for the European Region that was published in October 2018 is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is risk of adverse health risks.

In relation to wind turbine noise, the WHO Guideline Development Group (GDG) state the following:

> "*For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB L_{den}, as wind turbine noise above this level is associated with adverse health effects.*
>
> *No recommendation is made for average night noise exposure L_{night} of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.*
>
> *To reduce health effects, the GDG conditionally recommends that policymakers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another."*

The quality of evidence used for the WHO research is stated as being 'Low', the recommendations are therefore conditional.

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national and international level, thus shall be considered by Irish policy makers for any future revisions of Irish National Guidelines.

There is potential increased uncertainty due to the parameter used by the WHO for assessment of exposure (i.e. L_{den}), which it is acknowledged may be a poor characterisation of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes, as stated below.

> "*Even though correlations between noise indicators tend to be high (especially between LAeq-like indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes...*
>
> *...Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region.*"

Based upon the review set out above, it is concluded that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) should not currently be applied as target noise criteria for an existing or proposed wind turbine development in Ireland.

9. ***Infrasound Does Not Explain Symptoms Related to Wind Turbines:*** *Finnish Government's Analysis, Assessment and Research Activities (VN TEAS), 2020*

The study targeted to adverse health effects of wind turbine infrasound and was funded by the Finnish Government's Analysis, Assessment and Research Activities (VN TEAS).

It was found that the low-frequency, inaudible sounds made by wind turbines are not damaging to human health despite fears that they cause unpleasant symptoms. The project, which was carried out over two years, examined the impact of low-frequency—or infrasound—emissions which cannot be picked up by the human ear.

People in many countries have blamed the infrasound waves for symptoms ranging from headaches and nausea to tinnitus and cardiovascular problems, researchers said.

Interviews, sound recordings and laboratory tests were used to explore possible health effects on people living within 20 kilometres (12 miles) of the generators.

The report notes:

> *'...the behavioral findings of the current study suggest that wind turbine infrasound cannot be reliably perceived and it does not result in increased annoyance. Participants that showed health effects did not show signs of increased infrasound sensitivity and did not rate wind turbine sounds more annoying.*

As a result:

'These findings do not support the hypothesis that infrasound is the element in turbine sound that causes annoyance. Instead, they suggest that people who have health symptoms which they associate with wind turbine sound are not likely to have these symptoms because they perceive turbine sound more annoying than controls, at least in laboratory settings. It is more likely that these symptoms are triggered by other factors such as symptom expectancy'.

5.5.2 Turbine Safety

Turbines pose no threat to the health and safety of the general public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s '*Wind Energy Development Guidelines for Planning Authorities 2006*' (referred to as the Guidelines) and the Draft Wind Energy Development Guidelines (December 2019) (referred to as the draft Guidelines) iterate that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations and should be kept to a minimum. People or animals can safely walk up to the base of the turbines.

The Guidelines and the draft Guidelines state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. However, most blades are composite structures with no bolts or separate components and the danger is therefore minimised. The build-up of ice on turbines is unlikely to present problems. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to resuming operation.

Turbine blades are manufactured of glass reinforced plastic which will prevent any likelihood of an increase in lightning strikes within the Wind Farm Site or the local area. Lightning protection conduits will be integral to the construction of the turbines. Lightning conduction cables, encased in protection conduits, will follow the electrical cable run, from the nacelle to the base of the turbine. The conduction cables will be earthed adjacent to the turbine base. The earthing system will be installed during the construction of the turbine foundations.

5.5.3 Electromagnetic Interference

The provision of underground electric cables of the capacity proposed is common practice throughout the country and installation to the required specification does not give rise to any specific health concerns.

The extremely low frequency (ELF) electric and magnetic fields (EMF) associated with the operation of the proposed cables fully comply with the international guidelines for ELF-EMF set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the World Health Organisation, as well as the EU guidelines for human exposure to EMF. Accordingly, there will be no operational impact on properties (residential or other uses) as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.

The EirGrid document '*EMF & You: Information about Electric & Magnetic Fields and the electricity transmission system in Ireland'* (EirGrid, 2017) provides further practical information on EMF and is included as Appendix 5-3 of this EIAR.

Further details on the potential impacts of electromagnetic interference to telecommunications and aviation are presented in Section 14.2 in Chapter 14 of this EIAR: Material Assets.

5.5.4 Assessment of Effects on Human Health

As set out in the Department of Housing, Planning, Community and Local Government '*Key Issues Consultation Paper on the Transposition of the EIA Directive 2017*' and the guidance listed in Section

1.2.2 of Chapter 1: Introduction, the consideration of the effects on populations and on human health should focus on health issues and environmental hazards arising from the other environmental factors, for example water contamination, air pollution, noise, accidents, disasters.

A wind farm is not a recognised source of pollution. It is not an activity that falls within any thresholds requiring Environmental Protection Agency licensing under the Environmental Protection Agency Licensing Act 1992, as amended. As such, a wind farm is not considered to have ongoing significant emissions to environmental media and the subsequent potential for human health effects during construction, operation or decommissioning for the reasons explained below in this section and on the basis of published research discussed in Section 5.5.

Chapter 8: Land, Soils and Geology, Chapter 9: Water, Chapter 10: Air and Climate, Chapter 11: Noise and Vibration and Chapter 14: Material Assets (Traffic and Transport) provide an assessment of the effects of the Proposed Development on these areas of consideration. There is the potential for negative effects on human health during the Proposed Development construction phase related to potential emissions to air of dust, potential emissions to land and water of hydrocarbons, release of potentially silt-laden runoff into watercourses and noise emissions. The assessments however show that the residual effects are not significant and do not have the potential to cause negative health effects for human beings. On this basis, the potential for negative health effects associated with the Proposed Development is imperceptible.

The proposed site design and mitigation measures outlined in Chapter 8 and Chapter 9 ensures that the potential for impacts on the water environment are not significant. No impacts on local water supplies are anticipated.

As set out in Chapter 9, potential health effects are associated with negative impacts on public and private water supplies and potential flooding. There are no mapped public or group groundwater scheme protection zones in the area of the Proposed Development.

The Stage III Flood Risk Assessment included as Appendix 9-1 of this EIAR has also concluded that there will be no increase in flood risk to people, property, the economy or the environment during extreme flood events.

Once operational, the Proposed Development, will contribute to the offsetting of carbon emissions associated with the burning of fossil fuels. During the operational stage, the Proposed Development will have a long term, significant, positive effect on air quality as set out in Chapter 10 which will contribute to positive effects on human health.

5.5.5 Vulnerability of the Proposed Development to Natural Disasters and Major Accidents

An assessment of the Proposed Development's vulnerability to natural disasters can be found in Chapter 16 of this EIAR. A brief discussion can be found below.

As outlined in Section 5.5.4 above, a wind farm is not a recognised source of pollution. Should a major accident or natural disaster occur, the potential sources of pollution onsite during the construction, operational and decommissioning phases, are limited. Sources of pollution with the potential to cause significant environmental pollution and associated negative effects on health, such as bulk storage of hydrocarbons or chemicals, storage of wastes etc., are limited.

There is limited potential for significant natural disasters to occur at the Proposed Development site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur at the Proposed Development site are therefore limited to flooding and fire. It is considered that the risk of significant fire occurring, affecting the Wind Farm Site and Grid Connection, and causing the Proposed Development to have significant environmental effects is limited and therefore a significant effect on human health is similarly limited. As described earlier, there are no significant sources of pollution in the Proposed Development site with the potential to cause environmental or health effects. Also, the spacing of the turbines and distance of turbines from any properties limits the potential for impacts on human health. The issue of turbine safety is addressed in Section 5.5.2 along with an assessment of effects of the Proposed Development on human health in Section 5.5.4. Chapter 8 further outlines mitigation which will be implemented to further reduce the likelihood of impacts on soil and subsoil erosion during excavation. Reinstatement and long-term storage will be undertaken to prevent erosion and potential water quality impacts. Based on this, and with the implementation of the mitigation measures outlined in Chapter 8, no significant impacts on soils and geology are predicted to occur.

Major industrial accidents involving dangerous substances pose a significant threat to humans and the environment; such accidents can give rise to serious injury to people or serious damage to the environment, both on and off the site of the accident. The Proposed Development site is not regulated or connected to or close to any site regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations i.e. SEVESO sites and so there are no potential effects from this source.

5.6 Property Values

In the absence of any Irish studies on the effect of wind farms on property values, this section provides a summary of the largest and most recent studies from the United States and Scotland.

The largest study of the impact of wind farms on property values has been carried out in the United States. '*The Impact of Wind Power Projects on Residential Property Values in the United States: A multi-Site Hedonic Analysis*', December 2009, was carried out by the Lawrence Berkley National Laboratory (LBNL) for the U.S Department of Energy. This study collected data on almost 7,500 sales of single-family homes situated within ten miles of 24 existing wind farms in nine different American states over a period of approximately ten years. The conclusions of the study are drawn from eight different pricing models including repeat sales and volume sales models. Each of the homes included in the study was visited to demonstrate the degree to which the wind facility was visible at the time of the sale, and the conclusions of the report state that "The result is the most comprehensive and data rich analysis to date on the potential impacts of wind energy projects on nearby property values."

The main conclusion of this study is as follows:

> *"Based on the data and analysis presented in this report, no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities. Although the analysis cannot dismiss the possibility that individual or small numbers of homes have been or could be negatively impacted, if these impacts do exist, they are either too small and/or too infrequent to result in any widespread and consistent statistically observable impact."*

This study has been recently updated by LBNL who published a further paper entitled '*A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States*', in August 2013. This study analysed more than 50,000 home sales near 67 wind farms in 27 counties across nine U.S. states, yet was unable to uncover any impacts to nearby home property values. The homes were all within 10 miles of the wind energy facilities - about 1,100 homes were within 1 mile, with 331 within half a mile. The report is therefore based on a very large sample and represents an extremely robust assessment of the impacts of wind farm development on property prices. It concludes that:

> *"Across all model Specifications, we find no statistical evidence that home prices near wind turbines were affected in either the post-construction or post announcement/pre-construction periods."*

Both LBNL studies note that their results do not mean that there will never be a case of an individual home whose value goes down due to its proximity to a wind farm – however if these situations do exist, they are considered to be statistically insignificant. Therefore, although there have been claims of significant property value impacts near operating wind turbines that regularly surface in the press or in local communities, strong evidence to support those claims has failed to materialise in all the major U.S. studies conducted thus far.

A further study was commissioned by RenewableUK and carried out by the Centre for Economics and Business Research (Cebr) in March 2014. Its main conclusions are:

- Overall the analysis found that the county-wide property market drives local house prices, not the presence or absence of wind farms.
- The econometric analysis established that construction of wind farms at the five sites examined across England and Wales has not had a detectable negative impact on house price growth within a five-kilometre radius of the sites.

A relatively new study issued in October 2016 '*Impact of wind Turbines on House Prices in Scotland'* (2016) was published by Climate Exchange. Climate Exchange is Scotland's independent centre of expertise on climate change which exists to support the Scottish Governments policy development on climate and the transition to a low carbon economy. A copy of the report is included as Appendix 5-4 of this EIAR.

The report presents the main findings of a research project estimating the impact on house prices from wind farm developments. It is based on analysis of over 500,000 property sales in Scotland between 1990 and 2014. The key findings from the study are:

- **No evidence of a consistent negative effect on house prices**: Across a very wide range of analyses, including results that replicate and improve on the approach used by Gibbons (2014), we do not find a consistent negative effect of wind turbines or wind farms when averaging across the entire sample of Scottish wind turbines and their surrounding houses. Most results either show no significant effect on the change in price of properties within 2km or 3km or find the effect to be positive.
- **Results vary across areas**: The results vary across different regions of Scotland. Our data does not provide sufficient information to enable us to rigorously measure and test the underlying causes of these differences, which may be interconnected and complex.

Although there have been no empirical studies carried out in Ireland on the impacts of wind farms on property prices, the literature described above demonstrates that at an international level, wind farms have not impacted property values in the local areas. It is a reasonable assumption based on the available international literature, that the provision of a wind farm at the proposed location would not impact on the property values in the area.

5.7 Shadow Flicker

5.7.1 Background

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby property. Shadow flicker is an indoor phenomenon, which may be experienced by an occupant sitting in an enclosed room when sunlight reaching the window is momentarily interrupted by a shadow of a wind turbine's blade. Outside in the open, light reaches a viewer (person) from a much less focused source than it would through a window of an enclosed room, and therefore shadow flicker assessments are typically undertaken for the nearby adjacent properties around a proposed wind farm site.

The frequency of occurrence and the strength of any potential shadow flicker impact depends on several factors, each of which is outlined below.

1. ***Whether the sunlight is direct and unobstructed or diffused by clouds:***

If the sun is not shining, shadow flicker cannot occur. Reduced visibility conditions such as clouds, haze, and fog greatly reduce the chance of shadow flicker occurring.

"*Cloud amounts are reported as the number of eights (okta) of the sky covered. Irish skies are completely covered by cloud for over 50% of the time. The mean cloud amount for each hour is between five and six okta. This is due to Ireland's geographical position off the northwest of Europe, close to the path of Atlantic low-pressure systems which tend to keep the country in humid, cloudy airflows for much of the time. A study at 12 stations over a 25-year period showed that the mean cloud amount was at a minimum in April and maximum in July. Cloud amounts were less at night than during the day, with the mean minimum occurring roughly between 2100 and 0100 GMT and the mean maximum occurring between 1000 and 1500 GMT at most stations."* (Source: Met Éireann, www.met.ie).

2. ***The presence of intervening obstructions between the turbine and the observer:***

For shadow flicker to occur, the windows of a potentially affected property must have direct visibility of a wind turbine, with no physical obstructions such as buildings, trees and hedgerows, hills or other structures located on the intervening land between the window and the turbine.

Any obstacles such as trees or buildings located between a property and the wind turbine will reduce or eliminate the occurrence and/or intensity of the shadow flicker.

3. ***How high the sun is in the sky at a given time:***

At distances of greater than approximately 500m between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the shadow cast by the turbine is longer. The current adopted 'Wind Energy Development Guidelines for Planning Authorities' published by the Department of Environment, Heritage and Local Government (DoEHLG) in 2006, iterates that at distances greater than ten rotor diameters from a turbine, the potential for shadow flicker is very low (*'Wind Energy Development Guidelines for Planning Authorities'*, DoEHLG, 2006).

Figure 5-4 illustrates the shadow cast by a turbine at various times during the day; the red shading represents the area where shadow flicker may occur. When the sun is high in the sky, the length of the shadow cast by the turbine is significantly shorter.

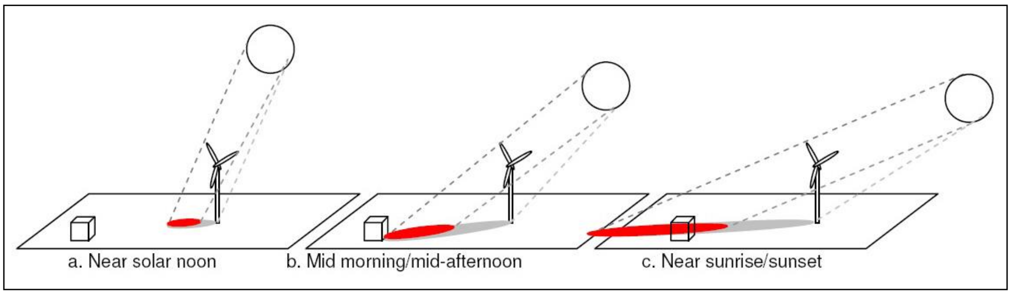


Figure 5-4 Shadow-Prone Area as Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, Dec 2008)

4. ***Distance and bearing, i.e. where the property is located relative to a turbine and the sun:***

The further a property is from the turbine the less pronounced the impact will be. There are several reasons for this: there are fewer times when the sun is low enough to cast a long shadow; when the sun is low it is more likely to be obscured by either cloud on the horizon or intervening buildings and vegetation; and the centre of the rotor's shadow passes more quickly over the land reducing the duration of the impact.

At a distance, the turbine blades do not cover the sun but only partly mask it, substantially weakening the shadow. This impact occurs first with the shadow from the blade tip, the tips being thinner in section than the rest of the blade. The shadows from the tips extend the furthest and so only a very weak impact is observed at distance from the turbines. (Source: Update of Shadow Flicker Evidence Base, UK Department of Energy and Climate Change, 2010).

5. ***Property usage and occupancy:***

Where shadow flicker is predicted to occur at a specific location, this does not imply that it will be witnessed. Potential occupants of a property may be sleeping or occupying a room on another side of the property that is not subject to shadow flicker, or completely absent from the location during the time of shadow flicker events. As shadow flicker usually occurs only when the sun is at a low angle in the sky, i.e. very early in the morning after sunrise or late in the evening before sunset, even if there is a bedroom on the side of the property affected, the shadow flicker may not be witnessed if curtains or blinds in the bedroom are closed.

6. ***Wind direction, i.e. position of the turbine blades:***

The direction of wind turbine blades changes according to wind direction, as the turbine rotor turns to face the wind. In order to cast a shadow, the turbine blades must be facing directly toward or away from the sun, so they are moving across the source of the light relative to the observer. This is demonstrated in Figure 5-5 below.

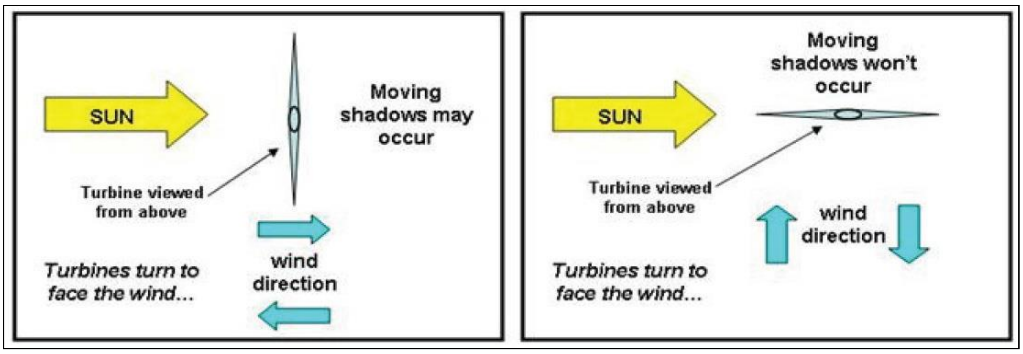


Figure 5-5 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC)

7. ***Rotation of turbine blades:***

Shadow flicker occurs only if there is sufficient wind for the turbine blades to be continually rotating. Wind turbines begin operating at a specific wind speed referred to as the 'cut-in speed', i.e. the speed at which the turbine produces a net power output, and they cease operating at a specific 'cut-out speed'. Therefore, even during the sunlight hours when shadow flicker has been predicted to occur, if the turbine blades are not turning due to insufficient wind speed, no shadow flicker will occur.

5.7.2 Guidance

The current, adopted guidance for shadow flicker in Ireland is derived from the '*Wind Energy Development Guidelines for Planning Authorities 2006'* (DoEHLG) (referred to as the Guidelines), and the '*Best Practice Guidelines for the Irish Wind Energy Industry'* (Irish Wind Energy Association, 2012). The Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The Guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year or 30 minutes per day. The closest inhabitable dwelling is located approximately 757 metres from the nearest turbine location.

The Guidelines state that shadow flicker lasts only for a short period of time and occurs only during certain specific combined circumstances, as follows:

- the sun is shining and is at a low angle in the sky, i.e. just after dawn and before sunset, **and**
- the turbine is located directly between the sun and the affected property, **and**
- there is enough wind energy to ensure that the turbine blades are moving, **and**
- the turbine blades are positioned so as to cast a shadow on the receptor.

Although the Guidelines threshold applies to properties located within 500 metres of a proposed turbine location, for the purposes of this assessment, the Guideline thresholds of 30 hours per year or 30 minutes per day have been applied to all properties located within ten rotor diameters (i.e. for the Proposed Development, this is assumed at 1.62 kilometres based on a rotor diameter of 162 metres) of the proposed turbines within the Wind Farm Site (as per IWEA guidelines, 2012). The Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The Guidelines were the subject of a targeted review. The proposed changes to the assessment of impacts associated with onshore wind energy developments were outlined in the document Draft Wind Energy Development Guidelines (December 2019) (referred to as the draft Guidelines). The draft Guidelines recommend local planning authorities and/or An Bord Pleanála impose conditions to ensure that:

> *"no existing dwelling or other affected property will experience shadow flicker as a result of the wind energy development subject of the planning application and the wind energy development shall be installed and operated in accordance with the shadow flicker study submitted to accompany the planning application, including any mitigation measures required."*

The draft Guidelines are based on the recommendations set out in the *'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review'* (December 2013) and the *'Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach'* (June 2017). At time of writing, the draft Guidelines have not yet been adopted, and the relevant guidelines for the purposes of section 28 of the Planning and Development Act 2000, as amended, remain those issued in 2006.

The assessment herein is based on compliance with the Guidelines limit (30 hours per year or 30 minutes per day). However, it should also be noted the Proposed Development can be brought in line with the requirements of the draft Guidelines (or any amended version of the current draft), should they be adopted while this application is in the planning system, through the implementation of the mitigation measures outlined in Section 5.9.3.

5.7.3 Scoping

Section 2.6 in Chapter 2 of this EIAR describes the scoping and consultation exercise undertaken for the Proposed Development. The HSE issued a Consultation Report on the Proposed Development in September 2021. With respect to Shadow Flicker, the HSE Consultation Report recommended the following:

> *"A shadow flicker assessment should be carried out. All possible impacted dwellings and sensitive receptors shall be identified. The assessment should include identification of the room use in properties potentially impacted by shadow flicker. If reduction factors are applied as part of the shadow flicker assessment, the rationale for applying same shall be clearly outlined.*

Any mitigation measures for the control of shadow flicker shall be described. If the exact model of turbine is not finalised, it is recommended the impact of all various turbine designs considered by the applicant should be modelled in the assessment."

5.7.4 Shadow Flicker Prediction Methodology

Shadow flicker occurs only under certain, combined circumstances, as detailed above. Where shadow flicker does occur, it is generally short-lived. The Guidelines state that careful site selection, design and planning, and good use of relevant software can help avoid the possibility of shadow flicker, all of which have been employed at the Wind Farm Site. Proper siting of wind turbines is key in eliminating shadow flicker.

The occurrence of shadow flicker can be precisely predicted using specialist computer software programmes specifically developed for the wind energy industry, such as WindFarm (ReSoft) or WindFarmer (DNV.GL) or AWS OpenWind. The computer modelling of the occurrence and magnitude of shadow flicker is made possible by the fact that the sun rises and sets in the same position in the sky on every day each year.

Any potential impact can be precisely modelled to give the start and end time (accurate to the second) of any incidence of shadow flicker, at any location, on any day or all days of the year when it might occur. Where a shadow flicker impact is predicted to occur, the total maximum daily and annual durations can be predicted, along with the total number of days. Any incidence of predicted shadow flicker can be attributed to a particular turbine or group of turbines to allow effective mitigation strategies to be planned and proposed as detailed further below.

For the purposes of this shadow flicker assessment, the software package ReSoft WindFarm Version 5.0.1.2 has been used to predict the level of shadow flicker associated with the Wind Farm Site. WindFarm is a commercially available software tool that enables developers to analyse, design and optimise proposed wind farms. It allows proposed turbine layouts to be optimised for maximum energy yield whilst taking account of environmental, planning and engineering constraints.

5.7.5 Shadow Flicker Assessment Criteria

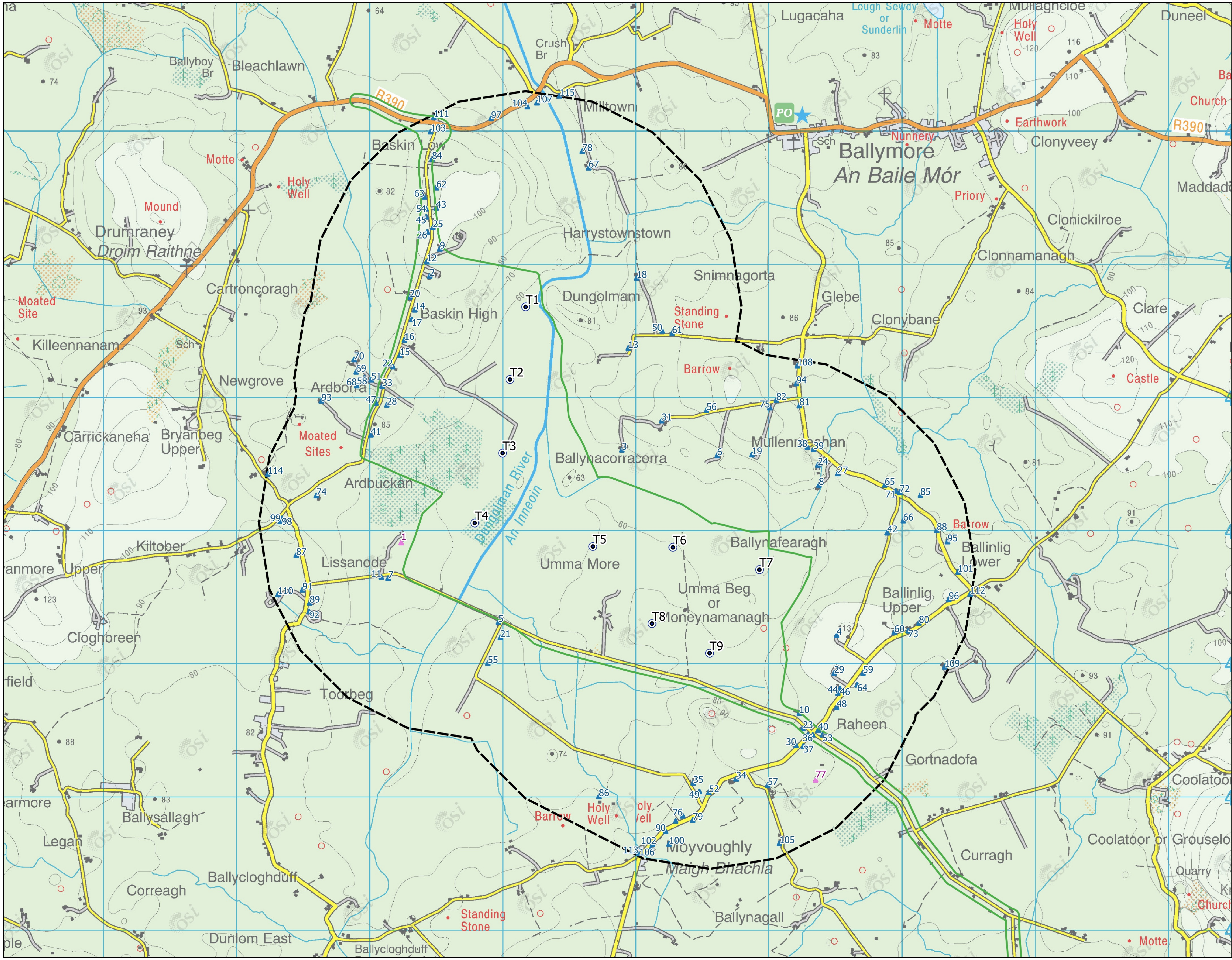
5.7.5.1 Turbine Dimensions

The turbine model to be installed on the Wind Farm Site will have an overall ground-to-blade tip height of 185 metres; blade rotor diameter of 162 metres and hub height of 104 metres.

5.7.5.2 Shadow Flicker Study Area

The Shadow Flicker Study Area for the shadow flicker assessment is ten times rotor diameter from each turbine as set out in the Guidelines. All residential properties located within ten rotor diameters have been included in the assessment. A planning history search to identify properties that may have been granted planning permission, but not yet been constructed, was carried out. Any property with a valid planning permission for a dwelling house was also added to the sensitive receptors' dataset. As detailed in Section 5.2.1 above, here is an existing derelict property located within the Wind Farm Site which was historically Umma House and it will not be occupied should the Proposed Development be granted planning permission. Therefore, the property is not considered any further in this assessment.

There is a total of 115 No. receptors identified within the Shadow Flicker Study Area (ten times rotor diameter of 1.62km), of which 113 are inhabitable dwellings and 2 are derelict properties. The Shadow Flicker Study Area and sensitive receptor locations are shown in Figure 5-6. There is a derelict property located 571 metres from the closest turbine. Following that, the closest turbine to any sensitive third-party receptor is located 759 metres from (T5).



Map Legend

- EIAR Site Boundary
- Proposed Turbine Layout
- Dwellings
  - Derelict
  - Dwelling
- 10 x Rotor Diameter (1.62km) Shadow Flicker Study Area

Drawing Title	
Shadow Flicker Study Area	
Project Title	
Umma More Renewable Energy Development	
Drawn By: BT	Checked By: EC
Project No.: 201050	Drawing No.: Figure 5-6
Scale: 1:25,000	Date: 2023-02-02

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5.7.5.3 Assumptions and Limitations

Due to the latitude of Ireland and the UK, shadow flicker impacts are only possible at properties 130 degrees either side to the north as turbines do not cast shadows on their southern side (ODPM Annual Report and Accounts 2004: Housing, Planning, Local Government and the Regions Committee; Planning Policy Statement 22;). As such properties located outside of this potential shadow flicker zone will not be impacted. However, in this assessment, all 115 no. properties within 360 degrees of the Wind Farm Site within the Shadow Flicker Study Area were assessed for shadow flicker impact.

At each property, shadow flicker calculations were carried out based on 4 no. notional windows facing north, east, south and west, labelled Windows 1, 2, 3 and 4 respectively. The degrees from north value for each window is:

- Window 1: 0 degrees from North
- Window 2: 90 degrees from North
- Window 3: 180 degrees from North
- Window 4: 270 degrees from North

Each window measures one-metre-high by one-metre-wide, and tilt angle is assumed to be zero. The centre height of each window is assumed to be two metres above ground level and no screening due to trees or other buildings or vegetation is assumed. It was not considered necessary or practical to measure the dimensions of every window on every property in the Shadow Flicker Study Area. While the actual size of a window will marginally influence the incidence and duration of any potential shadow flicker impact, with larger windows resulting in slightly longer shadow flicker durations, any incidences or durations or shadow flicker can be countered by the measures outlined in Section 5.9 below.

The use of computer models to predict the amount of shadow flicker that will occur is known to produce an over-estimate of possible impact, due to the following limitations:

- The sun is assumed to be shining during all daylight hours such that a noticeable shadow is cast. This will not occur in reality.
- The wind is always assumed to be within the operating range of the turbines such that the turbine rotor is turning at all times, thus enabling a periodic shadow flicker. Wind turbines only begin operating at a specific ‘cut-in speed’, and cease operating at a specific ‘cut-out speed’. In periods where the wind is blowing at medium to high speeds, the probability of there being clear or partially clear skies where the sun is shining and could cast a shadow, is low.
- The wind turbines are assumed to be available to operate, i.e. turned on at all times. In reality, turbines may be switched off during maintenance or for other technical or environmental reasons.
- The turbine rotor is considered (as a sphere) to present its maximum aspect to observers in all directions. In reality, the wind direction and relative position of the turbine rotor would result in a changing aspect being presented by the turbine. The rotor will actually present as ellipses of varying sizes to observers from different directions. The time taken for the sun to pass across the sky behind a highly elliptical rotor aspect will be shorter than the modelled maximum aspect.

The total annual shadow flicker calculated for each property assumes 100% sunshine during daytime hours, as referred to above. However, weather data for this region shows that the sun shines on average for 30.07% of the daylight hours per year. This percentage is based on Met Eireann data recorded at Mullingar over the 30-year period from 1981 to 2010 (www.met.ie). The actual sunshine hours at the Wind Farm Site and therefore the percentage of time shadow flicker could actually occur is 30.07% of daylight hours. Table 5-9 therefore lists the annual shadow flicker calculated for each property when corrected for the regional average of 30.07% sunshine, to give a more accurate annual average shadow flicker prediction.

Table 5-9 outlines whether a shadow flicker mitigation strategy is required for any property within the Shadow Flicker Study Area which may be impacted by shadow flicker.

5.7.6 Shadow Flicker Assessment Results

5.7.6.1 Daily and Annual Shadow Flicker

The ReSoft WindFarm computer software was used to model the predicted daily and annual shadow flicker levels in significant detail, identifying the predicted daily start and end times, maximum daily duration and the individual turbines predicted to give rise to shadow flicker.

The model results assume theoretical precautionary conditions, including

- 100% sunshine during all daylight hours throughout the year,
- An absence of any screening (vegetation or other buildings),
- That the sun is behind the turbine blades,
- That the turbine blades are facing the property, and
- That the turbine blades are moving.

The maximum daily shadow flicker model assumes that daylight hours consist of 100% sunshine. This is a conservative assumption which represents a worst-case scenario. Following the detail provided above on sunshine hours, a sunshine factor of 30.07% has been applied to the annual shadow flicker results. Taking this information into consideration, the predicted shadow flicker which is estimated to occur at nearby dwellings is presented in Table 5-9.

The predicted maximum daily and annual shadow flicker levels are then considered in the context of the Guidelines daily threshold of 30 minutes per day and annual threshold of 30 hours per year. If there is a predicted exceedance of the threshold limits at any property, the turbines that contribute to the exceedance are also identified.

The Guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 minutes per day or 30 hours per year. As detailed in Section 5.1 there are no sensitive receptors less than 757 metres of the proposed turbine locations. There is a derelict property located 571 metres to the southwest of (T4). However, for the purposes of this assessment, the predicted shadow flicker levels have been modelled for all receptors within 1.62 kilometres (10 times rotor diameter of 1,620 metres) of the proposed turbine locations.

A total of 115 No. receptors have been modelled as part of the shadow flicker assessment, the results of which are presented in Table 5-9. Former residential dwellings termed as “derelict” within this assessment are defined as properties that are currently in an uninhabitable condition.

Table 5-9 Maximum Potential Daily & Annual Shadow Flicker – Proposed Umma More Renewable Energy Development

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
1	618187	745934	Derelict	571	T4	01:09:00	140:42:00	42:18:28	3, 4	No*	No*
2	618399	747936	Dwelling	757	T1	00:51:36	73:30:00	22:06:04	1, 2,	No**	No
3	619841	746630	Dwelling	759	T5	01:30:00	198:48:00	59:46:41	2, 3, 4, 5, 6, 7	Yes	Yes
4	621453	745239	Dwelling	759	T7	00:40:12	71:30:00	21:29:59	7, 9,	No**	No
5	618915	745338	Dwelling	763	T4	00:37:48	69:30:00	20:53:54	5, 8,	Yes	No
6	620556	746589	Dwelling	767	T6	01:09:00	87:06:00	26:11:26	5, 6,	No**	No
7	618087	745667	Dwelling	770	T4	00:54:00	71:48:00	21:35:24	4,	Yes	No
8	621320	746366	Dwelling	777	T7	00:49:48	82:18:00	24:44:50	6, 7,	Yes	No
9	618475	748140	Dwelling	779	T1	00:51:36	42:48:00	12:52:11	1,	Yes	No
10	621172	744654	Dwelling	808	T9	00:51:36	55:48:00	16:46:43	8, 9,	No**	No
11	618036	745676	Dwelling	809	T4	00:52:12	79:00:00	23:45:18	4,	Yes	No
12	618376	748045	Dwelling	818	T1	00:48:36	52:24:00	15:45:23	1,	Yes	No
13	619889	747394	Dwelling	829	T1	00:49:12	128:18:00	38:34:45	1, 2, 3,	No**	No
14	618287	747683	Dwelling	833	T1	00:46:48	73:30:00	22:06:04	1, 2,	Yes	No
15	618174	747340	Dwelling	847	T2	00:46:12	109:54:00	33:02:47	1, 2, 3,	Yes	Yes
16	618208	747455	Dwelling	847	T2	00:46:12	104:00:00	31:16:20	1, 2, 3,	Yes	Yes
17	618264	747610	Dwelling	860	T1	00:46:12	86:12:00	25:55:12	1, 2,	Yes	No
18	619952	747921	Dwelling	861	T1	00:45:00	61:24:00	18:27:45	1, 2,	Yes	No
19	620818	746596	Dwelling	868	T7	00:42:00	67:36:00	20:19:37	6,	Yes	No
20	618250	747779	Dwelling	873	T1	00:45:00	67:00:00	20:08:48	1, 2,	Yes	No
21	618929	745223	Dwelling	878	T4	00:34:48	57:12:00	17:11:59	8	Yes	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
22	618121	747256	Dwelling	885	T2	00:44:24	96:48:00	29:06:26	1, 2, 3,	Yes	No
23	621200	744540	Dwelling	898	T9	00:39:00	33:12:00	9:58:59	8, 9,	Yes	No
24	621312	746517	Dwelling	900	T7	00:37:48	38:30:00	11:34:36	6, 7,	Yes	No
25	618422	748301	Dwelling	919	T1	00:42:00	40:54:00	12:17:54	1,	Yes	No
26	618380	748267	Dwelling	930	T1	00:43:48	33:18:00	10:00:47	1,	Yes	No
27	621461	746453	Dwelling	931	T7	00:41:24	63:36:00	19:07:27	6, 7	No**	No
28	618077	746968	Dwelling	941	T3	00:42:36	120:54:00	36:21:14	1, 2, 3, 4	Yes	Yes
29	621434	744955	Dwelling	946	T9	00:55:48	52:30:00	15:47:11	9,	Yes	No
30	621149	744413	Dwelling	947	T9	00:11:24	3:24:00	1:01:21	N/A	No	No
31	620140	746850	Dwelling	956	T6	00:45:00	70:06:00	21:04:43	2, 3	Yes	No
32	621238	744491	Dwelling	959	T9	00:36:00	28:36:00	8:35:59	8	Yes	No
33	618042	747109	Dwelling	960	T2	00:40:48	108:18:00	32:33:55	1, 2, 3	Yes	Yes
34	620699	744161	Dwelling	963	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
35	620376	744130	Dwelling	981	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
36	621274	744492	Dwelling	986	T9	00:37:48	32:12:00	9:40:57	9	Yes	No
37	621203	744407	Dwelling	989	T9	00:22:12	10:18:00	3:05:50	N/A	No	No
38	621233	746652	Dwelling	989	T7	00:33:00	22:12:00	6:40:31	6	Yes	No
39	621280	746636	Dwelling	993	T7	00:32:24	17:54:00	5:22:57	6	Yes	No
40	621314	744527	Dwelling	997	T9	00:42:36	41:24:00	12:26:55	9	Yes	No
41	617957	746743	Dwelling	998	T3	00:40:12	98:06:00	29:29:53	2, 3, 4	Yes	No
42	621833	746010	Dwelling	999	T7	00:39:36	45:42:00	13:44:30	7	Yes	No
43	618447	748447	Dwelling	1003	T1	00:39:00	42:54:00	12:53:59	1	Yes	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
44	621462	744804	Dwelling	1007	T9	00:48:00	33:06:00	9:57:11	9	Yes	No
45	618372	748380	Dwelling	1008	T1	00:38:24	40:48:00	12:16:06	1	Yes	No
46	621478	744839	Dwelling	1013	T9	00:49:12	32:18:00	9:42:45	9	Yes	No
47	617996	746982	Dwelling	1020	T2	00:39:00	116:12:00	34:56:27	1, 2, 3, 4	Yes	Yes
48	621453	744698	Dwelling	1035	T9	00:41:24	36:00:00	10:49:30	9	Yes	No
49	620423	744066	Dwelling	1040	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
50	620144	747524	Dwelling	1040	T1	00:38:24	59:06:00	17:46:16	1, 2	Yes	No
51	617960	747157	Dwelling	1041	T2	00:37:48	84:48:00	25:29:56	1, 2, 3	Yes	No
52	620494	744059	Dwelling	1044	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
53	621347	744492	Dwelling	1044	T9	00:40:48	37:54:00	11:23:47	9	Yes	No
54	618372	748440	Dwelling	1050	T1	00:36:36	42:36:00	12:48:35	1	Yes	No
55	618835	745029	Dwelling	1056	T4	00:32:24	20:00:00	6:00:50	8	Yes	No
56	620477	746929	Dwelling	1062	T6	00:28:12	62:36:00	18:49:25	N/A	No	No
57	620936	744114	Dwelling	1081	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
58	617910	747172	Dwelling	1091	T2	00:36:36	77:36:00	23:20:02	1, 2, 3	Yes	No
59	621651	744955	Dwelling	1097	T7	00:34:12	17:36:00	5:17:32	9	Yes	No
60	621886	745261	Dwelling	1115	T7	00:36:36	35:36:00	10:42:17	7	Yes	No
61	620218	747506	Dwelling	1116	T1	00:36:00	50:36:00	15:12:55	1, 2	Yes	No
62	618449	748599	Dwelling	1119	T1	00:30:36	21:18:00	6:24:17	1	Yes	No
63	618359	748530	Dwelling	1123	T1	00:34:12	37:00:00	11:07:33	1	Yes	No
64	621608	744868	Dwelling	1132	T7	00:46:12	26:06:00	7:50:53	9	Yes	No
65	621814	746367	Dwelling	1135	T7	00:36:00	24:42:00	7:25:38	7	Yes	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
66	621953	746099	Dwelling	1140	T7	00:34:48	18:42:00	5:37:23	7	Yes	No
67	619592	748749	Dwelling	1148	T1	00:00:00	0:00:00	0:00:00	N/A	No	No
68	617851	747114	Dwelling	1151	T2	00:34:48	80:30:00	24:12:21	1, 2, 3	Yes	No
69	617846	747216	Dwelling	1156	T2	00:34:12	69:00:00	20:44:53	1, 2, 3	Yes	No
70	617831	747309	Dwelling	1180	T2	00:33:36	58:00:00	17:26:25	1, 2, 3	Yes	No
71	621896	746322	Dwelling	1181	T7	00:34:48	20:48:00	6:15:16	7	Yes	No
72	621926	746313	Dwelling	1202	T7	00:34:12	19:36:00	5:53:37	7	Yes	No
73	621990	745273	Dwelling	1206	T7	00:34:12	28:12:00	8:28:47	7	Yes	No
74	617548	746289	Dwelling	1207	T4	00:33:00	29:36:00	8:54:02	4	Yes	No
75	620952	746948	Dwelling	1220	T7	00:23:24	10:12:00	3:04:02	N/A	No	No
76	620298	743884	Dwelling	1238	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
77	621296	744152	Derelict	1240	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
78	619544	748873	Dwelling	1245	T1	00:00:00	0:00:00	0:00:00	N/A	No	No
79	620373	743851	Dwelling	1258	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
80	622071	745331	Dwelling	1261	T7	00:32:24	24:30:00	7:22:01	7	Yes	No
81	621174	746964	Dwelling	1270	T7	00:28:48	25:00:00	7:31:03	N/A	No	No
82	621000	747004	Dwelling	1280	T7	00:22:48	10:00:00	3:00:25	N/A	No	No
83	620245	743844	Dwelling	1285	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
84	618416	748813	Dwelling	1314	T1	00:00:00	0:00:00	0:00:00	N/A	No	No
85	622082	746291	Dwelling	1332	T7	00:30:36	15:00:00	4:30:38	7	No**	No
86	619669	744029	Dwelling	1355	T8	00:00:00	0:00:00	0:00:00	N/A	No	No
87	617397	745840	Dwelling	1361	T4	00:29:24	13:00:00	3:54:32	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
88	622205	746027	Dwelling	1363	T7	00:29:24	12:12:00	3:40:07	N/A	No	No
89	617498	745482	Dwelling	1376	T4	00:30:36	20:30:00	6:09:51	4	Yes	No
90	620170	743767	Dwelling	1376	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
91	617444	745580	Dwelling	1386	T4	00:30:00	16:24:00	4:55:53	4	Yes	No
92	617494	745416	Dwelling	1409	T4	00:30:00	23:06:00	6:56:46	4	Yes	No
93	617586	746998	Dwelling	1415	T3	00:28:48	42:18:00	12:43:10	N/A	No	No
94	621151	747129	Dwelling	1426	T7	00:22:12	10:12:00	3:04:02	N/A	No	No
95	622285	745942	Dwelling	1426	T7	00:28:12	10:48:00	3:14:51	N/A	No	No
96	622295	745509	Dwelling	1438	T7	00:27:36	10:30:00	3:09:26	N/A	No	No
97	618860	749119	Dwelling	1439	T1	00:00:00	0:00:00	0:00:00	N/A	No	No
98	617289	746117	Dwelling	1448	T4	00:27:36	10:06:00	3:02:13	N/A	No	No
99	617278	746093	Dwelling	1459	T4	00:27:36	10:24:00	3:07:38	N/A	No	No
100	620195	743672	Dwelling	1463	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
101	622364	745714	Dwelling	1490	T7	00:26:24	9:48:00	2:56:49	N/A	No	No
102	620071	743671	Dwelling	1495	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
103	618406	749020	Dwelling	1498	T1	00:00:00	0:00:00	0:00:00	N/A	No	No
104	619132	749208	Dwelling	1505	T1	00:00:00	0:00:00	0:00:00	N/A	No	No
105	621024	743677	Dwelling	1519	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
106	620058	743635	Dwelling	1533	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
107	619204	749238	Dwelling	1537	T1	00:00:00	0:00:00	0:00:00	N/A	No	No
108	621159	747263	Dwelling	1559	T7	00:00:00	0:00:00	0:00:00	N/A	No	No
109	622263	745001	Dwelling	1568	T7	00:27:00	14:00:00	4:12:35	N/A	No	No

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Daily)	Mitigation Strategy Required (Annual)
110	617260	745546	Dwelling	1571	T4	00:26:24	11:54:00	3:34:42	N/A	No	No
111	618430	749128	Dwelling	1583	T1	00:00:00	0:00:00	0:00:00	N/A	No	No
112	622455	745549	Dwelling	1591	T7	00:25:12	7:48:00	2:20:44	N/A	No	No
113	619965	743600	Dwelling	1595	T9	00:00:00	0:00:00	0:00:00	N/A	No	No
114	617184	746449	Dwelling	1596	T4	00:25:12	9:00:00	2:42:23	N/A	No	No
115	619373	749288	Dwelling	1605	T1	00:00:00	0:00:00	0:00:00	N/A	No	No

* Derelict Property

**Participating Property

Of the 115 No. properties modelled; it is predicted that 70 properties may experience daily shadow flicker levels in excess of the Guidelines threshold of 30 minutes per day. This prediction is assuming theoretical precautionary conditions (i.e. 100% sunshine on all days where the shadow of the turbines passes over a house, wind blowing in the correct direction, no screening present, etc.) and in the absence of any mitigation measures.

Of these 70 No. properties:

- 69 No. properties are inhabitable dwellings (including 7 Participating Properties); and
- 1 No. property is a derelict property

Of the 115 no. properties modelled, when the regional sunshine average (i.e. the mean number of sunshine hours throughout the year) of 30.07% is taken into account, the Guidelines limit of 30 hours per year is predicted to be exceeded at 7 of the inhabitable dwellings, 6 of which are third party properties.

Additionally, it is worth reiterating that the predicted shadow flicker listed in Table 5-9 is considered conservative and in reality, the occurrence and/or duration of shadow flicker at these properties is likely to be eliminated or significantly reduced as the following items are not considered by the model:

- Receivers may be screened by topography, cloud cover and/or vegetation/built form i.e. adjacent buildings, farm buildings, garages or barns;
- Each receiver will not have windows facing in all directions onto the wind turbines.
- At distances, greater than 500-1000m '*the rotor blade of a wind turbine will not appear to be chopping the light but the turbine will be regarded as an object with the sun behind it. Therefore, it is generally not necessary to consider shadow casting at such distances*' (Danish Wind Industry Association, accessed 2010).

Section 5.9.3 below outlines the mitigation strategies which may be employed at the potentially affected properties to ensure that the Guidelines are complied with at any dwelling within the Shadow Flicker Study Area. The same mitigation strategies, outlined in Section 5.9.3, could be taken further to achieve stricter shadow flicker controls, should the shadow flicker requirements of the draft Guidelines be adopted in advance of a planning decision being made on the Wind Farm Site.

5.7.6.2 Cumulative Shadow Flicker

The cumulative assessment of shadow flicker arising from the Proposed Development and other wind farms was carried out based on the methodology, assumptions and criteria outlined in Section 5.7.4 and Section 5.7.5. For the assessment of cumulative shadow flicker, any other existing, permitted or proposed wind farms are considered where the project's ten times rotor diameter shadow flicker study area are located within the Shadow Flicker Study Area of ten times the rotor diameter for the Proposed Development. In this case, the closest wind farm is the proposed Lemanaghan Wind Farm located 16.3km southwest of the Wind Farm Site at its closest point, and as such the ten times rotor diameter shadow flicker study for this proposed project would not overlap with that of the Proposed Development ten times rotor diameter Shadow Flicker Study Area. At this distance, any potential properties that would be considered within the proposed Lemanaghan Wind Farm shadow flicker study area are excluded from the Proposed Development's Shadow Flicker Study Area and therefore are beyond the range for potential cumulative shadow flicker impacts. Therefore, there is no potential for shadow flicker in combination with the Proposed Development and therefore no cumulative shadow flicker assessment is required.

5.8 Residential Amenity

Residential amenity relates to the human experience of one's home, derived from the general environment and atmosphere associated with the residence. The quality of residential amenity is influenced by a combination of factors, including site setting and local character, land-use activities in the area and the relative degree of peace and tranquillity experienced in the residence.

As previously noted, the land use at the Wind Farm Site is currently used for coniferous forestry and agriculture, therefore a certain level of industrial activity and traffic movements are associated with the site, which will assist in the assimilation of the Wind Farm Site into the receiving environment. There are no inhabitable properties located within 757 metres of a proposed turbine location. There is a derelict property located 571 metres from the nearest proposed turbine location. There is an existing derelict property located within the Wind Farm Site which was historically Umma House (as detailed in Section 13.3.2.10.1), and it will not be occupied should the Proposed Development be granted planning permission. Therefore, the property is not considered any further in this assessment. Land use along the Grid Connection underground electrical cabling route comprises of public road corridor, public open space, discontinuous urban fabric and agriculture.

When considering the amenity of residents in the context of a proposed wind farm, there are three main potential impacts of relevance: 1) Shadow Flicker, 2) Noise, and 3) Visual Amenity. Shadow flicker and noise are quantifiable aspects of residential amenity while visual amenity is more subjective. Detailed shadow flicker and noise modelling have been completed as part of this EIAR (Section 5.7 above refers to shadow flicker modelling, Chapter 11 addresses noise). A comprehensive landscape and visual impact assessment has also been carried out, as presented in Chapter 12 of this EIAR. Impacts on population and human health during the construction, operational and decommissioning phases of the Proposed Development is assessed in relation to each of these key issues and other environmental factors such as traffic and dust; see Section 5.9 below. The impact on residential amenity is then derived from an overall judgement of the combination of impacts due to shadow flicker, changes to land-use and visual amenity, noise, traffic, dust and general disturbance.

5.9 Likely Significant Effects and Associated Mitigation Measures

The below assessment evaluates the impact (where there is the potential for an impact to occur) on health and safety, employment and economic activity, population, land-use, tourism, noise, dust, traffic, shadow flicker and residential amenity during the construction, operational and decommissioning phases, as a result of the Proposed Development.

5.9.1 'Do-Nothing' Scenario

If the Proposed Development was not developed, the Site will continue to function as it does at present, with no changes made to the current land-use of coniferous forestry, agriculture, public road corridor, public open space and discontinuous urban fabric.

If the Proposed Development were not to proceed, the opportunity to capture a part of County Westmeath's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

5.9.2 Construction Phase

5.9.2.1 Health and Safety

Pre-Mitigation Effects

Construction of the Proposed Development will necessitate the presence of a construction site. Construction sites and the machinery used on them pose a potential health and safety hazard to construction workers if site rules are not properly implemented. This will have a short-term potential significant negative effect.

Proposed Mitigation Measures

The Proposed Development will be constructed, operated and decommissioned in accordance with all relevant Health and Safety Legislation, including:

- Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005), as amended;
- Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No. 299 of 2007), as amended;
- Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. 291 of 2013), as amended; and
- Safety, Health and Welfare at Work (Work at Height) Regulations 2006 (S.I. No. 318 of 2006).

During construction of the Proposed Development, all staff will be made aware of and adhere to the Health & Safety Authority's '*Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006'.* This will encompass the use of all necessary Personal Protective Equipment, Risk Assessment and Method Statements and adherence to the site Health and Safety Plan.

Fencing will be erected in areas of the Site where uncontrolled access is not permitted. Appropriate health and safety signage will also be erected on this fencing and at locations around the Site.

The Proposed Development will connect to the existing Thornsberry 110kV substation. Grid Connection via Thornsberry will comprise an on-site 110kV substation and underground electrical cabling, measuring approximately 31km in total, predominantly located within the public road corridors. Health and safety guidelines for working within and around electrical substations and overhead lines will be adhered to on site.

Residual Effect

With the implementation of the above, there will be a short-term potential slight negative residual effect on health and safety during the construction phase of the Proposed Development.

Significance of Effects

Based on the assessment above there will be no significant direct and indirect effects on health and safety during the construction phase of the Proposed Development.

5.9.2.2 Employment and Investment

The design, construction and operation of the Proposed Development will provide employment for technical consultants, contractors and maintenance staff. The construction, operation and maintenance phases of the Proposed Development would generate approximately 80 - 100 jobs. The construction phase of the Proposed Development will last between approximately between 18 – 24 months. Many construction workers and materials will be sourced locally, thereby helping to sustain employment in the construction trade. This will have a short-term significant positive effect.

The injection of money in the form of salaries and wages to those employed during the construction phase of the Proposed Development has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a short-term positive effect on their cash flow. This will have a short-term slight positive indirect effect.

The Proposed Development will result in an influx of skilled people into the area, bringing specialist skills for both the construction and operational phases that could result in the transfer of these skills into the local workforce, thereby having a long-term positive effect on the local skills base. Up-skilling and training of local staff in the particular requirements of the wind energy industry is likely to lead to additional opportunities for those staff as additional wind farms are constructed in Ireland. This will have a long-term moderate positive indirect effect. The Irish Wind Energy Association estimates that there are over 5,500 people employed in roles related to wind energy in Ireland in 2020. This figure is anticipated to grow significantly in the coming years.

Proposed Community Benefit Fund

Based on the current RESS guidelines it is expected that for each megawatt hour (MWh) of electricity produced by the wind farm, the Proposed Development will contribute €2 into a community fund for the first 15 years of operation of the Proposed Development. If this commitment is changed in upcoming Government Policy, the fund would be adjusted accordingly.

Should the Proposed Development be developed under RESS, it would attract a community contribution in the region of approx. €340,000/year for the local community. The value of this fund would be directly proportional to the electricity generated by the wind farm. Under current T&C's of RESS, the following would be required for Umma More Renewable Energy Development:

- **Direct payments** – to those living closest to the Wind Farm Site. A minimum €1,000 payment per annum for houses within 1km of the Proposed Development;
- **Energy Efficiency** – Up to €136,000/year would be available for the development of energy initiatives to benefit people living in the local area. This is to be provided to not for profit community enterprises.
- **Support for local groups** –Up to €136,000/year would be available for local groups, clubs and not for profit organisations that provide services in the local area. This would include services for the elderly, local community buildings, and the development of sporting facilities such as all weather playing pitches etc.
- **Administration costs** - a maximum of 10% of this fund to be made available for the administration and governance costs of the fund.

The Community Benefit Fund belongs to the local community. The premise of the fund is that it should be used to bring about significant, positive change in the local area. To make this happen, the first task will be to form a benefit fund development working group that clearly represents both the close neighbours to the Proposed Development as well as nearby communities. This group will then work on designing the governance and structure of a community entity that would administer the Community Benefit Fund.

Similarly, should the Proposed Development be developed and not enter RESS, the community benefit scheme proposes to provide a fund of €100,000 per annum over the lifespan of the Proposed Development based on the current estimated generating capacity. This will equate to potential funding of €3 million to the local community, which is a substantial contribution. The administration of this fund would follow a similar format to the current RESS guidelines.

The types of projects and initiatives that could be supported by such a Community Gain proposal could include youth, sport and community facilities, schools, educational and training initiatives, and wider amenity, heritage, and environmental projects. Initial local suggestions for use of the fund included grants for Eon Naofa National School, the construction of footpaths and footpath improvement works, water-mains connections for residents who relied on river water, local enterprise schemes, riparian planting of native species, energy retro-fitting of houses and contributions to electrical bills. Overall, it is concluded that the socio-economic effects of the Wind Farm will be beneficial on a local, regional and national level.

5.9.2.3 Population

Those working on the construction phase of the Proposed Development will travel daily to the Proposed Development site from the wider area. The construction phase will have no effect on the Population Study Area in terms of changes to population trends or density, household size or age structure.

5.9.2.4 Land-use

Current land use on the Wind Farm Site comprises coniferous forestry and agriculture. Current land use along the Grid Connection comprises of public road corridor, public open space, discontinuous urban fabric and agriculture. Land use in the wider landscape of the site comprises agriculture, peat cutting, quarrying, low density residential and commercial forestry.

It is envisaged that the current land uses of coniferous forestry and agriculture will continue on the Wind Farm Site in conjunction with the Proposed Development. The Proposed Development will have no effect on existing land-uses as it has been designed to co-exist with these land-uses. Whilst there will be a change of land use to facilitate the development of the wind turbines and infrastructure, this is an acceptable and unavoidable part of the Proposed Development.

The existing land-use of road networks will continue on the underground electrical cabling route. There will be no change to existing land-uses in the wider area as a result of the Grid Connection.

5.9.2.5 Tourism and Amenity

Given that there are currently no tourism attractions specifically pertaining to the Wind Farm Site there are no effects associated with the construction phase of the Wind Farm Site. With regard to tourist attractions and amenity use around the Site, described in Section 5.3.2, traffic management safety measures will be in place. Please see Traffic effect s below for further details on proposed mitigation measures.

The Grid Connection underground electrical cabling route will be located within the public road network which passes under the Old Rail Trail tourist attraction, the impacts associated with this section of the underground electrical cabling route will be temporary in nature and will have a short-term slight negative effect to local tourism. There will be some traffic restrictions in place through the construction phase of the Grid Connection underground electrical cabling route, there may be a short-term slight negative effect to local tourism. Any impacts will however be limited to the active construction area (generally a 150m to 300m stretch of road) and will be temporary in nature. See Traffic impacts below for further details on proposed mitigation measures.

5.9.2.6 Noise

Pre-Mitigation Effects

There will be an increase in noise levels in the vicinity of the Wind Farm Site during the construction phase, as a result of heavy machinery and construction work which has the potential to cause a nuisance to sensitive receptors located closest to the Wind Farm Site. These effects will be short-term in duration. The noisiest construction activities associated with wind farm development are excavation and pouring of the turbine bases. Excavation of a wind turbine base can typically be completed in one to two days however, and the main concrete pours are usually conducted in one continuous pour, which is done within a matter of hours.

Construction noise at any given noise sensitive location will be variable throughout the construction phase, depending on the activities underway and the distance from the main construction activities to the receiving properties. The potential noise effects that will occur during the construction phase of the Wind Farm Site are further described in Chapter 11: Noise and Vibration.

With regard to the Grid Connection underground electrical cabling route, construction works may give rise to noise effects on sensitive receptors in the area, however these noise effects will be transient in nature as the works move along the underground electrical cabling route.

Proposed Mitigation Measures

Best practice measures for noise control will be adhered to onsite during the construction phase of the Proposed Development in order to mitigate against the slight short-term negative effect associated with this phase of the development. These measures will include:

Good site practices will be implemented to minimise the likely effects. Section 8 of BS5228-1:2009+A1:2014 recommends a number of simple control measures as summarised below that will be employed onsite:

- Keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern;
- Ensure that any extraordinary site work occurring outside of the core working hours (for example, crane operations lifting components onto the tower) will be programmed, when appropriate, so that haulage vehicles would not arrive at or leave the site between 19:00 and 05:00, with the exception of abnormal loads that would be scheduled to avoid anticipated periods of high traffic flows;
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and be subject to programmed maintenance;
- Select inherently quiet plant where appropriate - all major compressors would be ‘sound reduced’ models fitted with properly lined and sealed acoustic covers, which would be kept closed whenever the machines are in use;
- All ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Machines will be shut down between work periods (or when not in use) or throttled down to a minimum;
- Regularly maintain all equipment used on site, including maintenance related to noise emissions;
- Vehicles will be loaded carefully to ensure minimal drop heights so as to minimise noise during this operation; and
- All ancillary plant such as generators and pumps will be positioned so as to cause minimum noise disturbance and if necessary, temporary acoustic screens or enclosures will be provided.

Where the BS5228 threshold levels are anticipated to be exceeded due to directional drilling activities along the underground electrical cabling route, the following are examples of measures that will be considered, where necessary, to mitigate noise emissions from these activities are as follows:

- Temporary boarding alongside the drilling rig or use of 'acoustic blanket panels' to hang from heras fencing or similar. Installation will be as close to the drilling rig as is practicable and fitted so as to interrupt any direct line of site between the drilling rig and the closest residential receptors.
- Examples of appropriate products include Echo Noise Defender and Soundex DeciBloc. It is anticipated that this will be required should directional drilling be used for water crossings 3, 7 and 11, which are in close proximity to sensitive receptors.

Residual Effect

Predicted construction noise levels are below the assessment criteria at all receptors, for all phases of construction of the Wind Farm. Good practice mitigation measures are outlined above, however, with or without the good practice construction mitigation measures there will be **no significant residual effects**.

Although noise levels from the laying of the underground electrical cabling route has the potential to exceed the BS 5228 threshold levels during the daytime, due to the transient nature of the underground electrical cabling works, this will only occur for a short period of time at any one location. There will be short periods where threshold levels may be exceeded for the closest noise sensitive receptors. For trenching and backfill activities this will likely occur for less than one day at any given receptor. If directional drilling activities at watercourse, drain and culvert crossing locations are required close to noise sensitive receptors, the mitigation measures detailed above will be put into place and there will be **no significant residual effects**.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.7 Air (Dust)

Pre-Mitigation Effects

Potential dust emission sources during the construction phase of the Proposed Development include construction of new access roads and upgrading of existing access tracks, and excavation and construction of turbine foundations and substation, temporary construction compounds, and laying of underground cabling. An increase in dust emissions has the potential to cause a nuisance to sensitive receptors in the immediate vicinity of the Site. The entry and exit of construction vehicles from the Site may result in the transfer of mud to the public road, particularly if the weather is wet. This may cause nuisance to residents and other road users. These effects will not be significant and will be relatively short-term in duration. The potential dust effects that may occur during the construction phase of the Proposed Development are further described in Chapter 10: Air and Climate.

Proposed Mitigation Measures

As discussed in Section 4.4.2 of Chapter 4, aggregate material for the construction of roads, substation and turbine hardstanding areas may need to be imported from nearby quarries, should sufficient material not be obtained during excavation works for the Proposed Development. The quarries that could potentially provide stone and concrete for the Proposed Development, along with the specified construction haul routes are listed in Section 4.4 of Chapter 4. Truck wheels will be washed where necessary to remove mud and dirt before leaving the Site. All plant and materials vehicles shall be stored in the dedicated compound area. Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction. Construction traffic will be restricted to defined routes and a speed limit will be implemented.

In periods of extended dry weather, dust suppression may be necessary, and along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from the Site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads and the temporary construction compound to prevent the generation of dust. Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored, as the application of too much water may lead to increased runoff.

The active construction area along the underground electrical cabling route will be small, ranging from 150-300 metres in length at any one time. Should separate crews be used during the construction phase they will generally be separated by 1-2 kilometres. All construction machinery will be maintained in good operational order while on-site, minimising any emissions that are likely to arise. Aggregate materials for the construction of the underground electrical cabling route will be sourced from local quarries to reduce emissions associated with vehicle movements.

Potential dust emissions during the construction period will not be significant and will be relatively short-term in duration.

Residual Effects

Following the implementation of the above mitigation measures, there will be a short-term imperceptible effect due to dust emissions from the construction of the Proposed Development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.8 Traffic

Pre-Mitigation Effect

It is proposed that large wind turbine components will be delivered to the Wind Farm Site, from Galway Port, via the M6 National Road (other ports such as Shannon Port or Dublin Port could also be used). The proposed turbine transport route from Galway Port via the M6 National Road, N6, N55 and R390 to the Wind Farm Site. From Galway Port in Galway City, the turbines will be transported via the M6 and N6 at Athlone, turning northeast along the N55 for approximately 2.7km, before turning east onto the R390 Regional Road. The route continues along the R390 Regional Road for 13.5km before turning south onto the L5363 local road where the route continues south along this road for approximately 1km before turning east into the Wind Farm Site entrance.

The construction phase of the Proposed Development will last for approximately 18-24 months. The proposed turbine delivery and construction traffic route is shown in Figure 14-1 in Chapter 14 of this EIAR.

Non-turbine construction traffic will be comprised of Heavy Goods Vehicle (HGV) and Light Goods Vehicle (LGV) movements involved in the delivery of construction materials to the Wind Farm Site from nearby quarries and the export of excess construction materials and plant from the Wind Farm Site. Traffic associated with the construction phase of the Grid Connection will be predominantly comprised of LGV's and small excavators.

A complete Traffic and Transportation Assessment (TTA) of the Proposed Development has been carried out by Alan Lipscombe Traffic and Transport Consultants. The full results of the TTA are presented in Chapter 14: Material Assets.

The types of vehicles that will be required to negotiate the local network represent abnormal size loads and a detailed assessment of the geometry of the proposed route was therefore undertaken. This will have a temporary imperceptible to moderate negative effect on existing road users, which will be minimised with the implementation of the mitigation measures included in the proposed traffic management plan.

Proposed Mitigation Measures

The following mitigation measures will be implemented during the construction phase:

A detailed **Traffic Management Plan (TMP)**, incorporating all the mitigation measures set out in the CEMP included as Appendix 4-2 of this EIAR, will be finalised and confirmatory detailed provisions in respect of traffic management agreed with the roads authority and An Garda Síochána prior to construction works commencing on Site. Illustrations for the traffic arrangements and diversion routes identified for the Grid Connection works are included in Appendix 14-2: Grid Connection Traffic Arrangements and Diversion Routes, and identifies sections along the Grid Connection underground electrical cabling route where there will be road and pedestrian footpath closures, diverted traffic, and Stop/Go or traffic lights. The detailed TMP will include the following:

Traffic Management Coordinator – a competent Traffic Management Co-ordinator will be appointed for the duration of the construction of the Proposed Development and this person will be the main point of contact for all matters relating to traffic management.

Delivery Programme – a programme of deliveries will be submitted to Westmeath County Council and other relevant authorities in advance of deliveries of turbine components to the Wind Farm Site. Liaison with the relevant local authorities including the roads sections of local authorities that the delivery routes traverse and An Garda Siochana, during the delivery phase of the large turbine vehicles, when an escort for all convoys will be required.

Information to locals – Locals in the area will be informed of any upcoming traffic related matters e.g. delivery of turbine components at night, via letter drops and posters in public places. Information will include the contact details of the Contract Project Co-ordinator, who will be the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided.

A Pre and Post Construction Condition Survey – A pre-condition survey of roads associated with the Proposed Development will be carried out prior to construction commencement to record the condition of the road. A post construction survey will be carried out after works are completed. Where required the timing of these surveys will be agreed with the local authority.

Implementation of temporary alterations to road network at critical junctions – At locations where required highlighted in Section 14.1.8.

Identification of delivery routes – These routes will be agreed and adhered to by all contractors.

Travel plan for construction workers to Wind Farm Site– While the assessment above has assumed the worst case that construction workers will drive to the Wind Farm Site, the construction company will be required to provide a travel plan for construction staff, which will include the identification of a routes to / from the site and identification of an area for parking.

Travel plan for construction workers to underground electric cabling route – Due to the transient nature of the underground grid connection construction site which will generally be on a section of the public road, construction workers will be transported to and from the site by the construction company at the beginning and end of each shift.

Temporary traffic signs – As part of the traffic management measures temporary traffic signs will be put in place at all key junctions, including the access junction on the L5363. All measures will be in accordance with the *"Traffic Signs Manual, Section 8 – Temporary Traffic Measures and Signs for Road Works"* (DoT now DoTT&S) and "Guidance for the Control and Management of Traffic at Roadworks" (DoTT&S). A member of construction staff (flagman) will be present at key junctions during peak delivery times.

Delivery times of large turbine components - The management plan will include the delivery of large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage.

Additional measures - Various additional measures will be put in place in order to minimise the effects of the development traffic on the surrounding road network including wheel washing facilities on Site and sweeping / cleaning of local roads as required.

Re-instatement works - All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers.

Prior to commencement of any works, the occupants of dwellings in the vicinity of the proposed works will be contacted and the scheduling of works will be made clear. Local access to properties will also be maintained throughout any construction works and local residents will also be supplied with the number of the works supervisor in order to ensure that disruption will be kept to a minimum.

Deliveries of concrete and aggregate materials will occur early in the morning to reduce impact to road users. Furthermore, these deliveries will be sourced from local quarries which will reduce the distance of these deliveries, thereby reducing the impact to traffic and transport in the wider area.

Due to the very low volumes of traffic forecast to be generated during the operational phase, no mitigation measures are required.

In the event that the Proposed Development is decommissioned after 30 years of operation, a decommissioning plan will be prepared. This plan will include a material recycling/disposal and traffic management plan which will be agreed with the local authority prior to decommissioning commencing.

Residual Effect

Once a traffic management plan is implemented for the construction phase of the Proposed Development, there will be a short-term slight to imperceptible negative residual effect on local road users.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.9 Shadow Flicker

Shadow flicker, which occurs during certain conditions due to the movement of wind turbine blades, as described in Section 5.7 of this chapter, occurs only during the operational phase of a wind energy development. There are therefore no shadow flicker effects associated with the construction phase of the Proposed Development.

5.9.3 Operational Phase

The effects set out below relate to the operational phase of the Proposed Development including the period when turbines are being commissioned.

5.9.3.1 Health and Safety

Pre-Mitigation Effect

The operational phase of the Proposed Development poses little threat to the health and safety of the public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s '*Wind Energy Development Guidelines for Planning Authorities 2006'* state that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations. People or animals can safely walk up to the base of the turbines.

The Guidelines state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. However, most blades are composite structures with no bolts or separate components and the danger is therefore minimised. The build-up of ice on turbines is unlikely to present problems. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to beginning operation.

The turbine blades are typically manufactured of wood and laminated layers of glass fibre which will prevent any likelihood of an increase in lightning strikes within the Wind Farm Site or the local area. Lightning protection conduits will be integral to the construction of the turbines. Lightning conduction cables, encased in protection conduits, will follow the electrical cable run, from the nacelle to the base of the turbine. The conduction cables will be earthed adjacent to the turbine base. The earthing system will be installed during the construction of the turbine foundations. There will be no impact on health and safety.

It is not anticipated that the operation of the wind farm will present a danger to the public and livestock. Rigorous safety checks are conducted on the turbines during design, construction, commissioning and operation to ensure the risks posed to staff, landowners and general public are negligible.

As forementioned in Section 5.5.3 above, the extremely low frequency (ELF) electric and magnetic fields (EMF) associated with the operation of the proposed cables fully comply with the international guidelines for ELF-EMF set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the World Health Organisation, as well as the EU guidelines for human exposure to EMF. Accordingly, there will be no operational impact on properties (residential or other uses) as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.

The ESB document 'EMF & You' (ESB, 2017)[2] provides further practical information on EMF.

The consensus from health and regulatory authorities is that extremely low frequency EMFs, typically associated with powerlines of this nature, do not present a health risk.

[2] *EMF & You: Information about Electric & Magnetic Fields and the electricity network in Ireland Available at: https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0.*

Proposed Mitigation Measures

Notwithstanding the above, the following mitigation measures will be implemented during the operation of the Proposed Development to ensure that the risks posed to staff and landowners remain negligible throughout the operational life of the wind farm.

Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits.

Staff associated with the Proposed Development will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed or are becoming hidden by vegetation or foliage, with prompt action taken as necessary.

Signs will also be erected at suitable locations across the site as required for the ease and safety of operation of the wind farm. These signs include:

- Buried cable route markers at 50m (maximum) intervals and change of cable route direction;
- Directions to relevant turbines at junctions;
- "No access to Unauthorised Personnel" at appropriate locations;
- Speed limits signs at site entrance and junctions;
- "Warning these Premises are alarmed" at appropriate locations;
- "Danger HV" at appropriate locations;
- "Warning – Keep clear of structures during electrical storms, high winds or ice conditions" at site entrance;
- "No unauthorised vehicles beyond this point" at specific site entrances; and
- Other operational signage required as per site-specific hazards.

An operational phase Health and Safety Plan will be developed to fully address identified Health and Safety issues associated with the operation of the site and providing for access for emergency services at all times.

The components of a wind turbine are designed to last up to 35 years and are equipped with a number of safety devices to ensure safe operation during their lifetime. During the operation of the wind farm regular maintenance of the turbines will be carried out by the turbine manufacturer or appointed service company. A project or task specific Health and Safety Plan will be developed for these works in accordance with the site's health and safety requirements.

Residual Effect

With the implementation of the above mitigation measures, there will be a long-term, imperceptible residual effect on health and safety during the operational life of the Proposed Development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.3.2 Employment and Investment

The operational phase will present an opportunity for mechanical-electrical contractors and craftspeople to become involved with the maintenance and operation of the wind farm. On a long-term scale, the Proposed Development will create approximately 2 to 4 jobs during the operational phase relating to the maintenance and control of the wind farm, having a long-term slight positive effect.

The injection of money in the form of rental income to the landowners who are participating in the Proposed Development, where a rental agreement has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a long-term positive impact on their cash flow. This will have a long-term slight positive indirect effect.

Rates payments for the wind farm will contribute significant funds to Westmeath County Council, which will be redirected to the provision of public services within Co. Westmeath. These services include provisions such as road upkeep, fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives.

5.9.3.3 Renewable Energy Production and Reduction in Greenhouse Gas Emissions

In July 2022, the EPA published '*Ireland's Provisional Greenhouse Gas Emissions 1990-2022*' which indicates that Irelands emissions have decreased by 11.4% from 1990 to 2021. Electricity generated from wind increased by 15.3% in 2020, the increase of which contributed to the 8.1% decrease in the emissions intensity of power generation in 2020 to 295g CO2/kWh. The National Climate Change Strategy 2007 – 2012 stated that electricity generation from renewable sources provides the most effective way of reducing the contribution of power generation to Ireland's greenhouse gas emissions. The Proposed Development will offer significant benefits in terms of renewable energy production and reductions in greenhouse gas emissions. In this regard, it will have a long-term significant positive effect. The carbon loss and savings due to the Proposed Development are discussed in Chapter 10 of this EIAR.

5.9.3.4 Population

The operational phase of the Proposed Development will have no impact on the population of the area with regards to changes to trends, population density, household size or age structure.

5.9.3.5 Property Values

As noted in Section 5.6 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses. It is on this basis that it can be reasonably concluded that there would be a long-term imperceptible effect from the Proposed Development.

5.9.3.6 Land-use

The footprint of the Wind Farm Site, including turbines, roads, etc., will occupy only a small percentage of the total Population Study Area defined for the purposes of this EIAR. The predominant land-use of commercial forestry and agriculture in the Wind Farm Site will continue to co-exist with the Proposed Development. Land use along the Grid Connection comprises of public road corridor, public open space, discontinuous urban fabric and agriculture. There will be no change to existing land-uses as a result of the Grid Connection. The Proposed Development will have no effect on other land-uses within the wider area.

5.9.3.7 Noise

A baseline assessment of the existing background noise conditions was carried out, the results of which are presented in Chapter 11 of the EIAR. A noise assessment of the operational phase of the Proposed Development has also been carried out through modelling of the development using noise prediction software. The predicted noise levels for the Proposed Development have been compared with the existing background noise levels and the best practice guidance levels for noise emissions from wind farms.

Details of the noise assessment carried out by TNEI Consultancy are presented in Chapter 11 of the EIAR. The Guidelines Noise Limits were compared to the predictions of the Proposed Development operating on its own and the results are summarised in Table 11-12 for the daytime and Table 11-13 for the night time in Chapter 11 of this EIAR. The tables also show the exceedance level, which is the difference between the predicted noise level and the Guidelines Noise Limit at a given wind speed. A negative exceedance level indicates satisfaction of the noise limit. The assessment shows that the predicted wind turbine noise immission levels meet the Guidelines Noise Limits under all conditions for both daytime and night time periods at all receptors and as such there will be **no significant effects** at those receptors

The Grid Connection onsite 110 kV substation will be installed in the southern half of the Wind Farm Site. The closest receptor to the substation is H5, which is at a distance of approximately 290 m. With a separation distance of 290 m to the closest receptor, the level of distance attenuation will be approximately 50 dB. Accordingly, at distances of 290 m and greater the predicted noise level from the substation at the receptor is 0 dB and there is no potential for significant effects. There will be no operational noise from the Grid Connection underground electrical cabling route.

5.9.3.8 Traffic

Service technicians may have to attend to the Wind Farm Site on a weekly basis during the operational phase of the Proposed Development. A Traffic and Transportation Assessment (TTA) of the Proposed Development has been completed by Alan Lipscombe Traffic and Transport Consultants, the results of which are presented in Section 14.1 of this EIAR. The TTA found that there will be a long-term neutral effect on traffic created during the operational phase of the Proposed Development.

5.9.3.9 Tourism

Given that there are currently no tourism attractions or amenity walkways located within the Wind Farm Site there are no impacts associated with the operational phase of the Proposed Development. The Department of the Environment, Heritage and Local Government's *Wind Energy Development Guidelines for Planning Authorities* 2006 state that "*the results of survey work indicate that tourism and wind energy can co-exist happily*". It is not considered that the Wind Farm Site would have an adverse effect on tourism infrastructure in the vicinity. Renewable energy developments are an existing feature in the surrounding landscape, which will assist in the assimilation of the Proposed Development into this environment. The Grid Connection underground electrical cabling route will be located within the public road network which passes under the Old Rail Trail tourist attraction however, once operational the road corridors in which the underground electrical cabling route is located will be fully reinstated with no potential to give rise to any operational phase effects.

5.9.3.10 Shadow Flicker

Pre-Mitigation Effects

Of the 115 No. properties modelled; it is predicted that 70 properties may experience daily shadow flicker levels above the Guidelines threshold of 30 minutes per day.

Assuming theoretical precautionary conditions, a total of 70 properties may experience daily shadow flicker in excess of the Guidelines threshold of 30 minutes per day. Of these 70 properties, 1 is derelict, and 7 no. inhabitable dwellings are Participating Properties. The Guidelines total annual guideline limit of 30 hours is exceeded at 8 properties once the regional sunshine average of 30.07% is considered. Of these 8 properties, 7 properties are inhabitable dwellings and 6 of which are third party properties, and 1 no. property is derelict,

Proposed Mitigation Measures

Where daily or annual shadow flicker exceedances are predicted at any inhabitable or 3rd party dwelling, a site visit will be undertaken firstly to determine the existing screening and window orientation. This will determine if the receptor has an actual line of sight to any turbine. Once this is completed and all of the potential receptors identified, the following measures will be employed;

Screening Measures

In the event of an occurrence of shadow flicker exceeding guideline threshold values of 30 minutes per day at residential receptor locations, mitigation options will be discussed with the affected homeowner, including:

- Installation of appropriate window blinds in the affected rooms of the residence;
- Planting of screening vegetation;
- Other site-specific measures which might be agreeable to the affected party and may lead to the desired mitigation.

If agreement can be reached with the homeowner, then it would be arranged for the required mitigation to be implemented in cooperation with the affected party as soon as practically possible and for the full costs to be borne by the wind farm operator.

Wind Turbine Control Measures

If it is not possible to mitigate any identified shadow flicker limit exceedance locally using the measures detailed above, wind turbine control measures will be implemented.

Wind turbines can be fitted with shadow flicker control units to allow the turbines to be controlled to prevent the occurrence of shadow flicker at properties surrounding the wind farm. The shadow flicker control units will be added to any required turbines.

A shadow flicker control unit allows a wind turbine to be programmed and controlled using the wind farm's SCADA control system to change a particular turbine's operating mode during certain conditions or times, or even turn the turbine off if necessary.

All predicted incidents of shadow flicker can be pre-programmed into the wind farm's control software. The wind farm's SCADA control system can be programmed to shut down any particular turbine at any particular time on any given day to avoid excessive shadow flicker occurrences at properties which are not naturally screened or cannot be screened with measures outlined above. Where such wind turbine control measures are to be utilised, they need only be implemented when the specific combined circumstances occur that are necessary to give rise to the shadow flicker effect in the first instance. Therefore, if the sun is not shining on a particular day that shadow flicker was predicted to occur at a nearby property, there would be no need to shut down the relevant turbines that would have given rise to the shadow flicker at the property. Similarly, if the wind speed was below the cut-in speed that caused the turbine rotor to rotate and give rise to a shadow flicker effect at a nearby property, there would be no need to shut down the relevant turbines that otherwise would have caused shadow flicker.

The atmospheric variables that determine whether shadow flicker will occur or not, are continuously monitored at the Wind Farm Site and the data fed into the wind farm's SCADA control system. The strength of direct sunlight is measured by way of photocells, and if the sunlight is of sufficient strength to cast a shadow, the shadow flicker control mechanisms come into effect. Wind speed and direction are measured by anemometers and wind vanes on each turbine and on the wind farm's met mast, and similarly, and if wind speed and direction is such that a shadow will be cast, the shadow flicker control mechanisms come into effect. The moving blades of the turbine will require a short period of time to cease rotating and as such there may be a very short period (less than 3 to 5 minutes) during which the blades are slowed to a complete halt. The turbines giving rise to shadow flicker may be turned off on different days to prevent excessive wear and tear on any single turbine.

In order to ensure that the model and SCADA system is accurate and working well a site visit will be carried out to verify the system. The shadow flicker prediction data will be used to select dates on which a shadow flicker event could be observed at one or multiple affected properties and the following process will be adhered to.

1. *Recording the weather conditions at the time of the site visit, including wind speeds and direction (i.e. blue sky, intermittent clouds, overcast, moderate breeze, light breeze, still etc.).*
2. *Recording the house number, time and duration of site visit and the observation point GPS coordinates.*
3. *Recording the nature of the sensitive receptor, its orientation, windows, landscaping in the vicinity, any elements of the built environment in the vicinity, vegetation.*
4. *In the event of shadow flicker being noted as occurring the details of the duration (times) of the occurrence will be recorded*
5. *The data will then be sent to the wind farm operational team to confirm that the model and SCADA system are working.*
6. *Following 12 months of full operation of the Proposed Development a report can be prepared for the Local Authority describing the shadow flicker mitigation measures used at the wind farm and confirming the implementation and successful operation of the system.*

This method of shadow flicker mitigation has been technically well-proven at wind farms in Ireland and also in areas outside Ireland that experience significantly longer periods of direct sunlight.
In order to demonstrate how the SCADA control system can be applied to switch off particular turbines at the relevant times and dates, Table 5-10 below lists the 62 properties at which a shadow flicker mitigation strategy may be necessary to ensure the Guidelines 30-minute per day shadow flicker threshold is not exceeded. In this case, the relevant turbine(s) would be programmed to switch off for the time required to reduce daily shadow flicker to below the guideline limit of 30 minutes. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree alternative mitigation measures with the relevant property owner. The mitigation strategy outlined in Table 5-10 below is based on the theoretical precautionary scenario. The details presented in Table 5-0 list the days per year and the turbines that could be programmed to switch off at specific times, in order to reduce daily shadow flicker to a maximum of 28 minutes, which is below the guideline limit of 30 minutes.

Table 5-10 Shadow Flicker Mitigation Strategy for Daily Shadow Flicker Exceedance – Turbine Numbers and Dates

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Days)	Days of Year When Mitigation May be Required (Dates)*
3	237	2, 3, 4, 5, 6, 7	1-18, 20-27, 44-53, 80-99, 140-203, 245-264, 292-300, 319-365	1st January – 18th January, 20th January - 27th January, 13th February - 22nd February, 21st March - 31st March, 20th May - 22nd July, 1st - 21st September, 19th - 27th October, 15th November - 31st December
5	40	5, 8,	85-95, 164-181 250-260,	26th March - 5th April, 13th June - 30th June, 7th -17th September
7	69	4	138-206	18th May – 25th July

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Days)	Days of Year When Mitigation May be Required (Dates)*
8	88	6, 7,	1-29, 50-58, 316-365,	1st January - 29th January, 19th February - 27th February, 12th November - 31st December
9	47	1	29-51, 294 - 317	30th January - 20th February, 21st October - 13th November
11	80	4	133-212	13th May - 31st July
12	39	1	45-63, 282-301,	14th February - 4th March, 9th October - 28th October
14	83	1,2	26-46, 85-103, 241-261, 299-320	26th January - 15th February, 26th March - 13th April, 29th August - 18th September, 26th October - 16th November
15	125	1, 2, 3,	10-31, 64-83, 118-137, 207-227, 262-281, 315-336	10th January - 31st January, 5th March - 24th March, 28th April - 17th May, 26th July - 15th August, 19th September - 8th October, 11th November - 2nd December
16	136	1, 2, 3,	1-15, 17-18, 52-71, 107-126, 219-238, 274-294, 327-329, 331-365	1st January - 15th January, 17th-18th January, 21 February - 12th March, 17 April - 6th May, 7 August - 2th August, 1 October - 21 October, 23rd - 25th November, 27th November - 31st December
17	85	1, 2,	33-53, 92-111, 233-253, 291-312,	4th February - 22nd February, 2nd April - 21st April, 21 August - 10 September, 18th October - 8th November
18	72	1, 2,	21-35, 60-80, 264-284, 310-324	21st January - 4th February, 1st March - 21st March, 21 September - 11th October, 6th November - 20th November
19	73	6	1-26, 319-365	1st January - 26th January, 12th November - 31st December
20	75	1, 2,	20-38, 75-92, 253-270, , 307-326,	20th January - 7th April, 16th March - 2nd April, 10th September - 27th September, 3rd November - 22 November
21	24	8	94-105, 240-251,	4th April - 15th April, 28 August – 8th September
22	108	1, 2, 3,	23-39, 74-91, 124-142, 203-220, 254-272, 306-322,	23 January - 8th February, 15th March - 1st April, 4th May – 22nd May, 22 July - 8th August, 11th September – 29th September, 2 November - 18th November
23	58	8, 9,	153-190, 162-181,	3rd June - 9th July,
24	45	6, 7,	1-11, 46-47, 298-299, 335-336, 338-365	1st January - 11th January, 15th February – 16th February, 25th-

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Days)	Days of Year When Mitigation May be Required (Dates)*
				26th October, 1st-2nd December, 4th December - 31st December
25	41	1,	17-36, 309-329,	17th January - 5th February, 5th November - 25th November
26	35	1,	24-41, 305-321,	24th January - 10th February, 1st November-17th November
28	148	1, 2, 3, 4	1-7, 11, 49-65, 101-119, 153-191, 225-243, 280-297, 335, 339-365	1st January - 7th January, 11th January, 18th February - 6th March, 11th April - 29th April, 3rd June - 10th July, 13th August - 31st August, 7th October - 24th October, 1st December, 5th December - 31st December
29	32	9	97-112, 232-247,	7th April - 21st April, 20 August - 4th September
31	33	2, 3	68-73, 109-118, 226-235, 271-277,	9th March - 14th March, 19th - 28th April, 14 August – 23rd August, 28th September - 4th October
32	30	8	157-186,	6th June - 5th July
33	97	1,2,3	39-53, 88-103, 135-151, 193-209, 242-257, 292-307,	8th February - 22nd February, 29th March – 13th April, 15th May – 31st May, 12th July - 28th July, 30th August - 14th September, 19th October - 3rd November
36	20	9	162-181,	11th June – 30th June
38	20	6	26-35, 310-319	26th January – 4th February, 6th November - 15th November
39	9	6	34-37, 308-312	3rd February - 6th February, 4 November - 8th November
40	46	9	149-194	29th May - 13th July
41	98	2,3,4	18-37, 72-85, 120-134, 211-225, 260-273, 309-328,	18th January - 6th February, 13th March- 26th March, 30th April - 14th May, 30th July - 13th August, 17th September – 30th September, 5th November - 24th November
42	27	7	59-71, 273-286,	28th February - 12th March, 30th September - 13th October
43	64	1	1-22, 324-365	1st January - 22 January, 20 November – 31st December
44	34	9	111-127, 217-233	21 April – 7th May, 5th August – 21st August
45	37	1	14-31, 314-332,	14th January – 31st January, 10th November – 28th November
46	31	9	107-122, 222-236	17th April - 2nd May, 10th August – 24th August

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Days)	Days of Year When Mitigation May be Required (Dates)*
47	131	1, 2, 3, 4	1-8, 51-64, 100-113, 146-163, 182-199, , 232-245, 281-294, 332-333, 337-365	1st January - 8th January, 20th February - 5th march, 10th April – 23rd April, 26th May - 12th June, 1st July - 18th July, 20th August - 2nd September, 8th October – 21st October, 18th November – 29th November, 3rd December - 31st December
48	40	9	121-140, 203-222	1st May – 20th May, 22nd July - 10th August
50	44	1, 2	58-65, 99-112, 231-245, 280-286,	27th February – 6th March, 9th April - 22nd April, 19th August – 2nd September, 7th October – 13th October
51	69	1,2,3	40-50, 84-96, 128-137, 208-217, 249-261, 295-306,	9th February - 19th February, 25th March - 6th April, 8th May - 17th May, 27th July - 5th August, 6th September – 18th September, 22nd October – 2nd November
53	42	9	151-192	31 may - 11th July
54	48	1	2-3, 6-26, 319-340, 342-344	2nd January - 3rd January, 6th January - 26th January, 15th November - 6th December, 8 December - 10th December
55	18	8	108-116, 229-237	18th April - 26th April, 17th August - 25th August
58	54	1,2,3	41-50, 84-93, 125-131, 213-219, 252-261, 296-305,	10th February - 19th February, 25th March - 3rd April, 5th May - 11th May, 1st August - 7th August, 9th September - 18th September, 23rd October - 1st November
59	15	9	96-103, 241-247	6th April - 13th April, 29th August - 4th September
60	25	7	126-138, 206-217	6th May - 18th May, 25th July-5th August
61	31	1,2	62-65, 100-110, 234-244, 279-283,	3rd March-6th March, 10th April - 20th April, 22nd August-1st September, 6th October- 10th October
62	10	1	351-360	17th December - 26th December
63	55	1	1-16, 327-365	1stJanuary -16th January, 23rd November - 31st December
64	19	9	103-112, 232-240	13th April - 22nd April, 20th August - 28th August
65	26	7	30-42, 303-315	30th January - 11th February, 30th October - 11th November
66	17	7	56-64, 281-288	25th February - 5th March, 8th October - 15th October

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Days)	Days of Year When Mitigation May be Required (Dates)*
68	37	1,2,3	47-54,89-96, 128-130, 215-216, 249-259, 291-298	16th February - 23rd February, 30th March - 6th April, 8th May - 10th May, 3rd August - 4th August, 6th September - 16th September, 18th October - 25th October
69	36	1,2,3	41-47,81-88, 121-123, 222-224, , 257-264, 299-305	10th February - 16th February, 22nd March - 29th March, 1st May - 3rd May, 10th August - 12th August, 14th September - 21st September, 26th October - 1st November
70	31	1,2,3	36-40, 74-81, 114-116, 229-231, 265-271, 306-310	5th February - 9th February, 15th March - 22nd March, 24th April - 26th April, 17th August - 19th August, 22nd September - 28th September, 2nd November - 6th November
71	20	7	38-47, 298-307	7th February - 16th February, 25th October - 3rd November
72	18	7	40-48, 297-305	9th February - 17th February, 24th October - 1st November
73	16	7	122-129, 215-222	2nd May - 9th May, 3rd August - 10th August
74	13	4	71-76, 269-275	12th March - 17th March, 26th September - 2nd October
80	9	7	116-119, 224-228	26th April - 29th April, 12th August - 16th August
89	9	4	130-133, 211-215	10th May - 13th May, 30th July - 3rd August
91	2	4	121,223	1st May, 11th August
92	6	4	135-137, 207-209	15th May – 17th May, 26th July – 28th July

**Note: days of year are based on the year 2022*

Where a shadow flicker mitigation strategy is to be implemented, it is likely that the control mechanisms would only have to be applied to a turbine to bring the duration of shadow flicker down to the 28-minute post-mitigation shadow flicker target.

Overall, the details presented in Table 5-10 demonstrate that using the turbine control system, it will be possible to reduce the level of shadow flicker at any affected property to below the daily guideline limit of 30 minutes, by programming the relevant turbines to switch off at the required dates and times.

Table 5-11 lists the 6 properties at which a shadow flicker mitigation strategy may be necessary to ensure the Guidelines 30-hour annual shadow flicker threshold is not exceeded. In this case, the relevant turbine(s) would be programmed to switch off for the time required to ensure that the annual shadow flicker limit of 30 hours annually is not exceeded. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree suitable alternative mitigation measures with the relevant property owner. Table 5-11 below illustrates the relevant turbines that may need to be controlled, based on the '*worst-case impact*' of shadow flicker impacts modelled.

Table 5-11 Shadow Flicker Mitigation Strategy for Annual Shadow Flicker Exceedance

Property No.	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Producing Shadow Flicker Exceedance	Post-mitigation Maximum Annual Shadow Flicker (hrs:mins:sec)
3	59:46:41	2,3,4,5,6,7	≤30:00:00
15	33:02:47	1,2,3	≤30:00:00
16	31:16:20	1,2,3	≤30:00:00
28	36:21:14	1,2,3,4	≤30:00:00
33	32:33:55	1,2,3	≤30:00:00
47	34:56:27	1,2,3,4,	≤30:00:00

Notwithstanding the approach set out above should shadow flicker associated with the Proposed Development be perceived to cause a nuisance at any home, the affected homeowner is invited to engage with the Developer. Should a complaint or query in relation to shadow flicker be received within 12 months of commissioning of the wind farm, field investigation/monitoring will be carried out by the wind farm operator at the affected property. The homeowner will be asked to log the date, time and duration of shadow flicker events occurring on at least five different days. The provided log will be compared with the predicted occurrence of shadow flicker at the residence, and if necessary, a field investigation will be carried out.

Residual Effect

Following the implementation of the above suite of mitigations measures, the Guidelines limit of 30 mins per day or 30 hours per year will not be exceeded and this will result in a long-term, imperceptible negative residual effect from shadow flicker on human health.

Significance of Effects

Based on the assessment above and the mitigation measures proposed there will be no significant effects related to shadow flicker.

5.9.3.11 Interference with Communication Systems

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The alternating current, electrical generating and transformer equipment associated with wind turbines, like all electrical equipment, also generates its own electromagnetic fields, and this can interfere with broadcast communications. The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting, for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path. This interference can be overcome by the installation of deflectors or repeaters.

As part of the scoping and consultation exercise undertaken by MKO, the national and regional broadcasters and fixed and mobile phone operators were contacted regarding potential interference from the Proposed Development. Full details are provided in of Chapter 2: Background to the Proposed Development and Section 14.2 (Telecommunications and Aviation) of Chapter 14: Material Assets. Copies of the scoping responses received are presented in Appendix 2-1 of the EIAR.

Responses were received from Ajisko Ltd, Broadcasting Authority of Ireland, BT Communications Ireland, ComReg (Commission for Communications Regulation), Eir, Eircom, Enet, ESB Telecoms, Irish Aviation Authority, Imagine Group, RTE Transmission Network (2rn), Three Ireland Ltd, Viatel, Virgin Media and Vodafone Ireland. Imagine and Vodafone have stated that they have links passing through the Wind Farm Site and the proposed turbines have been sited to avoid these links. Eircom stated that they have links in the area however there is no overlap with the Wind Farm Site.

The Irish Aviation Authority responded with the following requirements: the turbines will be marked on maps, lit at night and entered into aircraft navigation databases and therefore can be avoided during flight.

Further detail on the actions taken to ameliorate any potential interference, including micro-siting of turbines can be found in Chapter 3 and Chapter 14. Following these measures, there will be no interference risk from any of the proposed turbines providing the design complies with recommended buffer zones and telecommunication solutions. Therefore, the Proposed Development will have no impact on telecommunications.

5.9.3.12 Residential Amenity

Pre-Mitigation Effects

Potential impacts on residential amenity during the operational phase of the Proposed Development could arise primarily due to noise, shadow flicker or changes to visual amenity, and potential impact of dust and traffic.

Shadow Flicker:

Detailed shadow flicker modelling have been carried out, in Section 5.9.2.9 above, as part of this EIAR, which shows that the Proposed Development will be capable of meeting all required guidelines in relation to of all required guidelines in relation to shadow flicker thresholds.

Noise:

A detailed noise assessment has been carried out in Chapter 11, as part of this EIAR, which shows that once operational the Proposed Development will be capable of meeting all required guidelines in relation to noise thresholds.

Visual Amenity

The visual impact of the Proposed Development is addressed comprehensively in Chapter 12: Landscape and Visual. The Proposed Development has been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within 757 metres of an inhabitable dwelling. This Proposed Development achieves the four times tip height (740m) separation distance recommended in the draft Guidelines which explicitly addresses residential visual amenity.

An assessment of roadside screening was carried along the regional R390 road at a distance of 5km as it is a relatively prominent transport route in the LVIA study area. Both the methodology and findings of this are described in Chapter 12. In consideration of this, visual effects arising from these roads have been assessed in detail via photomontage viewpoints located on these routes and are presented in Chapter 12. As detailed in Section 12.7 of Chapter 12, four photomontage viewpoints were specifically selected to assess the visual effects on residential amenity and receptors of local community importance in close proximity to the Proposed Development. Visual effects are rated of relatively high significance (Moderate) from these areas due to the close proximity to the proposed turbines where the magnitude of change is greatest, and the sensitivity is relatively high in respect of residents who live in close proximity. These four viewpoints show a theoretical precautionary scenario where there are open views in very close proximity with no screening.

Dust

As detailed in Chapter 10.2.3.3, once the Proposed Development is operational, there will be no activities that will give rise to dust emissions.

Traffic

As detailed in Chapter 14, Section 14.1.11.3, There will be no direct effects resulting from the Proposed Development during the operational phase.

Proposed Mitigation Measures

The closest proposed turbine to any inhabitable dwelling is 757 metres, which is greater than 4 times the turbine tip height (740m) from any property, a recognised parameter in assisting in the protection of residential visual amenity. All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and shadow flicker in this EIAR will be implemented in order to reduce insofar as possible impacts on residential amenity at properties located in the vicinity of the Proposed Development works.

Residual Effect

With the implementation of the mitigation measures outlined in relation to noise and vibration, dust, traffic, shadow flicker and visual amenity, the Proposed Development will have an imperceptible effect on residential amenity.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects on residential amenity.

5.9.4 Decommissioning Phase

The wind turbines proposed as part of the Proposed Development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the site may be decommissioned fully.

The works required during the decommissioning phase are described in Section 4.9 in Chapter 4: Description of the Proposed Development and the accompanying Decommissioning Plan included as Appendix 4-6 of this EIAR.

Any impact and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during part of the construction phase when turbines were being erected. The impacts and associated effects will be materially less than during the construction phase as significant ground works are not required to decommission a wind farm.

The decommissioning phase will have no impact on shadow flicker, interference with communications system, residential amenity, employment, tourism or health & safety once all standard construction phase mitigation measures described above are implemented.

5.9.5 Cumulative Effects

For the assessment of cumulative effects, any other existing, permitted or proposed developments (wind energy or otherwise) have been considered. The factors to be considered in relation to cumulative effects include population and human health, biodiversity, land, soil, water, air, climate, material assets, landscape, and cultural heritage as well as the interactions between these factors.

The potential cumulative effect of the Proposed Development and other relevant developments has been carried out with the purpose of identifying what influence the Proposed Development will have on the surrounding environment when considered cumulatively and in combination with relevant approved, and existing projects in the vicinity of the Site.

Further information on projects considered as part of the cumulative assessment are given in Chapter 2: Background to the Proposed Development. The impacts with the potential to have cumulative effects on human beings are discussed below and in more detail in the relevant chapters: noise (Chapter 11), visual impacts (Chapter 12) and traffic (Chapter 14).

5.9.5.1 Employment and Economic Activity

Developments considered as part of the cumulative project list that are proposed, permitted, or already existing contribute to short-term employment during the construction stages and provide the potential for long-term employment resulting from maintenance operations. This results in a long-term significant positive effect.

5.9.5.2 Tourism and Amenity

There are no key identified tourist attractions pertaining specifically to the Wind Farm Site itself. The Grid Connection underground electrical cabling route will be located within the public road network which passes under the Old Rail Trail tourist attraction however, once operational the road corridors in which the underground electrical cabling route is located will be fully reinstated with no potential to give rise to any operational phase effects.

It is not considered that the Proposed Development together with other permitted or proposed projects and plans in the area, (wind energy or otherwise), as set out in Section 2.7 in Chapter 2 of this EIAR, will cumulatively affect any tourism infrastructure in the wider area. There are no existing wind farms in the surrounding area, the closest proposed wind farm development is 16km from the Wind Farm Site. As also noted in Section 5.3 above, the conclusions from available research indicate there is a generally positive disposition among tourists towards wind development in Ireland. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative effect from the Proposed Development and other projects in the area.

5.9.5.3 Air (Dust)

The nature of the Proposed Development is such that, once operational, it will have a long-term, moderate, positive effect on the air quality.

During the construction phase of the Proposed Development, and the construction phase of the existing, permitted and proposed projects and plans (wind energy or otherwise), as set out in Section 2.7 in Chapter 2 of this EIAR, that are yet to be constructed, there will be minor emissions from construction plant and machinery and potential dust emissions associated with the construction activities. However, once the mitigation proposals, as outlined in Section 10.2.3.2 of Chapter 10 are implemented during the construction phase of the Proposed Development, there will be no cumulative negative effect on air and climate.

The nature of the Proposed Development and other wind energy developments are such that, once operational, they will have a cumulative long-term, significant, positive effect on the air quality and climate.

5.9.5.4 Health and Safety

The Proposed Development will have a short-term potential slight negative residual effect on health and safety during the construction phase of the Proposed Development, and a long-term, imperceptible residual effect on health and safety during the operational life of the Proposed Development.. All other existing, permitted or proposed projects and plans (wind energy or otherwise), as set out in Section 2.7 in Chapter 2 of this EIAR, would be expected to follow all relevant Health and Safety Legislation during the construction, operation and decommissioning phases of the Proposed Development. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative effect from the Proposed Development and other developments in the area.

5.9.5.5 Property Values

As noted in Section 5.6 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative effect from the Proposed Development and other potential wind farm developments in the area. It should be noted that there are no other existing wind farm developments in the area, with the closest proposed wind farm development at a distance of 16km from the Wind Farm Site

5.9.5.6 Services

The rate payments from the Proposed Development and other existing, permitted and proposed projects and plans (wind energy or otherwise), as set out in Section 2.7 in Chapter 2 of this EIAR, in the area will contribute significant funds to Westmeath County Council, which will be redirected to the provision of public services within the County. In addition, the injection of money into local services though the establishment of community benefit funds is also expected to be a long-term positive cumulative effect.

5.9.5.7 Noise

The potential for noise impacts during the construction and operational phase of the Proposed Development is assessed fully in Chapter 10: Noise.

The assessment concluded that there is no significant noise and vibration effects associated with the construction phase of the Proposed Development in combination with any other existing, permitted and proposed project and plans in the area, (wind energy or otherwise), as set out in Section 2.7 in Chapter 2 of this EIAR.

The assessment also concluded that there is no significant noise and vibration effect associated with the operational phase of the Proposed Development in combination with any other existing, permitted and proposed project and plans in the area, (wind energy or otherwise), as set out in Section 2.7 in Chapter 2 of this EIAR. There are no existing, permitted or proposed wind farms within 10km of the Wind Farm Site and so, there is no potential for cumulative noise effects during the operation phase of the Proposed Development. There is no noise and vibration emission of significance anticipated from the operation of the Grid Connection underground electrical cabling route and onsite substation.

5.9.5.8 Shadow Flicker

As outlined in Section 5.7.5.2, there are no wind farm developments within 10 rotor diameters of the Shadow Flicker Study Area and therefore, there is no potential for shadow flicker from the Proposed Development in combination with other wind farm developments.

5.9.5.9 Residential Amenity

Pre-Mitigation Effects

There are no other existing wind farm developments in the area, with the closest proposed wind farm development at a distance of 16.3 km from the Wind Farm Site. There is no potential for cumulative noise, shadow flicker and residential visual effects from the Proposed Development and other wind farm developments in the area. In the extremely unlikely event that all permitted and proposed projects as described in the cumulative assessment in Chapter 2, other than that of wind energy developments, are constructed at the same time, there is the potential for a resulting short term, significant, cumulative, negative effect to occur on residential amenity, in relation to noise and vibration, dust, traffic, telecommunications and visual amenity.

Proposed Mitigation Measures

There are no turbines as part of the Proposed Development that will be located within 757 metres of any inhabitable dwellings. All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and telecommunications in this EIAR will be implemented in order to reduce insofar as possible effects on residential amenity at properties located in the vicinity of the Proposed Development works.

Residual Effect

The Proposed Development will have a short-term, slight negative effect on residential amenity during construction works. There are no other existing wind farm developments in the area, with the closest proposed wind farm development at a distance of 16km from the Wind Farm Site, and so there is no potential for cumulative noise, shadow flicker and residential visual effects from the Proposed Development and other wind farm developments in the area.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.10 Summary

Following consideration of the residual effects (post-mitigation) it is noted that the Proposed Development will not result in any significant effects on Human Beings in the area surrounding the Proposed Development. Following appropriate mitigation, '*Wind Energy Development Guidelines for Planning Authorities 2006*' (referred to as the Guidelines) shadow flicker limits will not be exceeded at any property. However, it should also be noted the Proposed Development can be brought in line with the requirements of the Draft Wind Energy Development Guidelines (December 2019) (referred to as the draft Guidelines), should they be adopted while this application is in the planning system, through the implementation of the mitigation measures outlined.

Provided that the Proposed Development is constructed, operated and decommissioned in accordance with the design, best practice and mitigation that is described within this application, significant effects on population and human health employment and economic activity, land-use, residential amenity, community facilities and services, tourism, property values and health and safety are not anticipated at international, national or county scale.