Planning and Environmental Consultants

Environmental Impact Assessment Report

Proposed Clonberne Wind Farm Development, Co. Galway

Chapter 5 – Population and Human Health

DOCUMENT DETAILS

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Prepared By:	**MKO Tuam Road Galway Ireland H91 VW84**

MKO Planning and Environmental Consultants

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01	Final	20/06/2024	JF, ER	OC

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 Project 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 Project is provided in Chapter 4 of this EIAR.

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, shadow flicker, noise, and health and safety.

There are 169 properties located within 1.62 kilometre (the study area for Shadow Flicker Assessment) of the proposed turbine locations. The closest occupied dwelling is located approximately 726 metres from the nearest proposed turbine location (T8). All 169 no. properties located within 1.62km of the proposed turbines have been assumed to be occupied and therefore assessed as receptors for shadow flicker.

5.1.1 Statement of Authority

This section of the EIAR has been prepared by Jonny Fearon and reviewed by Owen Cahill, of MKO. The Statement of Authority for both Jonny and Owen are detailed in Section 1.8.2.1 in Chapter 1 of this EIAR.

5.2 Assessment Methodology

5.2.1 Population

A desk-based assessment using sources and guidelines referenced in 5.2.2 below was undertaken to examine relevant information pertaining to the population impact assessment. Information on population statistics, employment, and social data for the relevant District Electoral Divisions (DEDs) were obtained from the Central Statistics Office (CSO) for census years 2016 and 2022. Fáilte Ireland's EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects was also considered in this assessment. See Section 5.4 below.

The Population Study Area for this assessment mainly focuses on the (DEDs within which the Proposed Wind Farm site is within and adjacent to, namely Dunmore South, Clonberne, Carrrownagur, and Cloonkeen but it also refers to county and national statistics.

5.2.2 Human Health

This human health analysis section was assessed using guidelines set out in section 5.2.2 above.

The World Health Organisation's (WHO) defines health as:

> "*A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*".[4]

5.2.2.1 National Guidance

The EPA 2022 EIAR Guidelines advise that "*in an EIAR, the assessment of impacts on population and human health should refer to the assessments of those factors under which human health effects might occur, as addressed elsewhere in this EIAR e.g., under the environmental factors of air, water, soil etc.*" Environmental Impacts from the Proposed Project which may also have an impact on population and human health are discussed in this chapter but addressed in more detail in the following chapters: Chapter 8 Land, Soil and Geology, Chapter 9 Hydrology and Hydrogeology, Chapter 10 Air Quality, Chapter 11 Climate, Chapter 12 Noise and Vibration, Chapter 14 Landscape and Visual, Chapter 15 Material Assets (including Traffic and Transport).

As referenced in the Department of Housing, Planning and Local Government (2018) *Guidelines for Planning Authorities and An Bord Pleanála*, (taken from the European Commission's Environmental Impact Assessment of Projects: Guidance on the Preparation of the Environmental Impact Assessment Report (2017)), human health is, "*a very broad factor that would be highly project dependent.*" The report continues:

> '* *The notion of human health should be considered in the context of the other factors in Article 3(1) of the EIA Directive and thus environmentally related health issues (such as health effects caused by the release of toxic substances to the environment, health risks arising from major hazards associated with the Project, effects caused by changes in disease vectors caused by the Project, changes in living conditions, effects on vulnerable groups, exposure to traffic noise or air pollutants) are obvious aspects to study. In addition, these would concern the commissioning, operation, and decommissioning of a Project in relation to workers on the Project and surrounding population.*'

The EIAR Guidance (EPA, 2022) also states that "*while no specific guidance on the meaning of the term Human Health has been issued in the context of Directive 2014/52/EU, the same term was used in 3.3.6 the SEA Directive (2001/42/EC). The Commission's SEA Implementation Guidance states 'The notion of human health should be considered in the context of the other issues mentioned in paragraph (f)'*" of the Directive, where paragraph f lists environmental factors such as soils, water, landscape, air etc. The Guidelines state that this approach is '*consistent with the approach set out in the 2002 EPA Guidelines where health was considered through assessment of the environmental pathways through which it could be affected, such as air, water or soil*'. The EIAR Guidelines (EPA, 2022) note that the above approach follows the 2002 EPA guidelines already in place which details the following:

> *'The evaluation of effects on these pathways is carried out by reference to accepted standards (usually international) of safety in dose, exposure or risk. These standards are in turn based upon medical and scientific investigation of the direct effects on health of the individual substance, effect or risk. This practice of reliance upon limits, doses and thresholds for environmental pathways, such as air, water or soil, provides robust and reliable health protectors [protection criteria] for analysis relating to the environment'.*

5.2.2.2 IEMA Guidance 2017

The Institute for Environmental Management and Assessment (IEMA) published 'Health In Environmental Impact Assessment: A Primer for a Proportionate Assessment' in 2017 examining what a proportionate assessment of the impacts on health should be in Environmental Impact Assessments. The document states that Health Impact Assessment (HIA) and EIA are separate processes.

> *'HIA is defined as a combination of procedures, methods and tools that systematically judges the potential, and sometimes unintended, effects of a policy, plan, programme or project on both the health of a population and the distribution of those effects within the population. HIA identifies appropriate actions to manage those effects... [...] ... HIA can inform EIA practice in relation to population and human health but conducting a HIA will not necessarily meet the*

EIA population and human health requirement. By the same token, conducting an EIA will not automatically meet the requirements of a HIA.'

The Primer Assessment Report acknowledges that *'disproportionate burdens maybe placed on developers if HIA is applied as a proxy for the consideration of population and human health in every future UK EIA'.* The focus of EIA should be on predicting health and wellbeing outcomes, rather than focusing on changes in determinants of health e.g., expected changes in noise levels. Determining the significance of impacts on population and human health should include a professional judgement, scientific literature; consultation responses; comparison with baseline conditions; local health priorities; and national/international regulatory standards and guidelines. The primer report refers to the WHO 2014 which provides and overview of health in different types of assessment:

> *"The health sector, by crafting and promoting HIA, can be regarded as contributing to fragmentation among impact assessments. Health issues can, and need to, be included [in impact assessment] irrespective of levels of integration. At the same time, from a civic society perspective, it would be unacceptable for HIA to weaken other impact assessments. A prudent attitude suggests optimizing the coverage of health along all three avenues:*
>
> - *better consideration of health in existing impact assessments other than HIA;*
> - *dedicated HIA;*
> - *and integrated forms of impact assessment."*

As such, the WHO does not support a stand-alone HIA unless it could be demonstrated to be of advantage over an EIAR. Therefore, given that this human health assessment is part of the EIAR; there is no stand-alone HIA.

5.2.2.3 EIA Significance Matric for Human Health, IEMA Guidance 2022

The IEMA Working Group 2022 published *Determining Significance For Human Health In Environmental Impact Assessment* in response to gaps and inconsistencies across existing guidance documents as to how health is assessed in EIA, particularly with regard to significance. The aim of this report is to assist and streamline discussions for consultants producing the assessments and for the decision makers who are reviewing the assessments. The report states that an EIA must identify, describe and assess the direct and indirect significant effects in an appropriate manner of a proposed development on human health. It must include the information that may reasonably be required for reaching a reasoned conclusion on the significant effects, taking into account current knowledge and methods of assessment.

5.2.3 Shadow Flicker

5.2.3.1 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 5-1 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.

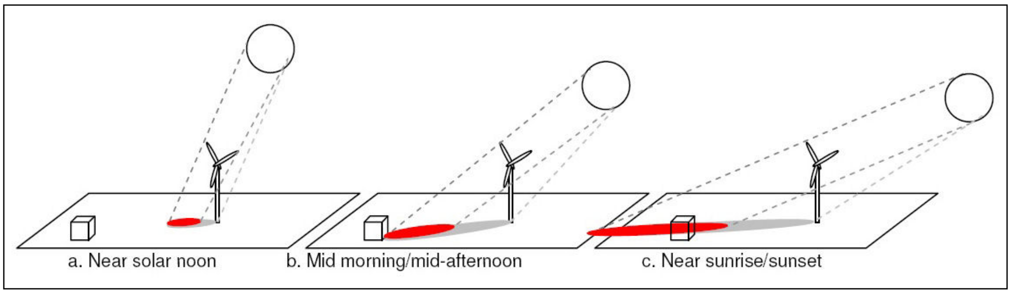


Figure 5-1 Shadow-Prone Area as Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, Dec 2008)

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 5-2 below.

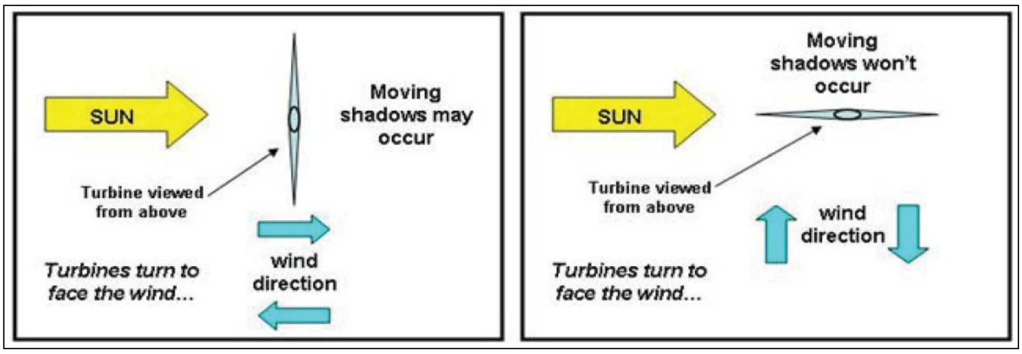


Figure 5-2 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC)

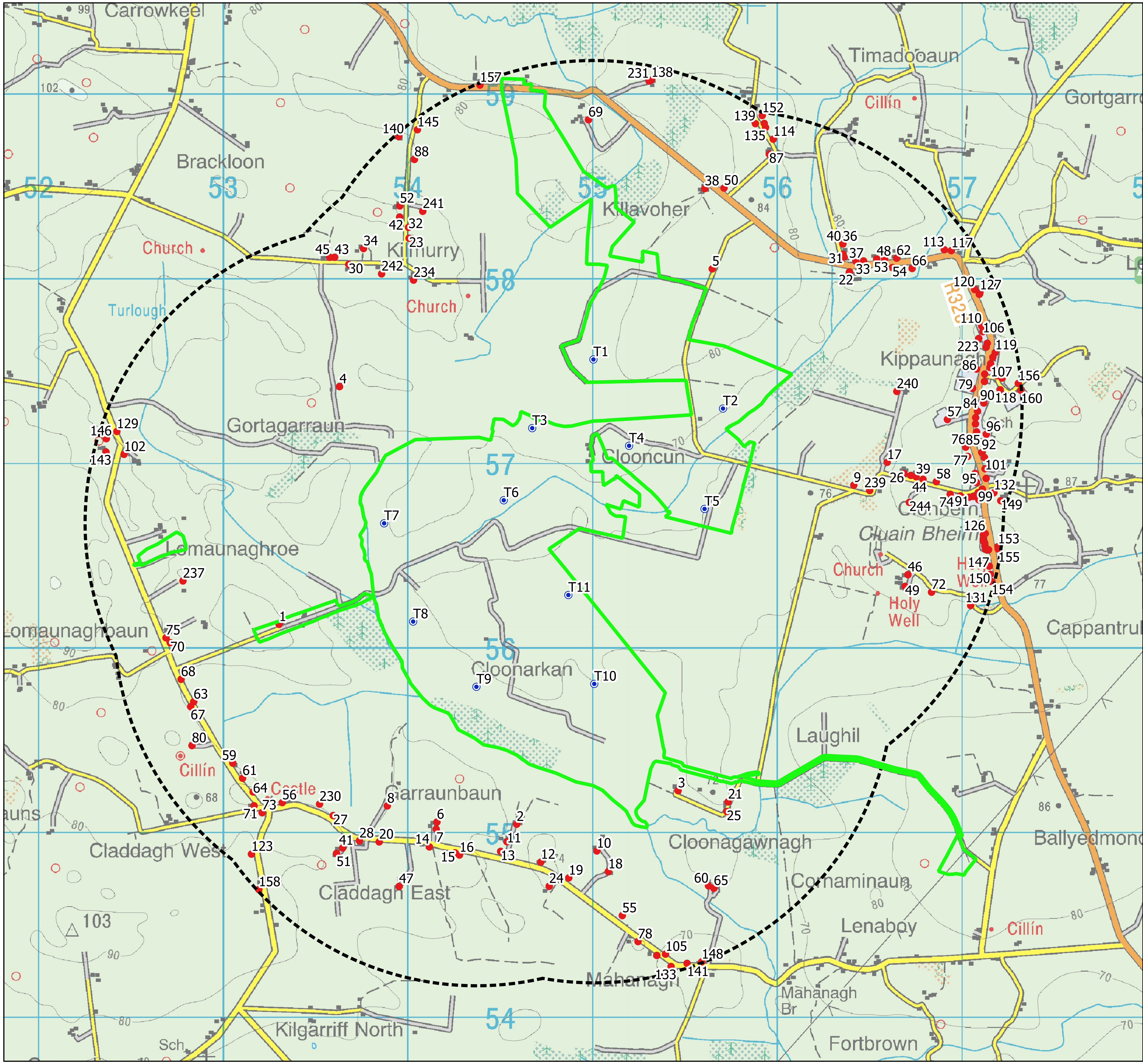
7. ***Rotation of turbine blades:***

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.

5.2.3.2 Guidance

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

The DoEHLG 2006 wind energy 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 occupied residential property is located approximately 726m from the nearest turbine location (See Figure 5-3)



Map Legend

EIAR Site Boundary

Sensitive Receptors (169 no. receptors)

Proposed Turbine Layout

Shadow Flicker Study Area 1.62km Buffer of Proposed Turbines (10 x 162m Rotor Diameter)

Drawing Title	
Shadow Flicker Study Area	
Project Title	
Clonberne WF	
Drawn By: JF	Checked By: OC
Project No.: 180740	Drawing No.: Fig. 5-3
Scale: 1:20,000	Date: 2024-06-26

MKO
Planning and Environmental Consultants
Tuam Road, Galway
Ireland, H91 VW84
+353 (0) 91 735611
email:info@mkoireland.ie
Website: www.mkoireland.ie

The DoEHLG 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 DoEHLG thresholds apply 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. assumed at 1.62 kilometres as a worst-case scenario) of the proposed turbines within the Proposed Project (as per IWEA guidelines, 2012). The DoEHLG Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The adopted 2006 DoEHLG guidelines are currently under review. The DoHPLG released the *'Draft Revised Wind Energy Development Guidelines'* in December 2019 for public consultation. The Draft 2019 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 2019 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).

The assessment herein is based on compliance with the current DoEHLG Guidelines limit (30 hours per year or 30 minutes per day). However, it should also be noted the Proposed Project can be brought in line with the requirements of the 2019 draft guidelines, should they be adopted while this application is in the planning system, through the implementation of the mitigation measures outlined in Section 5.10.5.2.9.

5.2.3.3 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 DoEHLG 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 site of the Proposed Project. 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 WindPRO or WindFarm (ReSoft) or WindFarmer (DNV.GL) or AWS OpenWind or WindPRO: Shadow. 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 WindPRO: Shadow - Version 4.0.531 has been used to predict the level of shadow flicker associated with the proposed wind farm development. WindPRO 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.

5.2.3.4 Turbine Dimensions

Planning permissions is being sought for a turbine of the following dimensions:

- Tip Height: 180 metres
- Hub Height: 99 metres
- Rotor Diameter: 162 metres

With the benefit of the mitigation measures outlined in Section 5.10.5.2.9, all turbines installed onsite will comply with the Guidelines, to ensure there is no shadow flicker occurrences in excess of 30 minutes per day or 30 hours per year at any property within the 1.62km shadow flicker study area as a result of the Proposed Wind Farm. This will be achieved through the use of turbine control software throughout the entire operational period of the Proposed Wind Farm. Any references to the turbine dimensions in this shadow flicker assessment should be considered in the context of the above.

Digital Terrain Modelling (DTM) was used to determine the approximate ground elevation at which the wind turbines and surrounding properties are located for the purposed of running the model. The use of DTM data ensures that realistic elevation variations between the turbines and properties is accounted for.

5.2.3.5 Shadow Flicker Study Area

At the outset of the Proposed Project, during the constraints mapping process detailed in Chapter 3 of this EIAR, all sensitive receptors within c.3km of the area suitable for siting wind turbines within the EIAR Site Boundary were identified and mapped. This included all occupied and unoccupied dwellings. In addition, 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.

The study area for the shadow flicker assessment is 10 times rotor diameter from each turbine as detailed in Section 5.2.3.2 above. The Guidelines note that, at distances greater than 10 times the rotor diameter of a proposed turbine, the potential for shadow flicker is very low, and therefore the shadow flicker study area is set at 1.62km from the proposed turbines. All inhabitable dwellings within 1.62km of the proposed turbines has been considered as part of the following shadow flicker assessment. A significant minimum separation distance of above 720m from any third-party dwelling has been achieved with the Proposed Project design, thus exceeding the necessary setback distance. There are 169 no. properties located within the shadow flicker study area as detailed above, of which 12 no. properties are in the ownership of landowners who form part of the Proposed Project. The shadow flicker study area and sensitive receptor locations are shown in Figure 5-3 above.

It is important to note that shadow flicker effects occur only in certain weather conditions when a turbine is located between the sun and the sensitive receptor location. Because of this, there will be many sensitive receptors located to the south of the turbines that will not experience any shadow flicker effects.

5.2.3.6 Assumptions and Limitations

Due to the latitude of Ireland and the UK, shadow flicker effects 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; the Guidelines). As such properties located outside of this potential shadow flicker zone will not be impacted. However, in this assessment, all 169 no. properties within 360 degrees of the Proposed Project within the Shadow Flicker Study Area were assessed for shadow flicker impact.

A precautionary approach has been taken in relation to the orientation of each individual properties in relation to the location of the proposed wind turbines through the use of a feature called 'greenhouse mode' within the WindPRO software. This feature assumes shadows can be seen from 360 degrees at a property as opposed to only through windows facing the wind turbines.

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 additional incidences or durations or shadow flicker over and above those predicted in this assessment can be countered by extending the mitigation strategies outlined in Section 5.10.5.2.9

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, referred to as the *'worst-case 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 the 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 24.44% of the daylight hours per year. This percentage is based on Met Éireann data recorded at Claremorris over the 30-year period from 1971 to 2000 (www.met.ie). The actual sunshine hours at the site of the Proposed Project and therefore the percentage of time shadow flicker could actually occur is 24.44% of daylight hours. Section 5.8 below lists the annual shadow flicker calculated for the property when the regional average of 24.44% sunshine is taken into account, to give a more accurate annual average shadow flicker prediction. Section 5.8 below also outlines whether a shadow flicker mitigation strategy is required for each property to mitigate potential exceedances of the daily and/or annual threshold figure..

5.3 Population

5.3.1 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 Galway County Development Plan 2022 – 2028, 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 2022, which is the most recent census for which a complete dataset is available, also the Census of Agriculture 2020 and from the CSO website (www.cso.ie). Census information is divided into State, Provincial, County, Major Town, and District Electoral Division (DED) level.

The Proposed Project is located approximately 14km kilometres to the northeast of Tuam and approximately 6.5 kilometres to the southeast of Dunmore Co. Galway. The Proposed Project is accessed via a proposed new access road off the R328 to the north of the site. The Proposed Project site itself is served by a number of existing forestry and agricultural roads and tracks. Please refer to Figure 1-4 of Chapter 1: Introduction, for the site location.

In order to assess the population in the vicinity of the Proposed Project, the Study Area for the population assessment in this EIAR has been defined in terms of the District Electoral Divisions (DEDs), where the Proposed Project is located, and where relevant, nearby DEDs which may be affected by the Proposed Project. The Proposed Project lies with the following DEDs: Dunmore South, Clonberne, Carrrownagur, and Cloonkeen, (See Figure 5-4). These DEDs will collectively be referred to hereafter as the Study Area for this chapter.

The Study Area has a population of 2,177 persons as of 2022 and comprises a total land area of 90.2 km^2 (Source: *CSO Census of Population 2022*). There are no properties located along the proposed grid connection route.

5.3.2 Population Trends

In the period between the 2016 and the 2022 Census, the population of Ireland increased by 8.1%. During this time, the population of County Galway (hereafter does not include Galway City as the Proposed Project site is located in the administrative area of Galway County Council) grew by 7.8% to 193,323. Other population statistics for the State, County Galway and the Study Area have been obtained from the Central Statistics Office (CSO) and are presented in Table 5-1.

Table 5-1 Population 2016-2022 (Source: CSO)

Area	Population Change		% Population Change
	2016	2022	2016-2022
State	4,761,865	5,149,139	8.1%
County Galway	179,390	193,323	7.8%
Study Area	2,102	2,177	3.6

The data presented in Table 5-1 shows that the population of the Study Area increased by 3.6% between 2016 and 2022. There is a smaller increase in population for the Study Area in comparison to population trends of County Galway. When the population data is examined in closer detail, it shows that the rate of population increase within the Study Area is unevenly spread through the District

Electoral Divisions (DEDs). Carrownagur DED is the only division to have shown a decrease in population, experiencing a -8.16% decreased in population while the other DEDs experienced an increase in population.

Dunmore South experienced an increase of 6.45%, Clonberne experienced an increase of 6.88% and Cloonkeen experienced an increase of 6.94%. The highest population (2022) was recorded in Dunmore South with 891 persons. The population for Carrownagur was 405, while the population for Clonberne was 388, and Cloonkeen was 493.

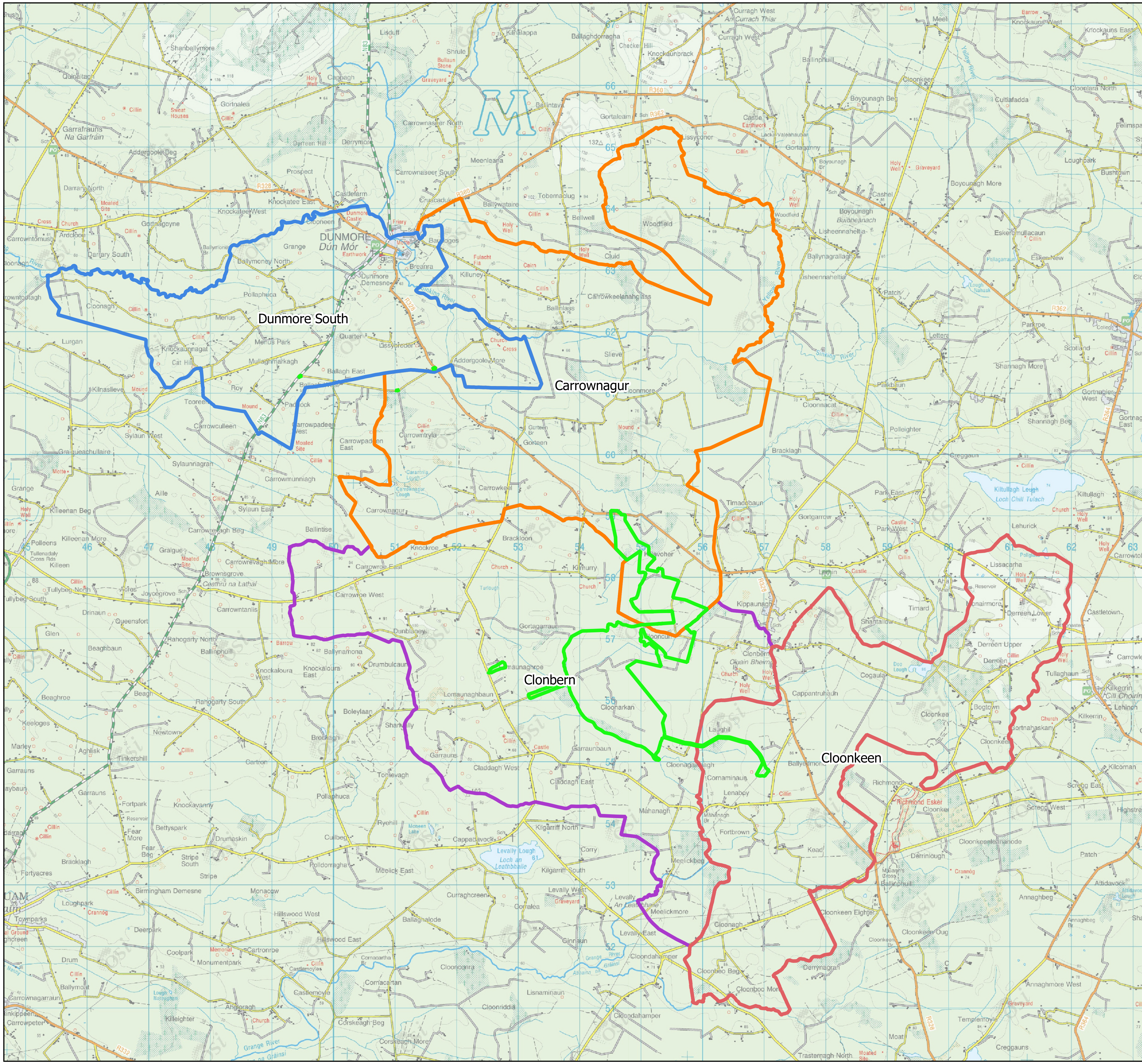
5.3.3 Population Density

The population densities recorded within the State, County Galway, and the Study Area during the 2016 and 2022 Census are shown in Table 5-2.

Table 5-2 Population Density in 2016 and 2022 (Source: CSO)

Area	Population Density (Persons per square kilometre)	
	2016	2022
State	67.76	73.27
County Galway	29.17	31.44
Study Area	23.30	24.14

The population density of the Study Area recorded during the 2022 Census was 24.14 persons per km^2. This figure is significantly lower than the national population density of 73.27 persons per km^2 and the county population density of 31.44 persons per km^2. These findings indicate that the study area has a low population density.



Map Legend

- EIAR Site Boundary

Population Study Area (District Electoral Divisions)

- Carrownagur
- Clonbern
- Cloonkeen
- Dunmore South

N

Drawing Title	
Clonberne WF - Population Study Area	
Project Title	
Clonberne Wind Farm Development	
Drawn By	Checked By
JF	OC
Project No.	Drawing No.
180740	Fig. 5-4
Scale	Date
1:60,000	2023-12-04

MKO
Planning and Environmental Consultants
Tuam Road, Galway
Ireland, H91 VW84
+353 (0) 91 735611
email:info@mkoireland.ie
Website: www.mkoireland.ie

5.3.4 Household Statistics

The number of households and average household size recorded within the State, County Galway, and the Study Area during the 2016 and 2022 Censuses are shown in Table 5-3.

Table 5-3 Number of Household and Average Household Size 2016 – 2022 (Source: CSO)

Area	2016		2022	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
State	1,702,289	2.8	1,841,152	2.8
County Galway	63,040	2.9	68,021	2.8
Study Area	762	2.8	771	2.8

In general, the figures in Table 5-3 show that the number of households within the State, County Galway and the Study Area has increased from 2016 to 2022. The average size of the household has remained the same from 2016 to 2022 within the State and the Study Area. County Galway experienced a slight increase in the average size of households in the period 2016 – 2022.

5.3.5 Age Structure

Table 5-4 presents the population percentages of the State, County Galway and Study Area within different age groups as defined by the Central Statistics Office during the 2022 Census. This data is also displayed in Figure 5-5.

Table 5-4 Population per Age Category in 2022 (Source: CSO)

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
State	19.7%	12.5%	27.6%	25.1%	15.1%
County Galway	20.9%	11.6%	24.1%	26.7%	16.6%
Study Area	18.6%	12.4%	19.1%	26.5%	23.5%

The proportion of the Study Area population is broadly similar to those recorded at national and county level for most categories. For the Study Area, the highest population percentage occurs within the 45-64 age category.

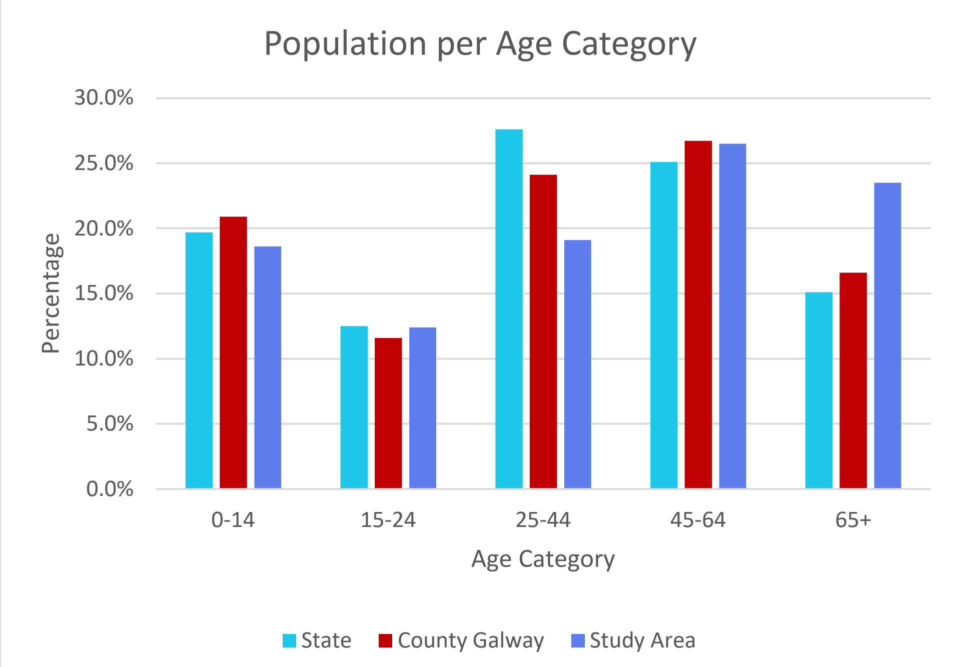


Figure 5-5 Population per Age Category in 2022 (Source: CSO)

5.3.6 Employment and Economic Activity

5.3.6.1 Economic Status of the 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 2022, there were 2,531,099 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 2022 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 2022 (Source: CSO)

Status		State	County Galway	Study Area
% of population aged 15+ who are in the labour force		61.2%	60.6%	55.8%
% of which are:	At work	91.7%	92.7%	93.2%
	First time job seeker	1.4%	1.1%	1.7%
	Unemployed	6.9%	6.2%	5.1%
% of population aged 15+ who are not in the labour force		38.8%	39.4%	44.2%
% of which are:	Student	28.6%	27.7%	23.9%
	Home duties	16.9%	16.8%	14.5%

Status		State	County Galway	Study Area
	Retired	40.9%	42.9%	53.3%
	Unable to work	11.8%	10.8%	6.5%
	Other	1.7%	1.7%	1.8%

Overall, the principal economic status of those living in the Study Area is broadly similar to that recorded at State and County level. During the 2022 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 lower within the study area with 55.8% in the labour force. Of those who were not in the labour force during the 2022 Census, the highest percentage of the Study Area population were 'Retired' individuals, similar to State and County populations.

5.3.6.2 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 5-6 shows the percentages of those employed in each socio-economic group in the State, County Galway, and the Study Area during 2022.

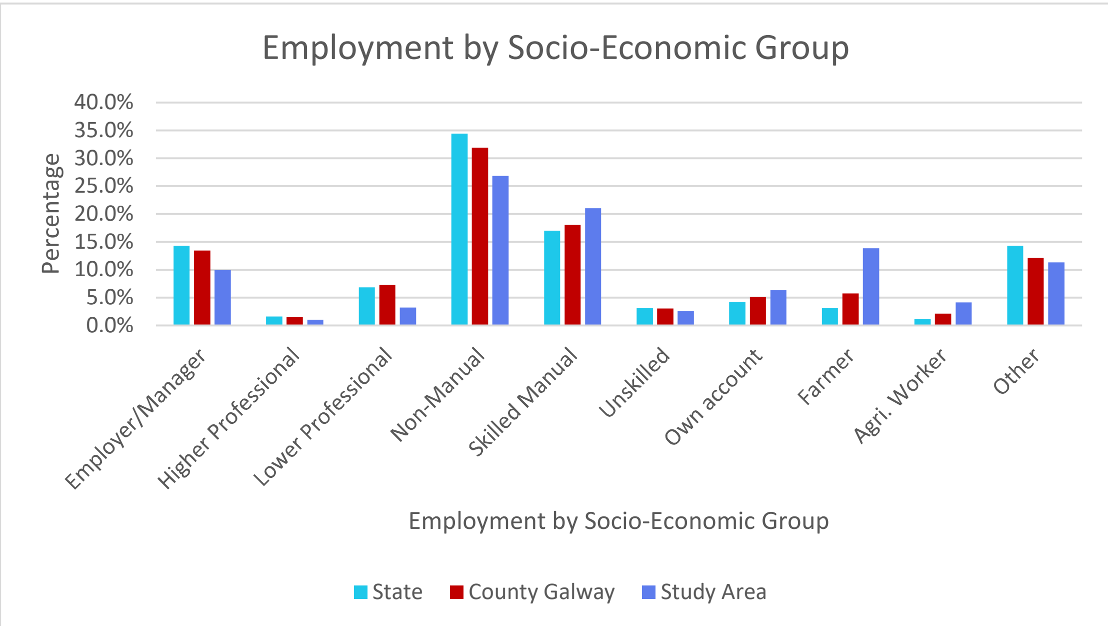


Figure 5-6 Employment by Socio-Economic Group in 2022 (Source: CSO).

The highest level of employment within the Study Area was recorded in the Non-Manual category. The levels of employment within the Employer/Manager, Higher Professional, Lower Professional, Non-manual, Un-skilled, and Other categories in the Study Area were lower than those recorded for the State and County Galway, while those recorded within the Skilled Manual, Farmer, Own Account and Agricultural Worker categories were higher than those recorded for the County and the State.

The CSO employment figures grouped by socio-economic status includes the entire population for the 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.

5.3.6.3 Employment and Investment Potential in the Irish Wind Energy Industry

5.3.6.3.1 *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

5.3.6.3.2 *Energy Targets*

The Climate Action Plan 2024 (CAP) was published in 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. It is envisaged that wind energy will provide the largest source of renewable energy in achieving this target. The plan also includes a target of at least 9GW of onshore wind capacity and 5 GW of offshore wind energy being produced by 2030.

5.3.6.3.3 *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 wind farms, 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.

5.3.6.3.4 Economic Value

The Deloitte report 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 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 Project will, if consent is granted, contribute to the economic value that renewable energy brings to the country.

5.3.7 Land-Use

As previously noted, the Proposed Project is currently used for coniferous forestry, agriculture and turf cutting. Land-use in the wider landscape comprises a mix of agriculture, low density housing, wind farms and commercial forestry.

The total area of farmland within the four DEDs around the wind farm site measures approximately 8,631.9 hectares, comprising approximately 96% of the Study Area, according to the CSO Census of Agriculture 2020. There are 234 farms located within the four DEDs, with an average farm size of 27.75 hectares. This is slightly larger than the 25.8 hectare average farm size for Co. Galway.

Within the Study Area, farming employs 374 people, and the majority of farms are family-owned and run. Table 5-6 shows the breakdown of farmed lands within the Study Area. Pasture accounts for the largest proportion of farmland, which is followed by silage, grazing and hay. There are no lands farmed for potatoes, crops or cereal within the study area.

Table 5-6 Farm Size and Classification within the Study Area in 2020 (Source: CSO)

DED	No of holdings	Average size (hectares)	Median age of holder	Livestock units	Total Cereals (hectares)	Average farmed (hectares)
Dunmore South	47	21.7	59	1428	0	1021.6
Clonberne	65	31.5	55	2712	0	2046
Carrownagur	69	31.2	60	2683	83.4	4154
Cloonkeen	53	26.6	51	2027	0	1410.3
Total	234	27.75 (Average)	56.25 (Average)	8850	83.4	2157.9 (Average)
Size of 4 DEDs			9,000 hectares			
Total Area Farmed within 4 DEDs			8,631.9 hectares			
Farmland as % of DEDs			96%			

5.3.8 Services

The Proposed Project is located approximately 14km kilometres to the northeast of Tuam and approximately 6.5 kilometres to the southeast of Dunmore Co. Galway. The Proposed Project is accessed via an existing access track off the R328 to the north of the site. The site itself is served by a number of existing forestry and agricultural roads and tracks. The main services for the Study Area are located within Dunmore, which is classified as a service town. Additionally, the nearest county town is Tuam, where larger scale retail and services are available.

5.3.8.1 Education

The nearest school to the Proposed Project is Clonberne National School, located approximately 1.08km to the east of the Proposed Project site boundary at its closest point. Lavally National School is located approximately 2.55km to the southwest of the Proposed Project site.

The closest secondary school is Dunmore Community School located approximately 5.4km northwest of the Proposed Project site boundary, and St. Jarlath's College, Tuam is located approximately 9.6km southwest of the Proposed Project site boundary.

The closest third-level institutes to the site are, University of Galway and Atlantic Technological University - Galway, both of which are located 38km and 36.5km southwest of the Proposed Project respectively.

5.3.8.2 Access and Public Transport

The Proposed Project is accessed via an existing access track off the R328 to the north of the site. The 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 Clonberne approximately 1.28km east of the site.

The nearest train station to the Proposed Project site is the Ballyhaunis train station which is 23.6km north of the site providing connections with Dublin Heuston – Ballina and Dublin Heuston - Westport.

5.3.8.3 Amenities and Community Facilities

Most of the amenities and community facilities, including GAA and other sports clubs, youth clubs, recreational areas, retail, and personal services are available in the nearby town of Dunmore and the village of Clonberne. Larger scale services are available in the larger county town of Tuam.

The varied environment of this area of County Galway provides many opportunities for swimming, fishing, walking, cycling, and playing golf. There are a number of lakes to the east and west of the Proposed Project, the closest being Kiltullagh Lough and Levally Lough, which is located 5km and 2.2km east and southeast of the Proposed Project. The Richmond Esker walking route is approximately 2.9km southeast of the Proposed Project at its closest point and the Suck Valley Way is 16.6km to the east of the Proposed Project site.

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

5.4 Tourism

5.4.1 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 €9.1 billion revenue recorded in 2018. Overseas tourist visits to Ireland in 2018 grew by 6.5% to 9.6 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 2018 (‘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	€720m	1,432
West	€653m	1,943
Border	€259m	768
Total	€5,173m	15,021

The Proposed Project is located within the West Region. According to '*Regional tourism performance in 2019'* (Fáilte Ireland, March 2021) the West Region which comprises Counties Galway, Mayo and Roscommon which benefited from approximately 13% of the total number of overseas tourists to the country and approximately 13% of the associated tourism income generated in Ireland in 2018.

Table 5-8 presents the breakdown of overseas tourist numbers and revenue to the West region during 2017 ('*2017 Topline Tourism Performance by Region,* Fáilte Ireland, August 2018). As can be observed in Table 5-8, County Galway had the highest number of overseas tourists visiting the Region during 2017 and had tourism revenue at €589 million.

Table 5-8 Overseas Tourism to West Region during 2017 (Source: Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
Galway	589	1,673
Mayo	78	324
Roscommon	27	54

5.4.1.1 Tourism Barometer: Strategic Research and Insight September 2023

Failte Ireland conducted a research survey in September 2023 aimed at the hotel and food service industry which compared visitor volumes in 2023 to date with 2022 figures in order to gauge the health of the industry, to predict expected volumes for the rest of the year and to shed light on the positives and areas of concern the industry is currently facing. The results are as follows:

- Better year so far in terms of visitor levels
- About half (52%) of businesses have had more visitors to date this year compared to 2022; 27% have had fewer.
- The highest proportions reporting to be up on last year are found among Dublin businesses (65%), inbound tour operators & DMCs (77%), attractions (66%) and hotels (68%).
- The return of overseas visitors is behind the good performance, especially the North American market, whereby 59% of operators report being up year to date, compared to only 22% reporting the market to be down.
- Increased visitor levels are not necessarily resulting in improved profitability.
- 61% of activity providers have had fewer visitors this year, compared to 31% reporting being up.
- Hotels remain the best performing accommodation sector where 68% of hotels have had more visitors to date this year vs 12% down.
- The food & drink sector is down, as are activity providers, where 61% report being down vs 31% being up.
- Rising costs (to businesses or consumers) dominate concerns again.
- Operating costs to the business (energy or otherwise) form the top two concerns in nearly every sector and in all regions.
- In spite of cost pressures, 37% cite 'investment in the business' and 37% cite 'own marketing' as a reason to be positive.

In spite of growing costs, the industry is slowly recovering with a majority of businesses predicting that the remainder of 2023 will see an increase in domestic and overseas visitors in comparison to 2022 visitor figures.

5.4.2 Tourist Attractions

There are no key identified tourist attractions pertaining specifically to the site of the Proposed Project itself. The nearest tourist attraction to the Proposed Project site is Dunmore Castle and Dunmore Abbey, which are located approximately 6.6km and 5.5km respectively northwest of the site. Tourist attractions within the Abbey includes a medieval Augustinian friary and National Monument.

The nearest designated walking routes and nature Reserve is the Richmond Esker Nature Reserve, located approximately 2.9 kilometres to the southeast of the Proposed Project site at its nearest point.

County Galway has a wide range of nationally significant tourism assets which include the following:

- The Connemara National Park- a walking, cycling, sightseeing, fishing destination and other outdoor activities.
- Kylemore Abbey- A Gothic Church with Victorian Walled Gardens, Craft Shop, Pottery studio, Restaurant and Tea Rooms as well as the Lake and Woodland walks.
- The River Corrib and Lough Corrib – important recreational amenity and fisheries areas.
- Mountain ranges including: the Twelve Bens, and Maumturk Mountains– important centres for walking, cycling and adventure related activities.
- The Coastline along the Wild Atlantic Way– Scenic coastline and peninsulas and marine related activities including some fine blue flag beaches.
- The Gaeltacht areas which are of significant cultural heritage value and frequently visited by tourists.
- Galway City Museum located in Galway City's famous Spanish Arch has significant cultural heritage and Folklore
- Salthill Promenade Galway City- Blue Flag Beaches and outdoor activities
- The West Galway Peninsula of Renvyle – with its unique visual amenity and landscape character offer potential for walking and cycling and other outdoor activities.
- Aran and Inishbofin Islands and all the other uninhabited islands along the County's coast.
- Galway's has rich fertile agricultural land and many bogs and peatlands with a higher than national average land mass of forest and woodland area.
- The Towns and Villages of County Galway where there is significant potential for heritage led tourism.

The Study Area is not within any of the strategic tourism areas identified in the CDP nor does it impact on any of the sites of existing tourism attractions.

The potential for visual effects arising from the Proposed Project on the wider landscape and scenic roads is assessed in Chapter 14 of this EIAR.

5.4.3 Tourist Attitudes to Wind Farms

5.4.3.1 Scottish Tourism Survey 2021

BiGGAR Economics undertook an independent study in 2021, entitled '*Wind Farms & Tourism Trends in Scotland: Evidence from 44 Wind Farms*' to understand the relationship, if any, that exists between the development of onshore wind 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.

Since 2009, the onshore wind sector has expanded considerably in Scotland. Employment in tourism-related sectors in Scotland also grew during the years since 2009, an overall increase of 20%.

Analysis of the rates of change in the number of onshore wind turbines and in tourism-related employment in local authority areas, found that there is no correlation between the two factors. This applies to whether the analysis covers the decade between 2009 – 2019, or the more recent 2015 to 2019 period.

The research also analysed trends in tourism employment within the immediate vicinity of wind farm developments. This included 16 no. wind farms with a capacity of at least 10MW that became operational between 2015 and 2019. Analysis of trends in tourism employment in the locality of these wind farms (study areas were based on a 15km radius) found that 11 of these 16 areas had experienced more growth in tourism employment than for Scotland as a whole. For 12 of the 16 wind farms, trends in tourism employment in the locality had outperformed the local authority area in which they were based.

The research also re-examined 28 wind farms constructed between 2009 and 2015 that had been analysed in a previous study published in 2017, finding that the localities in which they were based had outperformed Scotland and their local authority areas in the majority of cases. Moreover, the analysis, found that in the seven areas which had underperformed their local authority areas in the 2017 study, four had done better than their local authorities in the 2015 to 2019 period.

This research analysed trends in tourism employment in the localities of 44 no. wind farms developed in recent years, providing a substantial evidence base. The study found no relationship between tourism employment and wind farm development, at the level of the Scottish economy, across local authority areas, not in the locality of the wind farm sites.

5.4.3.2 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 landscape 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 Project 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 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 and 5.5 below.

5.5 Public Perception of Wind Energy

5.5.1 Sustainable Energy Ireland Survey 2003 and 2017

5.5.1.1 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.

5.5.1.2 SEAI 2003 Survey 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.

5.5.1.3 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.

5.5.1.4 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."*

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

5.5.2.1 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.

5.5.2.2 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.

5.5.2.3 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.

5.5.2.4 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.

5.5.3 Irish Wind Energy Association (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 for wind energy in recent years.

5.6 Health Effects of Wind Farms

5.6.1 Introduction

The 2022 Census of Ireland as carried out by the Central Statistics Office provides the general health conditions of the population of the DEDs which make up the Population Study Area for the Proposed Project. The vast majority of those within the Population Study Area marked their general health as being 'very good' across all DEDs. It is not anticipated that the general health of the population of the Population Study Area be altered due to the Proposed Project

5.6.2 Health Effect 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 effects 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 effects 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 effects 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 5-1 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 Wind Energy Development Guidelines (2006), 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 behavioural 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'.

5.6.3 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*' and the '*Draft Revised Wind Energy Development Guidelines'* (Department of Housing, Planning and Local Government (DoHPLG), December 2019) (referred to as the Draft 2019 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 adopted 2006 Guidelines and the Draft 2019 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 site of the Proposed Project 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.

The International Electrotechnical Commission (IEC) is a global organization that develops and publishes international standards for electrical and electronic technologies. One of the areas where the IEC has played a significant role is in the standardization of wind turbines. The IEC has developed a series of standards specifically for wind turbines, which cover various aspects such as design, testing, and performance. The IEC 61400-1 "Wind turbines – Part 1: Design requirements" provides guidelines and requirements for the design of wind turbines, including considerations for environmental conditions[3]. This standard covers a range of conditions that wind turbines may encounter, including those related to icing. It sets out criteria for the structural design, safety systems, and other aspects to ensure that wind turbines can operate safely and effectively in various environments.[4] As such, the Proposed Project, and like those across Ireland and in many other countries, is generally designed and assessed according to international standards, with the IEC standards being frequently employed in this process. Additionally, regulatory entities and energy authorities at the national level, such as the SEAI, often refer to and align their guidance with internationally recognized standards, including those established by the IEC, such as IEC 61400-1 for wind turbines. In conclusion, the Proposed Project adheres to the criteria specified in both the IEC 61400-1 design requirements and the SEAI guidance.

Turbine blades are manufactured of fiberglass and wood which will prevent any likelihood of an increase in lightning strikes within the site of the Proposed Project 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.

5.6.4 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, 2014) provides further practical information on EMF and is included as Appendix 5-2 of this EIAR.

Further details on the potential effects of electromagnetic interference to telecommunications and aviation are presented in Chapter 15 Material Assets.

5.6.5 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 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 Quality, Chapter 11: Climate, Chapter 12: Noise and Vibration and Chapter 15: Material Assets (Traffic and Transport) provide an assessment of the effects of the Proposed Project on these areas of consideration. There is the potential for negative effects on human health during the wind farm 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 Project is imperceptible.

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

As set out in Chapter 9, potential health effects are associated with negative effects 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 Project.

The preliminary Flood Risk Assessment has also shown that the risk of the proposed wind farm contributing to downstream flooding is imperceptible.

The proposed project is for the development of a renewable energy project, a wind farm, capable of offsetting carbon emissions associated with the burning of fossil fuels. During the operational stage the wind farm will have a long term, significant, positive effect on air quality as set out in Chapter 10 and Chapter 11 which will contribute to positive effects on human health.

5.6.6 Vulnerability of the Project to Natural Disasters and Major Accidents

As outlined in Section 5.6.5 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 Project site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to peat instability, flooding and fire. The risk of peat instability is addressed in Chapter 8: Soils and Geology and the Geotechnical Peat Stability Assessment Report included in Appendix 8-1. The findings of the geotechnical assessment showed that the Proposed Project has an acceptable margin of safety, is considered to be at low risk of peat failure and is suitable for wind farm development. Overall, the peat characteristics on the Proposed Project site are similar to that encountered on many developed wind farm sites. Flooding is addressed in Chapter 9: Hydrology and Hydrogeology. It is considered that the risk of significant fire occurring, affecting the wind farm and causing the wind farm 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 wind farm 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 effects on human health. The issue of turbine safety is addressed in Section 5.6.3.

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 wind farm 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.

5.7 Property Values

There is currently only one study within the context of Ireland detailing the effect of wind farms on property values. This section provides a summary of this paper by the Centre for Economic Research on Inclusivity and Sustainable (CERIS), as well as summaries on the largest and most recent studies from the United States and Scotland.

In 2023 CERIS published a working paper entitled *'Wind Turbines and House Prices Along the West of Ireland: A Hedonic Pricing Approach'*.[33] This paper looked at wind turbine developments in Donegal, Leitrim, Sligo, Mayo, Galway, Kerry and Cork and associated property values. This working paper utilised satellite imagery to identify individual turbines and sourced its housing data from www.daft.ie; while the published price on Daft is not equivalent to the final agreed sale price, it was assumed that the listing and transaction prices are correlated. The findings of this research revealed a potential decrease in property values of -14.7% within a 0-1km radius of a wind turbine. However, the sample size of only 225 houses within this range does not adequately represent the broader landscape of Irish rural housing and the distribution of wind turbines. The author states that there are 'no significant reduction in house prices beyond 1km' and that the effects seen within the 1km band were not persistent and diminished over the operational lifetime of the turbines.

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 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. The findings of the study were produced in a report titled '*The Effect of Wind Farms on House Prices'* and 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 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 5-3 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.

In September 2023, the Energy Policy Journal published '*Commercial wind turbines and residential home values: new evidence from the universe of land-based wind projects in the United States.*'[34] This study targeted urban counties in the United Stated with populations over 250,000 persons, and found that on average, after a commercial wind energy project is announced, houses located within 1mile of a proposed wind energy project experience a decrease in value of 11% relative to homes located within 3-5miles of the proposed wind energy project. The decline in property values was found to recover post construction with property value impacts becoming relatively small (~2%) and statistically insignificant 9 years or more after project announcement (roughly 5 years after operation begins). This suggests that the housing market is reacting negatively to the expectation of likely impacts (after announcement) and the heightened activity during construction, but after operation begins, those negative perceptions and related home price impacts appear to fade.

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 potential to impact property values in local areas; however, it is important to note that this impact is proven to reduce throughout the operational phase of a wind farm.

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.

5.8 Shadow Flicker

5.8.1 Shadow Flicker Assessment Results

5.8.1.1 Daily and Annual Shadow Flicker

The WindPRO 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 worst-case 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 24.4% 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 considered in the context of the existing DoEHLG Wind Energy Guidelines recommendation of committing to less than 30 minutes of shadow flicker per day or less than 30 hours per year. As detailed in Section 5.1 there are no sensitive receptors less than 720 metres of the proposed turbine locations. However, for the purposes of this assessment, the predicted shadow flicker levels have been modelled for all receptors within 1,620 metres (10 times rotor diameter of 162m) of the proposed turbine locations.

A total of 169 No. receptors have been modelled as part of the shadow flicker assessment, the results of which are presented in Table 5-9.

Table 5-9 Maximum Potential Daily & Annual Shadow Flicker – Proposed Clonberne Wind Farm, Co. Galway

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	553264	756150	Dwelling	726	T08	00:59:00	75:37:00	18:29:03	T09, T08	Yes	No
2	554551	755067	Dwelling	776	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
3	555425	755249	Dwelling	735	T10	00:32:00	25:11:00	06:09:21	T09	Yes	No
4	553591	757438	Dwelling	779	T07	00:35:00	60:33:00	14:48:04	T06, T03, T07	Yes	No
5	555610	758076	Dwelling	759	T02	00:48:00	46:55:00	11:28:07	T01, T03	Yes	No
6	554119	755079	Dwelling	763	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
7	554115	755040	Dwelling	802	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
8	553850	755166	Dwelling	806	T09	00:31:00	29:24:00	07:11:12	T10	Yes	No
9	556377	756904	Dwelling	819	T05	00:49:00	99:01:00	24:12:15	T05, T02	Yes	No
10	554985	754922	Dwelling	906	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
11	554498	754972	Dwelling	856	T09	00:00:00	00:00:00	00:00:00	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)
12	554682	754862	Dwelling	1008	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
13	554464	754920	Dwelling	901	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
14	554078	754944	Dwelling	904	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
15	554217	754912	Dwelling	907	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
16	554241	754900	Dwelling	916	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
17	556558	757028	Dwelling	936	T02	00:41:00	53:36:00	13:06:08	T05, T02	Yes	No
18	555047	754810	Dwelling	1020	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
19	554833	754776	Dwelling	1060	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
20	553806	754971	Dwelling	992	T09	00:15:00	07:39:00	01:52:12	N/A	No	No
21	555696	755188	Dwelling	967	T10	00:24:00	10:40:00	02:36:27	N/A	No	No
22	556354	758060	Dwelling	1010	T02	00:50:00	60:53:00	14:52:57	T02, T04	Yes	No
23	553968	758242	Dwelling	1195	T01	00:31:00	25:37:00	06:15:43	T01	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)
24	554727	754731	Dwelling	1123	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
25	555689	755136	Dwelling	997	T10	00:24:00	11:34:00	02:49:39	N/A	No	No
26	556649	756967	Dwelling	1042	T02	00:36:00	42:53:00	10:28:57	T05, T02	Yes	No
27	553557	755114	Dwelling	1043	T09	00:23:00	10:59:00	02:41:05	N/A	No	No
28	553699	754977	Dwelling	1048	T09	00:24:00	16:07:00	03:56:23	N/A	No	No
29	556324	758140	Dwelling	1051	T02	00:45:00	58:09:00	14:12:52	T02	Yes	No
30	553641	758100	Dwelling	1332	T03	00:28:00	21:39:00	05:17:32	N/A	No	No
31	556319	758155	Dwelling	1059	T02	00:44:00	55:41:00	13:36:41	T02	Yes	No
32	553965	758301	Dwelling	1231	T01	00:30:00	17:20:00	04:14:13	T01	No	No
33	556388	758118	Dwelling	1075	T02	00:45:00	54:51:00	13:24:28	T02	Yes	No
34	553721	758186	Dwelling	1335	T03	00:29:00	29:46:00	07:16:35	N/A	No	No
35	556686	756957	Dwelling	1080	T02	00:35:00	39:06:00	09:33:28	T05, T02	Yes	No
36	556318	758211	Dwelling	1103	T02	00:40:00	46:38:00	11:23:57	T02, T04	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)
37	556430	758119	Dwelling	1105	T02	00:45:00	49:35:00	12:07:13	T02, T04	Yes	No
38	555570	758511	Dwelling	1105	T01	00:37:00	23:04:00	05:38:19	T01, T03	Yes	No
39	556714	756950	Dwelling	1109	T02	00:34:00	36:29:00	08:55:05	T02	Yes	No
40	556308	758233	Dwelling	1116	T02	00:38:00	43:22:00	10:36:03	T02, T04	Yes	No
41	553608	754938	Dwelling	1135	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
42	553917	758357	Dwelling	1303	T01	00:29:00	12:45:00	03:07:00	N/A	No	No
43	553565	758139	Dwelling	1415	T03	00:26:00	19:15:00	04:42:20	N/A	No	No
44	556752	756936	Dwelling	1149	T02	00:32:00	32:55:00	08:02:47	T02	Yes	No
45	553538	758139	Dwelling	1436	T03	00:25:00	20:29:00	05:00:25	N/A	No	No
46	556670	756419	Dwelling	1158	T05	00:32:00	17:04:00	04:10:19	T05	Yes	No
47	553914	754730	Dwelling	1160	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
48	556501	758130	Dwelling	1162	T02	00:34:00	26:56:00	06:35:01	T02	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)
49	556655	756356	Dwelling	1165	T05	00:33:00	19:02:00	04:39:09	T05	Yes	No
50	555674	758514	Dwelling	1168	T01	00:35:00	28:56:00	07:04:21	T01	Yes	No
51	553575	754909	Dwelling	1179	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
52	553918	758417	Dwelling	1339	T01	00:28:00	12:26:00	03:02:21	N/A	No	No
53	556544	758129	Dwelling	1193	T02	00:33:00	22:02:00	05:23:09	T02	Yes	No
54	556586	758083	Dwelling	1194	T02	00:32:00	18:43:00	04:34:31	T02	Yes	No
55	555123	754572	Dwelling	1265	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
56	553281	755184	Dwelling	1211	T08	00:33:00	31:37:00	07:43:43	T09	Yes	No
57	556884	757260	Dwelling	1217	T02	00:29:00	17:40:00	04:19:07	N/A	No	No
58	556824	756923	Dwelling	1222	T02	00:29:00	23:18:00	05:41:44	N/A	No	No
59	553013	755398	Dwelling	1242	T08	00:26:00	14:27:00	03:31:56	N/A	No	No
60	555590	754733	Dwelling	1257	T10	00:00:00	00:00:00	00:00:00	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)
61	553066	755316	Dwelling	1255	T08	00:27:00	13:17:00	03:14:49	N/A	No	No
62	556609	758134	Dwelling	1245	T02	00:31:00	17:36:00	04:18:08	T02	Yes	No
63	552801	755730	Dwelling	1266	T08	00:30:00	22:17:00	05:26:49	T08	No	No
64	553123	755242	Dwelling	1267	T08	00:29:00	17:28:00	04:16:11	N/A	No	No
65	555619	754720	Dwelling	1283	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
66	556693	758078	Dwelling	1275	T02	00:30:00	13:56:00	03:24:21	T02	No	No
67	552785	755704	Dwelling	1290	T08	00:29:00	21:31:00	05:15:35	N/A	No	No
68	552733	755852	Dwelling	1296	T08	00:28:00	21:48:00	05:19:44	N/A	No	No
69	554940	758884	Dwelling	1299	T01	00:00:00	00:00:00	00:00:00	N/A	No	No
70	552674	756051	Dwelling	1321	T08	00:28:00	35:06:00	08:34:48	N/A	No	No
71	553128	755167	Dwelling	1319	T08	00:28:00	22:37:00	05:31:43	N/A	No	No
72	556798	756324	Dwelling	1310	T05	00:28:00	13:16:00	03:14:35	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)
73	553172	755129	Dwelling	1320	T08	00:29:00	27:34:00	06:44:19	N/A	No	No
74	556899	756855	Dwelling	1315	T02	00:27:00	19:45:00	04:49:40	N/A	No	No
75	552651	756077	Dwelling	1335	T07	00:28:00	27:48:00	06:47:44	N/A	No	No
76	556983	757110	Dwelling	1331	T02	00:24:00	14:11:00	03:28:01	N/A	No	No
77	556994	757060	Dwelling	1351	T02	00:25:00	13:59:00	03:25:05	N/A	No	No
78	555208	754431	Dwelling	1416	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
79	557021	757429	Dwelling	1357	T02	00:23:00	11:40:00	02:51:07	N/A	No	No
80	552792	755493	Dwelling	1374	T08	00:28:00	31:23:00	07:40:17	N/A	No	No
81	557037	757270	Dwelling	1370	T02	00:23:00	11:45:00	02:52:20	N/A	No	No
82	556954	756846	Dwelling	1370	T02	00:25:00	17:16:00	04:13:15	N/A	No	No
83	557036	757236	Dwelling	1370	T02	00:23:00	11:52:00	02:54:03	N/A	No	No
84	557047	757305	Dwelling	1379	T02	00:23:00	11:21:00	02:46:28	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)
85	557042	757193	Dwelling	1380	T02	00:23:00	11:52:00	02:54:03	N/A	No	No
86	557042	757533	Dwelling	1390	T02	00:23:00	06:35:00	01:36:33	N/A	No	No
87	555919	758698	Dwelling	1402	T02	00:27:00	21:33:00	05:16:04	N/A	No	No
88	553997	758669	Dwelling	1455	T01	00:27:00	21:38:00	05:17:17	N/A	No	No
89	557034	756968	Dwelling	1410	T02	00:23:00	13:10:00	03:13:07	N/A	No	No
90	557081	757349	Dwelling	1413	T02	00:22:00	10:14:00	02:30:05	N/A	No	No
91	557002	756839	Dwelling	1418	T02	00:23:00	15:23:00	03:45:37	N/A	No	No
92	557070	757081	Dwelling	1422	T02	00:22:00	11:32:00	02:49:09	N/A	No	No
93	557085	757466	Dwelling	1424	T02	00:22:00	05:57:00	01:27:16	N/A	No	No
94	557086	757506	Dwelling	1430	T02	00:21:00	05:51:00	01:25:48	N/A	No	No
95	557042	756918	Dwelling	1431	T02	00:22:00	13:19:00	03:15:19	N/A	No	No
96	557095	757180	Dwelling	1434	T02	00:21:00	10:28:00	02:33:31	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)
97	557024	756843	Dwelling	1437	T02	00:23:00	14:35:00	03:33:53	N/A	No	No
98	557085	757054	Dwelling	1441	T02	00:21:00	11:03:00	02:42:04	N/A	No	No
99	557051	756864	Dwelling	1456	T02	00:23:00	13:33:00	03:18:44	N/A	No	No
100	555310	754356	Dwelling	1510	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
101	557088	756993	Dwelling	1457	T02	00:22:00	11:28:00	02:48:11	N/A	No	No
102	552424	757071	Dwelling	1458	T07	00:22:00	06:21:00	01:33:08	N/A	No	No
103	557114	757542	Dwelling	1463	T02	00:21:00	05:23:00	01:18:57	N/A	No	No
104	557094	757652	Dwelling	1464	T02	00:21:00	05:32:00	01:21:09	N/A	No	No
105	555357	754363	Dwelling	1515	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
106	557076	757736	Dwelling	1468	T02	00:21:00	05:38:00	01:22:37	N/A	No	No
107	557118	757562	Dwelling	1470	T02	00:21:00	05:22:00	01:18:43	N/A	No	No
108	557073	756883	Dwelling	1471	T02	00:22:00	12:45:00	03:07:00	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)
109	557054	756825	Dwelling	1471	T02	00:22:00	13:47:00	03:22:09	N/A	No	No
110	557070	757766	Dwelling	1471	T02	00:21:00	05:41:00	01:23:21	N/A	No	No
111	557100	757673	Dwelling	1475	T02	00:21:00	05:21:00	01:18:28	N/A	No	No
112	557094	756941	Dwelling	1475	T02	00:22:00	11:39:00	02:50:52	N/A	No	No
113	556867	758180	Dwelling	1476	T02	00:24:00	08:38:00	02:06:37	N/A	No	No
114	555941	758779	Dwelling	1485	T02	00:25:00	16:41:00	04:04:41	N/A	No	No
115	557130	757597	Dwelling	1488	T02	00:20:00	05:08:00	01:15:17	N/A	No	No
116	557153	757497	Dwelling	1495	T02	00:20:00	05:01:00	01:13:35	N/A	No	No
117	556905	758175	Dwelling	1504	T02	00:23:00	07:55:00	01:56:07	N/A	No	No
118	557170	757421	Dwelling	1505	T02	00:19:00	04:54:00	01:11:52	N/A	No	No
119	557143	757622	Dwelling	1506	T02	00:20:00	04:57:00	01:12:36	N/A	No	No
120	557032	757964	Dwelling	1509	T02	00:22:00	06:22:00	01:33:23	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)
121	557079	756634	Dwelling	1517	T05	00:21:00	14:38:00	03:34:37	N/A	No	No
122	557078	756612	Dwelling	1519	T05	00:22:00	15:12:00	03:42:56	N/A	No	No
123	553114	754905	Dwelling	1519	T09	00:13:00	05:49:00	01:25:19	N/A	No	No
124	557179	757484	Dwelling	1520	T02	00:19:00	04:47:00	01:10:09	N/A	No	No
125	557080	756600	Dwelling	1522	T05	00:22:00	15:17:00	03:44:09	N/A	No	No
126	557089	756642	Dwelling	1527	T05	00:21:00	14:13:00	03:28:31	N/A	No	No
127	557060	757947	Dwelling	1527	T02	00:22:00	06:02:00	01:28:29	N/A	No	No
128	557086	756591	Dwelling	1529	T05	00:21:00	15:03:00	03:40:44	N/A	No	No
129	552385	757195	Dwelling	1531	T07	00:21:00	05:46:00	01:24:35	N/A	No	No
130	557087	756575	Dwelling	1532	T05	00:21:00	15:19:00	03:44:39	N/A	No	No
131	557010	756252	Dwelling	1534	T05	00:23:00	08:21:00	02:02:28	N/A	No	No
132	557136	756863	Dwelling	1537	T02	00:21:00	11:13:00	02:44:31	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)
133	555387	754296	Dwelling	1587	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
134	557091	756557	Dwelling	1538	T05	00:21:00	15:30:00	03:47:20	N/A	No	No
135	555899	758842	Dwelling	1540	T02	00:20:00	08:19:00	02:01:59	N/A	No	No
136	557212	757386	Dwelling	1545	T02	00:18:00	04:36:00	01:07:28	N/A	No	No
137	557098	756554	Dwelling	1546	T05	00:20:00	05:53:00	01:26:17	N/A	No	No
138	555280	759099	Dwelling	1546	T01	00:00:00	00:00:00	00:00:00	N/A	No	No
139	555844	758863	Dwelling	1550	T01	00:10:00	02:02:00	00:29:49	N/A	No	No
140	553911	758793	Dwelling	1604	T01	00:24:00	17:47:00	04:20:49	N/A	No	No
141	555474	754313	Dwelling	1596	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
142	557107	756554	Dwelling	1555	T05	00:20:00	05:47:00	01:24:49	N/A	No	No
143	552326	757084	Dwelling	1556	T07	00:20:00	05:04:00	01:14:19	N/A	No	No
144	555892	758864	Dwelling	1561	T02	00:16:00	05:44:00	01:24:05	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)
145	554013	758830	Dwelling	1568	T01	00:24:00	14:01:00	03:25:35	N/A	No	No
146	552328	757156	Dwelling	1573	T07	00:20:00	05:03:00	01:14:04	N/A	No	No
147	557111	756465	Dwelling	1574	T05	00:20:00	05:52:00	01:26:03	N/A	No	No
148	555553	754321	Dwelling	1615	T10	00:00:00	00:00:00	00:00:00	N/A	No	No
149	557173	756820	Dwelling	1585	T02	00:20:00	10:29:00	02:33:45	N/A	No	No
150	557116	756421	Dwelling	1588	T05	00:21:00	06:03:00	01:28:44	N/A	No	No
152	555881	758907	Dwelling	1602	T02	00:06:00	00:44:00	00:10:45	N/A	No	No
153	557158	756571	Dwelling	1603	T05	00:19:00	05:10:00	01:15:47	N/A	No	No
154	557123	756382	Dwelling	1604	T05	00:21:00	06:00:00	01:28:00	N/A	No	No
155	557159	756558	Dwelling	1606	T05	00:19:00	05:09:00	01:15:32	N/A	No	No
156	557268	757455	Dwelling	1606	T02	00:17:00	03:57:00	00:57:56	N/A	No	No
157	554352	759072	Dwelling	1609	T01	00:00:00	00:00:00	00:00:00	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)
158	553154	754713	Dwelling	1611	T09	00:00:00	00:00:00	00:00:00	N/A	No	No
160	557282	757418	Dwelling	1617	T02	00:17:00	03:56:00	00:57:41	N/A	No	No
223	557054	757699	Dwelling	1437	T02	00:22:00	06:04:00	01:28:59	N/A	No	No
230	553483	755176	Pl Ref 2360178	1062	T09	00:20:00	10:25:00	02:32:47	N/A	No	No
231	555268	759094	Vacant	1539	T01	00:00:00	00:00:00	00:00:00	N/A	No	No
234	553992	758015	Vacant	1028	T03	00:40:00	67:42:00	16:32:56	T03, T01	Yes	No
237	552743	756385	Vacant	1134	T07	00:33:00	26:24:00	06:27:12	T07	Yes	No
238	557057	757938	Vacant	1521	T02	00:21:00	05:58:00	01:27:31	T02	No	No
239	556463	756875	Vacant	900	T05	00:44:00	84:36:00	20:40:48	T05, T02	Yes	No
240	556610	757412	Vacant	947	T02	00:39:00	38:44:00	09:28:05	T05, T02	Yes	No
241	554042	758388	Vacant	1224	T01	00:32:00	17:48:00	04:21:04	T01	Yes	No
242	553819	758049	Vacant	1169	T03	00:34:00	38:16:00	09:21:15	T03, T01	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)
244	556678	756811	Vacant	1110	T05	00:34:00	46:57:00	11:28:36	T05, T02	Yes	No

Of the 169 No. properties modelled; it is predicted that 37 properties may experience daily shadow flicker levels in excess of the DoEHLG guideline threshold of 30 minutes per day. This prediction is assuming worst-case 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 turbine control measures.

Of the 169 no. properties modelled, when the regional sunshine average (i.e. the mean number of sunshine hours throughout the year) of 24.44% is taken into account, the DoEHLG guideline limit of 30 hours per year is predicted not to be exceeded.

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 farm.
- 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 5.10.5.2.9 below outlines the mitigation strategies which may be employed at the potentially affected properties to ensure that the 2019 Draft Revised Wind Energy Development Guidelines (DoEHLG) are complied with at any dwelling within the 1.62km study area. Therefore, the developer will commit to mitigation measures that will ensure that there are no occurrences of shadow flicker for any property within the 1.62km study area, as a result of the Proposed Project.

5.8.1.2 Cumulative Shadow Flicker

The cumulative assessment of shadow flicker generated by the Proposed Project and other existing and permitted wind farms within 1.62km was carried out based on the methodology, assumptions and criteria outlined in Section 5.2.3.

The potential cumulative shadow flicker impact of the Proposed Project in combination with existing and proposed wind farm developments within the 1.62km shadow flicker study area of the has been assessed. Within the shadow flicker study area there are no constructed wind farms, therefore no other wind farms have been included in the cumulative shadow flicker assessment.

5.9 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 Proposed Project is currently used for coniferous forestry, agriculture and turf cutting, therefore a certain level of industrial activity and traffic movements are associated with the site, which will assist in the assimilation of the Proposed Project into the receiving environment. There are no occupied properties located within 720 meters of a proposed turbine location.

When considering the amenity of residents in the context of a proposed wind farm, there are three main potential effects 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 5.8 above refers to shadow flicker modelling, Chapter 12 addresses noise). A comprehensive landscape and visual impact assessment has also been carried out, as presented in Chapter 12 of this EIAR. Effects on Population and Human Health during the construction, operational and decommissioning phases of the Proposed Project is assessed in relation to each of these key issues and other environmental factors such as noise, traffic and dust; see Effects in Section 5.10 below. The impact on residential amenity is then derived from an overall judgement of the combination of effects due to shadow flicker, changes to land-use and visual amenity, noise, traffic, dust and general disturbance.

5.10 Likely Significant Effects and Associated Mitigation Measures

5.10.1 Potential Effects

This section of the assessment of effects is structured as follows:

- Assessment of 'Do nothing' Effect.
- Assessment of effects in relation to the Construction Phase.
- Assessment of effects in relation to the Operational Phase
- Assessment of effects in relation to the Decommissioning Phase
- Assessment of effects in relation to the Cumulative Effects

All elements of the Proposed Project have been considered in assessing effects on ecological receptors, including: 11 no. turbines with an overall tip height of 180m, a substation, 1 no. borrow pits and all ancillary infrastructure. The assessment examines the Wind Farm Site and the Proposed Grid Connection for each potential effect assessed. A Residual Effect is then provided for the Proposed Project (the Proposed Wind Farm Site and the Proposed Grid Connection) for each potential effect assessed.

5.10.2 'Do-Nothing' Scenario

If the Proposed Project was not developed, the site will continue to function as it does at present, with no changes made to the current land-use of commercial forestry, turf cutting and agriculture and the public road where accommodation works and grid connection cabling are proposed would also remain unaltered and continue to function as a part of the public road network. This would lead to a neutral environmental impact as these landuses evolve over time.

If the Proposed Project were not to proceed, the opportunity to capture an even greater part of County Galway'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. This would result in a slight negative effect over time.

5.10.3 Construction Phase

5.10.3.1 Population

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

5.10.3.1.1 *Population Levels*

Pre-Mitigation Impacts

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

Residual Impact

Based on the above it is concluded that there would be a short-term, imperceptible impact on population due to the construction phase of the Proposed Project.

Significance of Effects

The effect on population in the wider landscape due to construction phase the Proposed Project is imperceptible.

5.10.3.1.2 *Employment and Investment*

Pre-Mitigation Impacts

The design, construction and operation of the Proposed Project will provide employment for technical consultants, contractors and maintenance staff. The construction, operation and maintenance phases of the Proposed Project is anticipated to generate approximately 80 to 100 jobs. The construction phase of the Proposed Project will last between approximately between 18 – 24 months. Most construction workers and materials will be sourced locally, thereby helping to sustain employment in the construction trade.

The injection of money in the form of salaries and wages to those employed during the construction phase of the Proposed Project 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.

Residual Impact

The Proposed Project 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 impact 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.

Significance of Effects

This will have a short-term significant positive indirect effect.

5.10.3.1.3 *Land-use*

Pre-Mitigation Impacts

It is envisaged that the current land uses of coniferous forestry, agriculture and turf cutting will continue on site in conjunction with the Proposed Project. The Proposed Project will have no impact 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 Project.

The existing land-use of forestry, agriculture and road networks will continue on the proposed underground cable route. There will be a requirement to place an unbound surface layer over the underground cable route where it traverses forestry and agricultural land, as per Eirgrid design requirements, in order to accommodate maintenance vehicles. This is an acceptable and unavoidable part of the Proposed Project.

Residual Impact

Based on the above it is concluded that there would be a short-term, negative, imperceptible impact on land-use due to the construction phase of the Proposed Project.

Significance of Effects

The effect on land-use in the wider landscape due to construction phase the Proposed Project is not significant.

5.10.3.1.4 *Property Values*

Pre-Mitigation Impacts

As noted in Section 5.7 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of a wind farm such as that in Proposed Project near them.

Residual Impact

It is on this basis that it can be concluded that there would be a short term negative imperceptible impact from the construction phase of the Proposed Project.

Significance of Effects

The effect on property values due to the construction of the Proposed Project is not significant.

5.10.3.1.5 *Tourism and Amenity*

Pre-Mitigation Impact

Given that there are currently no tourism attractions specifically pertaining to the site there are no effects associated with the construction phase of the Proposed Project. Furthermore, these proposed structures are located on private property therefore no entrance to tourists is currently or will be permitted. There are no tourist attractions located along the Proposed Project underground cabling route. As the proposed underground cabling route is not located at a cul de sac, tourists seeking to travel to various attractions in the wider landscape during the construction phase, can utilise other routes and therefore will not be impacted by the rolling construction phase of the underground cabling route.

With regard to tourist attractions and amenity use around the site, described in Section 5.4.2, traffic management safety measures will be in place. Please see Traffic effects below for further details on proposed mitigation measures.

Residual Impact

Based on the above it is concluded that there would be a short-term, negative, imperceptible impact on tourism and the wider landscape due to the construction phase of the Proposed Project.

Significance of Effects

The effect on tourism in the wider landscape due to construction phase the Proposed Project is not significant.

5.10.3.1.6 *Residential Amenity*

Pre-Mitigation Impacts

The potential for impacts on residential amenity is discussed in Section 5.9 above. There is potential for impacts on residential amenity during the construction phase of the Proposed Project due to air, traffic, noise and vibration emissions due to the presence of additional traffic and plant machinery.

Mitigation and Monitoring Measures

All mitigation as outlined above and the corresponding chapters: Chapter 10 Air Quality, Chapter 12 Noise and Vibration, and Chapter 15 Material Assets will be implemented in order to reduce insofar as possible, impacts on residential amenity at properties located in the vicinity of the Proposed Project construction works. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

Residual Impact

Based on the above it is concluded that there would be a short-term, negative, imperceptible impact on residential amenity due to the construction phase of the Proposed Project.

Significance of Effects

The effect on residential amenity due to construction phase the Proposed Project is not significant.

5.10.4 Health

5.10.4.1.1 *Health and Safety*

Pre-Mitigation Impacts

Construction of the Proposed Project 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 has the potential to result in a short-term, significant negative effects.

Proposed Mitigation Measures

The Proposed Project 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);

- 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 Project, 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 Project will connect the proposed on-site 220kV substation to the 220kV Cashla – Flagford overhead line. Connection via the 220kV substation would comprise underground cabling, measuring approximately 2.8 km in total, located within peatland, agricultural land and within the public road corridor. Health and safety guidelines for working within and around electrical substations and overhead lines will be adhered to on site.

Residual Effects

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

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 Project.

5.10.4.1.2 *Noise*

Pre-Mitigation Impacts

There will be an increase in noise levels in the vicinity of the Proposed Project 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 the Proposed Project. These effects will be short-term, negative. The noisiest construction activities associated with wind farm development are excavation and pouring of the turbine bases and the extraction of stone from the borrow pit. Excavation of a 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 project, 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 Proposed Project are further described in Chapter 12: Noise and Vibration.

With regard to the proposed underground cable route, construction works may give rise to noise effects on sensitive receptors in the area, however these noise effects will be temporary in nature as the works move along the underground cable route and associated works for the connection to the existing Cashla – Flagford 220kV overhead line.

Proposed Mitigation Measures

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

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Chapter 12 using methods outlined in British Standard BS5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, large turbine component delivery, rotor/blade lifting) it could occasionally be necessary to work out of these hours.

Where rock breaking is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Use a dampened bit to eliminate ringing.
- Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.
- Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

Residual Impact

Following the implementation of the above mitigation measures, there will be a short-term imperceptible negative residual effect due to an increase in noise levels during the construction phase of the Proposed Project.

Significance of Effects

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

5.10.4.1.3 Air (Dust)

Pre-Mitigation Impacts

Potential dust emission sources during the construction phase of the Proposed Project include tree felling, upgrading of existing access tracks and construction of new access roads, turbine foundations, construction compounds, borrow pits, 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 Project are further described in Chapter 10 Air.

Proposed Mitigation Measures

All aggregate material for the construction of roads and turbine bases will be sourced onsite and will only be outsourced where necessary; therefore, reducing the need to transport this material to the site. Truck wheels will be washed 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 during tree felling, along haul roads and around the borrow pit areas 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 site 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 proposed underground cable route options will be small, ranging from 150-300m 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 cable route will be sourced from the on-site borrow pits to reduce the amount of emissions associated with vehicle movements.

Residual Impact

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

Significance of Effects

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

5.10.4.1.4 Climate

Pre-Mitigation Impacts

The construction of infrastructure listed in the Proposed Project description, as stated in Chapter 4, will require the removal and reinstatement of peat habitat, tree felling, the use of construction materials (such as cement), and the operation of vehicles and plant machinery. Greenhouse gas emissions e.g., carbon dioxide (CO_2), carbon monoxide and nitrogen oxides associated will arise as a result of the aforementioned construction activities.

The effects arising from construction activities will be short-term and slight, given the quantity of greenhouse gases that will be emitted to the atmosphere, and will be restricted to the duration of the construction phase.

Some potential long-term slight negative effects will occur due to the removal of carbon fixing vegetation and habitat, however, that has been avoided where possible by the design and layout of the Proposed Project, which has ensured the utilisation of as much of the existing roads within the Proposed Project as possible to gain access to the proposed turbine locations and minimise the construction of additional roads. This impact will be long-term and slight only, given the quantity of greenhouse gases that will be emitted to the atmosphere.

Construction waste will arise from the Proposed Project mainly from excavation and unavoidable construction waste including material surpluses, damaged materials and packaging waste. Waste management will be carried out in accordance with Best Practice Guidelines on the Preparation of Resource and Waste Management Plans for Construction & Demolition Projects (2021) produced by the EPA.

This potential impact will be short-term and slight only, given the quantity of greenhouse gases associated with the generation and management of these waste streams that will be emitted to the atmosphere, and will be restricted to the duration of the construction phase.

The transport of turbines and construction materials to the site, which will occur on specified routes only (see Section 4.4 in Chapter 4 of this EIAR), will also give rise to greenhouse gas emissions associated with the transport vehicles and exhaust emissions.

This impact will be short-term and slight only, given the quantity of greenhouse gases that will be emitted, and will be restricted to the duration of the construction phase.

Proposed Mitigation Measures

All construction vehicles and plant machinery will be maintained in good operational order while onsite, thereby minimising any emissions that arise. Where applicable, low carbon intensive construction materials will be sourced and utilised onsite.

The expected waste volumes generated onsite are unlikely to be large enough to warrant source segregation at the Proposed Project site. Therefore, all wastes streams generated onsite will be deposited into a single waste skip which will be covered. This waste material will be transferred to a licensed /permitted Materials Recovery Facility (MRF) by a fully licensed waste contractor where the waste will be sorted into individual waste streams for recycling, recovery, or disposal. The MRF facility will be local to the Proposed Project site to reduce the amount of emissions associated with vehicle movements. The nearest licensed waste facility to the site is located approximately 12.7km to the southwest of the Proposed Project site.

When stationary, delivery and on-site vehicles will be required to turn off engines. Turbines components will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority.

Residual Impact

Following implementation of the mitigation measures above, residual effects of greenhouse gas emissions arising from the construction phase of the Proposed Project will have a short-term imperceptible negative effect.

However, once emitted to the atmosphere, the greenhouse gas emissions that will arise from construction phase activities will have a permanent imperceptible negative effect on climate.

Significance of Effects

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

5.10.4.1.5 *Traffic and Transport*

Pre-Mitigation Impacts

It is proposed that large wind turbine components will be delivered to the site of the Proposed Project, from a port that connects to the national primary roads, for example Port of Galway, Shannon Foynes Port or Dublin Port via the N83 National Secondary Road. From the Port of Galway, the turbines will be transported northwards along the M6 and M18 motorways towards Tuam. In Tuam, the vehicles will travel along the N17 national primary road and N83 towards Dunmore. The vehicles will travel on the N83 for 9.7km before turning eastwards onto the L6466 Local Road. The vehicles will travel for the entirety of the L6466 before turning southwards onto the R328 Regional Road. The vehicles will travel for approximately 4km along the R328 to the site entrance. The construction phase of the Proposed Project will last for approximately 18-24 months. The proposed turbine delivery and construction traffic route is shown in Figure 15-1 in Chapter 15 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 site and the export of excess construction materials and plant from the site. A complete Traffic and Transportation Assessment (TTA) of the Proposed Project has been carried out by Alan Lipscombe Traffic and Transport Consultants. The full results of the TTA are presented in Section 15.1 of Chapter 15 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 slight to moderate negative impact on existing road users.

Proposed Mitigation Measures

Mitigation measures have been outlined in Appendix 15-1 Traffic Management Plan will be developed and implemented, prior to construction, to ensure any impact is short term in duration and slight in significance during the construction of the Proposed Project. 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.

Aggregate materials for the construction of any additional site tracks will be obtained from the proposed borrow pit on the site of the Proposed Project. This will significantly reduce the number of delivery vehicles required to access the site.

Residual Impact

Once the mitigation measures outlined in Appendix 15-1 Traffic Management Plan is implemented for the construction phase of the Proposed Project, there will be a short-term imperceptible negative residual impact on local road users.

Significance of Effects

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

5.10.4.1.6 Major Accidents and Natural Disasters

Pre-Mitigation Impacts

A risk register has been developed which contains all potentially relevant risks identified during the construction phase of the Proposed Wind Farm. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the construction phase have been identified and are presented in Chapter 16: Major Accidents and Natural Disasters. As outlined in 1.4.1 of this EIAR, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during the construction is identified as 'Contamination' of the Site and risk of 'Fire/Explosion' during construction.

Residual Impact

The impact assessment concludes that the risk of a major accident and/or disaster during the construction phase of the Proposed Project is considered 'low' in accordance with the 'Guide to Risk Assessment in Major Emergency Management' (DoEHLG, 2010).

Significance of Effects

Based on the above risk assessment in Chapter 16, the effects to/from Major Accidents and Natural Disasters during the construction phase of the Proposed Project is not significant.

5.10.4.1.7 Shadow Flicker

Shadow flicker, which occurs during certain conditions due to the movement of wind turbine blades, as described in Section 5.8 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 Project.

5.10.5 Operational Phase

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

5.10.5.1 Population

5.10.5.1.1 *Population Levels*

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

Residual Impact

No residual impacts.

Significance of Effects

No significance of effects.

5.10.5.1.2 *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 Project will create approximately 2 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 Project, 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 Galway County Council, which will be redirected to the provision of public services within Co. Galway. 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.

Proposed Community Benefit Scheme

The applicant company has given careful consideration to the issue of community gain arising from the Proposed Project, if permitted and constructed. Community gain from significant development proposals, including wind farms, whilst a relatively recent approach, is now a common consideration for developers and, indeed, planning authorities. This approach recognises that, with any significant wind farm proposal, the locality in which the site is situated is making a significant contribution towards helping achieve national renewable energy and climate change targets, and the local community should derive some benefit from accommodating such a development in their locality.

Community gain proposals can take a number of forms, generally depending on the nature and location of the Proposed Project and the nature and make-up of the local community. In some instances, funds are paid by the developer, either annually or as a one-off payment, to a community fund that is administered by a voluntary committee. These funds may then be used for a variety of projects, such as environmental improvements, local amenities and facilities, voluntary and sporting groups and clubs, educational projects and energy efficiency improvement works.

Residual Impact

The community gain proposal for the Proposed Project is to contribute to community benefit scheme to support local environmental improvements and recreational, social or community amenities and initiatives in the locality of the Proposed Project.

The Community Benefit scheme, derived from the RESS recommendations of €2 per MWh, has proposed the provision of a fund of approximately €400,000 to be distributed to local community clubs and societies with or as part of a near neighbour scheme, with the closest residents benefitting the most. The number and size of grant allocations will be decided by a Community Fund liaison committee with various groups and project benefiting to varying degrees depending on their funding requirement.

Significance of Effects

Overall, it is concluded that the socio-economic effects of the Proposed Project will have a significant, positive, long-term effect on a local, regional, and national level.

5.10.5.1.3 Land-use

Pre-Mitigation Effects

The footprint of the Proposed Project, including turbines, roads, underground cable route etc., will occupy only a small percentage of the total Study Area defined for the purposes of this EIAR. The main land-use of commercial forestry, agriculture and turf cutting in the EIAR primary study area will continue to co-exist with the Proposed Project.

Residual Impact

Based on the above it is concluded that there would be a long-term, negative, imperceptible impact on land-use due to the construction phase of the Proposed Project.

Significance of Effects

The Proposed Project will have no effect on other land-uses within the wider area.

5.10.5.1.4 Property Values

Pre-Mitigation Impact

As noted in Section 5.7 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms, such as that which forms part of the Proposed Project, near houses.

Residual Impacts

It is on this basis that it can be reasonably concluded that there would be a long-term imperceptible impact from the Proposed Project.

Significance of Effects

No significance of effects.

5.10.5.1.5 *Tourism*

Pre-Mitigation Effects

Given that there are currently no tourism attractions or amenity walkways located within the Proposed Project site there are no effects associated with the operational phase of the Proposed Project. 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*".

Residual Impact

No residual impact.

Significance of Effects

It is not considered that the Proposed Project would have a negative 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 Project into this environment.

5.10.5.1.6 *Residential Amenity*

Pre-Mitigation Effects

Potential impacts on residential amenity during the operational phase of the Proposed Project could arise primarily due to noise, shadow flicker or changes to visual amenity. Detailed noise and shadow flicker modelling have been carried out as part of this EIAR, which shows that the Proposed Project will be capable of meeting all required guideline limits in relation to noise and the shadow flicker set out in the Guidelines or the draft Guidelines if adopted. The noise and vibration assessment is detailed in Chapter 12. It should be noted that the Proposed Project will be brought in line with the noise thresholds imposed on the development by the consenting authority should the application be granted. The visual impact of the Proposed Wind Farm is addressed in Chapter 14: Landscape and Visual. The turbine locations have been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within 720 metres of non-involved sensitive receptors, achieving the recommended four times turbine setback for visual amenity purposes.

Mitigation and Monitoring Measures

- There are no turbines proposed within 720m (4 x tip height) of any sensitive receptors.
- All mitigation measures outlined in Chapter 12 (Noise), shadow flicker (Section 5.8 of this EIAR) and visual (Chapter 14) in this EIAR will be implemented in order to reduce insofar as possible, impacts on residential amenity at properties located within the in the vicinity of the Proposed Project

Residual Effects

The Proposed Project has been designed in accordance with best practice measures set out in in the Guidelines and the draft Guidelines in terms of setbacks for visual amenity. Furthermore, the Proposed Project can be brought inline to meet shadow flicker and noise thresholds imposed as part of a planning consent. The residual effect is considered to be a negative, moderate, long-term impact residential amenity.

Significance of Effects

Based on the assessment above there will be a moderate effect on residential amenity during the operational phase.

5.10.5.2 Health

5.10.5.2.1 *Health and Safety*

Pre-Mitigation Effect

The operational phase of the Proposed Project 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 will be placed around where with restricted access such as the proposed borrow pit for safety considerations. People or animals can safely walk up to the base of the turbines.

The DoEHLG 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 site of the optimised development 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 imperceptible.

Proposed Mitigation Measures

Notwithstanding the above, the following mitigation measures will be implemented during the operation of the Proposed Project to ensure that the risks posed to staff and landowners remain imperceptible 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 project 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 Impact

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 Project.

Significance of Effects

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

5.10.5.2.2 *Noise*

Pre-Mitigation Effects

As stated in Section 12.8.2 in Chapter 12, an assessment of the operational phase predicted noise levels relating to the Proposed Project at all the NALs and NSRs lie below the Total WEDG Noise Limits and it has also been demonstrated that Total WEDG Noise Limits can be met following minor mitigation or following selection of an alternative candidate wind turbine model.

Residual Impact

As stated in Section 12.8.2 in Chapter 12, there will be no significant residual impacts.

Significance of Effects

As stated in the noise assessment in Chapter 12, it has been demonstrated that the relevant national guidance in relation to noise associated with proposed wind turbines can be satisfied, therefore the predicted impact associated with the operational turbines is long term, negative and not significant.

5.10.5.2.3 *Air (Exhaust Emissions)*

Pre-Mitigation Effects

The operational phase of the Proposed Project will generate additional traffic to the area in the form of light goods vehicles (LGVs) visiting the Site 1-2 times per day for inspections but on occasion, daily visits by Light Goods Vehicles (LGVs) and Heavy Goods Vehicle (HGVs) may be required over short periods during maintenance/component replacement activities.

The addition of a LGV to the area 1-2 times per day type during the operational phase will give rise to a long-term imperceptible negative impact on air quality. The addition of several HGVs on occasion over the thirty-five-year lifetime of the Proposed Project will give rise to a long-term imperceptible negative effect on air quality.

Proposed Mitigation Measures

- Any vehicles or plant brought onsite during the operational phase will be maintained in good operational order that comply with the Road Traffic Acts 1961 as amended, thereby minimising any emissions that arise.
- When stationary, delivery and on-site vehicles will be required to turn off engines.

Residual Impact

Following implementation of the mitigation measures above, residual impacts of exhaust emissions for the operational phase of the Proposed Project will have a long-term imperceptible negative effect.

Significance of Effects

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

5.10.5.2.4 *Air (Dust)*

Pre-Mitigation Effects

The operational phase of the Proposed Project will generate additional traffic to the area in the form of LGVs 1-2 visits per day and on occasion, daily LGVs and HGVs for short periods if maintenance or component replacement is required. This additional traffic may give rise to dust emissions. This will be a long-term imperceptible negative impact on air quality due to dust emissions.

Proposed Mitigation Measures

- Maintenance vehicles brought onsite during the operational phase will be maintained.
- in good operational order, thereby minimising any dust emissions that arise.
- Waste material will be transferred to a licensed /permitted Materials Recovery Facility
- (MRF) by a fully licensed waste contractor where the waste will be sorted into individual waste streams for recycling, recovery, or disposal. The MRF facility will be local to the Site to reduce the emissions associated with vehicle movements.

Residual Effect

Based on the above, the impact on air quality from dust emissions during the operational phase is a long-term imperceptible negative effect.

Significance of Effects

Based on this assessment above the effects on air quality from dust emissions generated at the Site during the operational phase will be imperceptible.

5.10.5.2.5 Air Quality

Although a long term negative imperceptible impact on air quality is expected during the operational phase due to exhaust and dust emissions from maintenance vehicles, there will be no net carbon dioxide (CO_2) emissions from operation of the Proposed Project. The Proposed Project, by providing an alternative to electricity derived from coal, oil, or gas-fired power stations, will result in emission savings of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide SO_2. The production of renewable energy from the Proposed Project will have a long-term, significant, positive effect on air quality due to the offsetting of approximately 72,217 tonnes of CO_2 per annum. Please see Chapter 11 Climate for further details on carbon displacement calculations.

Residual Effect

The overall impact will be a long-term, significant, positive impact on air quality due to the offsetting of approximately 72,217 tonnes of CO_2 per annum (see Chapter 11 for details).

Significance of Effects

Based on the assessment above there will be a significant, positive effect on the air quality due to the operation of the Proposed Project.

5.10.5.2.6 Climate

The Proposed Project will generate energy from a renewable source. This energy generated will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive effect on climate. As detailed in Chapter 11, the Proposed Project will displace carbon dioxide from fossil fuel-based electricity generation, over the proposed 35-year lifespan of the Proposed Project. The Proposed Project will assist in reducing carbon dioxide (CO2) emissions that would otherwise arise if the same energy that the Proposed Project will generate were otherwise to be generated by conventional fossil fuel plants. This is a long-term significant positive effect on climate.

Some potential long-term slight negative effects that may occur during the operational phase of the Proposed Project are the release of carbon dioxide to the atmosphere due to maintenance and monitoring activities, and the removal of carbon fixing vegetation and habitat, site reinstatement and associated drainage.

Proposed Mitigation Measures

Ensure that all maintenance and monitoring vehicles will be maintained in good operational order while onsite, and, when stationary, be required to turn off engines thereby minimising any emissions that arise. As detailed in Appendix 6-6, a Biodiversity Enhancement Plan for the Proposed Project has identified enhancement activities such as planting of hedgerow and peatland enhancement.

Residual Effect

Following implementation of the biodiversity enhancement outlined above, the loss of carbon fixing vegetation and in particular peat habitat over the lifetime of the Proposed Project will be partially offset by the biodiversity enhancement plan and using the precautionary principle, will have a potential long-term imperceptible negative effect on Climate. However, the Proposed Project will displace carbon dioxide from fossil fuel-based electricity generation, over the proposed 35-year lifespan of the Proposed Project. Therefore, while there will be greenhouse gas emissions associated with the operation of the Proposed Project, this will be offset by the operation of the Proposed Project within its operational life.

There will be a Long-term Moderate Positive Effect on Climate as a result of reduced greenhouse gas emissions. For the purposes of this EIAR, a rated output of 7.2 MW has been chosen (a mid-range capacity) to calculate the power output of the proposed 11-turbine renewable energy development, which would result in an estimated installed capacity of 79.2 MW, displacing approximately 72,217 tonnes of carbon dioxide per annum from traditional carbon-based electricity generation. Whilst there are potentially higher rated turbines, the residual effect will not be altered.

Significance of Effects

Based on the assessment above there will be no significant effects a s a result of the Proposed Project.

5.10.5.2.7 *Traffic and Transport*

Pre-Mitigation Impacts

Major component failures are considered unlikely and therefore the presence of abnormal load vehicles and HGVs at the Proposed Wind Farm site is considered extremely rare. Should a turbine component need replacing, the measures detailed in Chapter 15 will be implemented.

All site visits for maintenance and inspection purposes for the Proposed Project will be done so via LGVs with just one or two LGVs per day.

Residual Effects

Effects on local road users during the operational phase are considered to be a long term negative imperceptible impact.

Significance of Effects

Based on the assessment above, the effects on traffic will be imperceptible.

5.10.5.2.8 *Major Accidents and Natural Disasters*

Pre-Mitigation Impacts

A risk register has been developed which contains all potentially relevant risks identified during the operational phase of the Proposed Wind Farm. Five risks (, Severe Weather, Collapse/Damage to Structures, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the operational phase have been identified and are presented in Chapter 16 Major Accidents and Natural Disasters. As outlined in Section 16.4.1, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during operation is identified as "Fire/Explosion' during operation.

Residual Effect

The impact assessment concludes that the risk of a major accident and/or disaster during the operational phase of the Proposed Project is considered 'low' in accordance with the 'Guide to Risk Assessment in Major Emergency Management' (DoEHLG, 2010).

Proposed Mitigation Measures

- The Proposed Project will be designed and built in line with current best practice and, as such, mitigation against the risk of major accidents and/or disasters will be embedded through the design. In accordance with the provision of the European Commission '*Guidance on the preparation of Environmental Impact Assessment Reports*' 2017, a Risk Management Plan will be prepared and implemented onsite to ensure an effective response to disasters or the risk of accidents. The plan will include sufficient preparedness and emergency planning measures.
- The Proposed Project will also be subject to a fire safety risk assessment in accordance with Chapter 19 of the Safety, Health and Welfare at Work Acts 2005 to 2014, which will assist in the identification of any major risks of fire onsite, and mitigation of the same during operation.

Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures which details all proposed mitigation and monitoring measures for the operation of the Proposed Project.

Residual Effect

The impact assessment concludes that the risk of a major accident and/or disaster during the operational phase of the Proposed Project is considered 'low' in accordance with the '*Guide to Risk Assessment in Major Emergency Management*' (DoEHLG, 2010).

Significance of Effects

Based on the above and the risk assessment in Chapter 16, the effects to/from Major Accidents and Natural Disasters during the operational phase of the Proposed Project are not significant.

5.10.5.2.9 Shadow Flicker

Pre-Mitigation Impacts

Assuming worst-case conditions, a total of 37 properties as a result of the Proposed Project may experience daily shadow flicker in excess of the current DoEHLG guideline threshold of 30 minutes per day. The DoEHLG total annual guideline limit of 30 hours is predicted to not be exceeded at the 169 no. properties when the regional sunshine average of 24.44% is taken into account.

These mitigation measures are outlined below. Where a property is derelict or unoccupied, there are no perceived shadow flicker effects and therefore does not require mitigation strategies.

Proposed Mitigation Measures

Where daily or annual shadow flicker exceedances are predicted at any occupied receptor or 3rd party property, 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.

Wind Turbine Control Measures

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 Supervisory Control And Data Acquisition (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 ensure that shadow flickers 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 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 Project 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. This measure can be utilised at the site of the Proposed Project to prevent incidences of shadow flicker values at any house in line and with the Wind Energy Development Guidelines 2006. Where a shadow flicker mitigation strategy is to be implemented, the control mechanisms would only have to be applied to the turbines, which are causing the shadow flicker to occur.

Should a complaint be received within twelve months of commissioning of the Wind Farm, field investigation/monitoring will be undertaken by the Wind Farm operator at the affected property.

Notwithstanding the approach outlined above, should shadow flicker associated with the permitted development be perceived to cause nuisance at any home, the affected homeowner is invited to engage with the Developer. 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.

Screening Measures

In the event of an occurrence of shadow flicker 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.

Residual Effect

Following the implementation of the above suite of mitigation 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.

5.10.5.2.10 *Interference with Communication Systems*

Pre-Mitigation Effect

Consultation regarding the potential for electromagnetic interference from the Proposed Project was carried out with the relevant national and regional broadcasters, fixed line and mobile telephone operators and other operators. The first round of consultation occurred in 2020 and identified that no links were identified to be impacted from the Proposed Project. A second round of consultation was undertaken in December 2023 given the time that had elapsed since the first round. The second round of consultation identified links owned by Three and Enet which would be impacted by the Proposed Project.

Without mitigation measures, there could be the potential for interference of the wind turbine blades on the identified Three and Enet links which traverse the Proposed Wind Farm Site.

Mitigation Measures

As outlined in Appendix 15-5 of this EIAR, the Developer and Three have reached agreement in relation to a radio link which traverses the site. The Developer has agreed to bear the costs related to the re-routing of the impacted radio link. The Developer and Three have agreed that any re-routing solution will take place in advance of the construction and operation of the Proposed Project.

In the event of interference occurring to telecommunications owned by Enet, the Guidelines acknowledge that '*electromagnetic interference can be overcome'* by the use of divertor to relay links out of line with the wind farm. As outlined in their scoping replies, Enet are in agreement regarding the commitment by the Developer for the implementation of the necessary mitigation measures in order to protect the link should both the Proposed Project and the link co-exist.

Residual Effect

The Proposed Project will have no residual impact on the telecommunications signals of any other operator, due to distance from or absence of any links in the area.

Significance of Effects

There will be no significant effect on telecommunications from the Proposed Project.

5.10.6 Decommissioning Phase

The wind turbines proposed as part of the Proposed Project are expected to have a lifespan of approximately 35 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 substation will remain in place as it will be under the ownership of Eirgrid.

The works required during the decommissioning phase are described in Section 4.9 in Chapter 4 Description of the Proposed Project. Upon decommissioning of the Proposed Project, the wind turbines will be disassembled in reverse order to how they were erected. The turbines will be disassembled with the same model of cranes that were used for their erection. The turbine will be removed from site using the same transport methodology adopted for delivery to site initially. The turbine materials will be transferred to a suitable recycling or recovery facility.

All above ground turbine components would be separated and removed off-site for recycling. Turbine foundations would remain in place underground and would be covered with earth and reseeded as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in environment emissions such as noise, dust and/or vibration.

Site roadways could be in use for purposes other than the operation of the development by the time the decommissioning of the Proposed Project is to be considered, and therefore it may be more appropriate to leave the site roads in situ for future use. It is envisaged that the roads will provide a useful means of extracting the commercial forestry crop which exists on the site. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be removed where required.

The underground electrical cabling connecting the Clonberne Wind Farm to the existing 220kV Overhead Line will be removed from the underground cable ducting at the end of the useful life of the renewable energy development. The cable ducting will be left in-situ as it is considered the most environmentally prudent option, avoiding unnecessary excavation and soil disturbance for an underground element that is not visible.

A standalone decommissioning plan is contained in Appendix 4-6 of this EIAR for the decommission of the Proposed Project, the detail of which will be agreed with the local authority prior to any decommissioning. The potential for effects during the decommissioning phase of the proposed wind farm has been fully assessed in the 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 effects 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, employment, tourism or health & safety once all standard construction phase mitigation measures described above are implemented.

5.10.7 Cumulative and In-Combination Effects

For the assessment of cumulative effects, any other existing, permitted or proposed projects (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 for impact between the Proposed Project (Proposed Wind Farm and Proposed Grid Connection combined), wind projects, and other relevant non-wind projects (existing, permitted or proposed) has been carried out with the purpose of identifying what influence the Proposed Project will have on population and human health as well as the interactions between these factors, when considered cumulatively and in combination with relevant existing, permitted or proposed projects and plans in the vicinity of the Site, as set out in Chapter 2 of this EIAR. Please see Section 2.8 of Chapter 2 for cumulative assessment methodology. Please refer to Appendix 2-3 for a comprehensive listing of the considered cumulative and in combination with relevant existing, permitted or proposed projects and plans in the vicinity of the Site.

The effects with the potential to have cumulative effects on human beings are discussed below and in more detail in the relevant chapters: noise (Chapter 12), visual effects (Chapter 14) and traffic (Chapter 15).

5.10.7.1 Employment and Economic Activity

Wind farms within 20 kilometres of the Proposed Project which may be proposed, permitted or operational/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.

5.10.7.2 Tourism and Amenity

There are no key identified tourist attractions pertaining specifically to the site of the Proposed Project itself.

It is not considered that the Proposed Project together with other projects in the area will cumulatively affect any tourism infrastructure in the wider area. As mentioned previously, wind farms are an existing feature in the surrounding landscape, which will assist in the assimilation of the Proposed Project into this environment. As also noted in Section 5.4 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 effects from the Proposed Project and other wind farm developments in the area.

5.10.7.3 Traffic

There are no permitted wind farm developments within 5km of the Proposed Project site. The nearest wind farm in the vicinity of the Proposed Project is the proposed Cooloo Wind Farm which is 5.3km to the south of the Proposed Project site. This project has not yet entered the planning system however the project website has provided the necessary information for its consideration in this cumulative assessment.

The considerable distance will result in no potential for cumulative effects between the Proposed Project and the neighbouring developments.

5.10.7.4 Air (Dust)

The nature of the Proposed Project 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 Project and the construction phase of other developments within 20 kilometres of the wind farm site 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 10.3.2.1 and Section 10.3.2.2 of Chapter 10 are implemented during the construction phase of the Proposed Project, there will be no cumulative negative effect on air and climate.

The nature of the Proposed Project and other wind energy developments within 20 kilometres are such that, once operational, they will have a cumulative long-term, significant, positive effect on the air quality and climate.

5.10.7.5 Health and Safety

The Proposed Project will have no effects in terms of health and safety. There is no credible scientific evidence to link wind turbines with adverse health effects. All other existing, permitted or proposed projects (wind energy or otherwise) would be expected to follow all relevant Health and Safety Legislation during the construction, operation, and decommissioning phases of the development. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented.

It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative effect from the Proposed Project and other developments in the area.

5.10.7.6 Property Values

As noted in Section 5.7 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 Project and other wind farm developments in the area.

5.10.7.7 Services

The rate payments from the Proposed Project and other projects in the area will contribute significant funds to Galway 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.

5.10.7.8 Shadow Flicker

As outlined above, no dwellings may be impacted by shadow flicker from the Proposed Project in combination with permitted wind farms within 5km of the Proposed Project site.

5.10.7.9 Residential Amenity

Pre-Mitigation Effects

In the extremely unlikely event that all permitted and proposed projects as described in the cumulative assessment in Chapter 2 are constructed at the same time, there is the potential for a resulting short term, significant, cumulative, negative effects 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 Project that will be located within 720 metres of any occupied 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 Project works, including along the proposed turbine and construction materials haul route. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented.

Residual Effects

The Proposed Project will have a short-term, slight negative effect on residential amenity during construction works. During the operational phase, noise and shadow flicker from the proposed and permitted projects will be limited to below guideline levels or as committed to by the developer, resulting in a long-term, imperceptible residual impact from on residential amenity.

Significance of Effects

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

5.11 Summary

Following consideration of the residual effects (post-mitigation) it is noted that the Proposed Project will not result in any significant effects on human beings in the area surrounding the Proposed Project. Following appropriate mitigation, the Guidelines shadow flicker limits will not be exceeded at any property. It is noted that the Proposed Project can be brought in line with the requirements of the draft Guidelines, should they be adopted while this application is in the planning system, through the implementation alteration of the mitigation measures outlined.

Provided that the Proposed Project is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant effects on Population and Human Health, associated with health and safety, noise, dust, traffic and shadow flicker, are not anticipated at international, national or county scale.