5. POPULATION AND HUMAN HEALTH

5.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses the potential significant, direct and indirect effects of the proposed Ballivor Wind Farm development (the "Proposed Development"), on population and human health and has been completed in accordance with the guidance set out by the Environmental Protection Agency (EPA), in particular the '*Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*' (EPA, 2022) and Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU and as transposed into Irish Law through Regulations in 2018 (S.I. No. 296 of 2018). The full description of the project is provided in Chapter 4 of this EIAR.

Impacts of a proposed development that may impinge on human health, directly and indirectly, positively and negatively have been considered. The key issues examined in this chapter of the EIAR include employment, settlement and land use patterns, population and demographic trends, tourism and amenity, and human health (health and safety and shadow flicker). Vulnerability of the project to risk of major accidents and /or disasters is dealt with separately.

5.1.1 Statement of Authority

This section of the EIAR has been prepared by Karen Mulryan and reviewed by Michael Watson, of MKO. Karen is a Project Environmental Scientist with MKO with over 6 years' experience in the consultancy sector. Karen holds a BA International in Archaeology from NUI Galway and a MSc in Archaeology from the University of Edinburgh. Karen's key strengths and areas of expertise are in project management, environmental impact assessment, wind energy site selection and feasibility assessment. Since joining MKO, Karen has experience managing wind farm Environmental Impact Assessment Report applications of various scales including SID applications across Ireland. Karen has experience in report writing, including EIAR Population and Health chapters, feasibility studies and EIA screening reports. Karen holds memberships with the Chartered Institute for Archaeologists (ACIfA) and the Institute of Archaeologists of Ireland (IAI).

Michael Watson is Project Director and head of the Environment Team in MKO. Michael has over 20 years' experience in the environmental sector. Michael's professional experience includes managing and overseeing Environmental Impact Assessment Reports including Population and Human Heath reports, EPA License applications, hydrogeological assessments, environmental due diligence and general environmental assessment on behalf of clients in the wind farm, waste management, public sector, commercial and industrial sectors nationally. Michael also has a Bachelor of Arts Degree in Geography and Economics from NUI Maynooth, is a Member of IEMA, a Chartered Environmentalist (CEnv) and Professional Geologist (PGeo).

5.1.2 Relevant Guidelines

In addition to the guidelines set out in the EPA 2022 report and Directive 2011/92/EU as amended by Directive 2014/52/EU, the following guidelines, plans and reports have also influenced the preparation of this chapter:

- Department of Housing, Planning and Local Government (DoHPLG), Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (2018)
- European Commission (EC), Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report (2017)

- Department of the Environment, Heritage and Local Government Wind Energy Development Guidelines (2006)
- Environmental Impact Assessment of National Road Schemes- A practical Guide, National Roads Authority/ Transport Infrastructure Ireland, Revision 1, November 2008;
- EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects
- Health Impact Assessment Resource and Tool Compilation, United States Environmental Protection Agency 2016;
- Health Impact Assessment Guidance, Institute of Public Health Ireland. 2009;
- Framework for Human Health Risk Assessment to Inform Decision Making developed by the United States Environmental Protection Agency (US EPA). 2014
- Central Statistics Office (CSO): Census of Ireland 2016; Census of Ireland 2011; Census of Agriculture 2020;
- Meath County Development Plan 2021-2027,
- Westmeath County Development Plan 2021-2027.

5.1.2.1 Shadow Flicker 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 adopted 2006 DoEHLG guidelines are currently under review. The DoHPLG released the 'Draft Revised Wind Energy Development Guidelines' in December 2019 which were released for public consultation in 2019. The consultation period closed February 2020; however, no update or final guidelines was released. 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 Climate Action Plan 2023 published in December 2022 states that new draft guidelines will be issued in 2023 with the final guidelines adopted in 2024. The shadow flicker assessment in methodology and assessment within this chapter are based on compliance with the current, adopted 2006 guidelines. However, it should also be noted the Proposed Development can be brought in line with the requirements of the 2019 draft guidelines through the implementation of the mitigation measures outlined in Section 5.6.3.2.6

5.1.3 Scoping

Chapter 2 of this EIAR describes the scoping and consultation exercise undertaken for the proposed Ballivor Wind Farm. The only comment in relation to shadow flicker was included in the Health Service Executive's response to the EIA Scoping request sent in August 2020. The HSE response requested room-use is identified and reduction factors (if required) and mitigation measures (if required) are described. This assessment is included in the following sections of the EIAR.

5.1.4 Health Impacts of Wind Farms

5.1.4.1 Health Impact Studies

While there are anecdotal reports of negative health effects on people who live very close to wind turbines, peer-reviewed research has generally not supported 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 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. Pierpoint'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.

2. ***'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."*

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

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

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

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

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

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

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

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

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

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

CAHA notes that:

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

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

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

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

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

> *"There is no evidence for a set of health effects, from exposure to wind turbines that could be characterized as a "Wind Turbine Syndrome."*
>
> *The strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental health problems. There were two smaller, weaker, studies: one did note an association, one did not. Therefore, we conclude the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems.*
>
> *None of the limited epidemiological evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine."*

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

> *"Scientific evidence suggests that shadow flicker does not pose a risk for eliciting seizures as a result of photic stimulation.*
>
> *There is limited scientific evidence of an association between annoyance from prolonged shadow flicker (exceeding 30 minutes per day) and potential transitory cognitive and physical health effects."*

(summary needed)

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.

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 human 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 (2019), 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 provide recommendations for protecting human health from exposure to environmental noise originating from various sources such as transportation noise, wind turbine noise and leisure noise. The Guideline Development Group (GDG) defined priority health outcomes and from this were able to produce guideline exposure levels for noise exposure.

For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB Lden. The GDG recognise the potential for increased risk of annoyance at levels below this value but cannot determine whether this increased risk can impact health. Wind turbine noise above this level is associated with adverse health effects.

The GDG points out that evidence on health effects from wind turbine noise (apart from annoyance) is either absent or rated low/very low quality and effects related to attitudes towards wind turbines are hard to differentiate from those related to noise and may be partly responsible for the associations. The GDG also recognises that the percentage of people exposed to noise from wind turbines is far lower than other sources such as road traffic and state that any benefit from specifically reducing population exposure to wind turbine noise in all situations remains unclear.

That being said, the GDG recommends renewable energy policies include provisions to ensure noise levels from wind farm developments do not rise above the guideline values for average noise exposure. The GDG also provides a conditional recommendation for the implementation of suitable measures to reduce noise exposure. Please see Chapter 11 Noise and Vibration for details.

5.1.4.2 Turbine Safety

Turbines pose no threat to the health and safety of the general public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s 'Wind Energy Development Guidelines for Planning Authorities 2006' and the 'Draft Revised Wind Energy Development Guidelines' (Department of Housing, Planning and Local Government (DoHPLG), December 2019), 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 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.

5.1.4.3 Electromagnetic Interference

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

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

The ESB document 'EMF & You' (ESB, 2017)[1] provides further practical information on EMF. Further details on the potential impacts of electromagnetic interference to telecommunications and aviation are presented in Chapter 14: Material Assets.

[1] *ESB 2017 EMF & You'. Available at: https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0)*

5.2 Assessment Methodology

5.2.1 Population

A desk-based assessment using sources and guidelines referenced in 5.1.2 above was undertaken to examine relevant information pertaining to the population impact assessment. Information on population statistics, employment and social data for the relevant Electoral Divisions (Eds) were obtained from the Central Statistics Office (CSO) for census years 2016. Census 2022 data will not be publicly available until April 2023. Fáilte Ireland's EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects was also considered in this assessment. See section 5.3 below.

The study area for this assessment mainly focuses on the electoral divisions (ED) within which the wind farm site is located, namely Ballyhealy, Copperalley, Cloghbrack, Killaconnigan, Killyon, Riverdale, Ballynaskeagh and Bracklin, but it also refers to county and national statistics.

5.2.2 Human Health

The human health analysis section was assessed using guidelines set out in section 5.1.2 above. 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 Ballivor Wind Farm 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 and Climate, Chapter 11 Noise and Vibration, Chapter 13 Landscape and Visual, Chapter 14 Material Assets (including Traffic and Transport).

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".

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.'*

In 2022 the Environmental Protect Agency published EIAR Guidelines which state 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 Guidelines 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'.*

5.2.2.1 Shadow Flicker Assessment Methodology

5.2.2.1.1 *Background*

The assessment methodology in this chapter follows the British Shadow flicker methodology detailed in a study produced by Parsons Brinckerhoff 2013 for the Department of Energy and Climate Change titled *Update of UK Shadow Flicker Evidence Base Department of Energy and Climate Change*[2].

Shadow is an effect that occurs when rotating wind turbine blades cast shadows at 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 which are listed UK *Update of UK Shadow Flicker Evidence* report and reiterated in the draft Wind Energy Guidelines 2019.

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 weather 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.

[2] *Parsons Brinckerhoff (2010) Update of UK Shadow Flicker Evidence Base Department of Energy and Climate Change. Department of Energy and Climate Change. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48052/1416-update-uk-shadow-flicker-evidence-base.pdf*

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.

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.

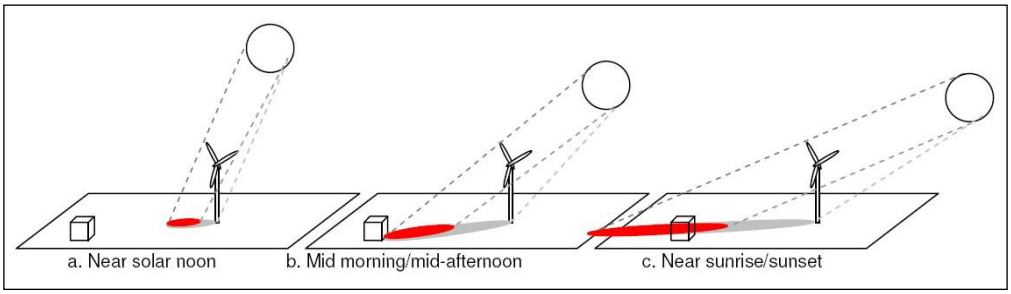


Figure 5-1 Shadow-Prone Area as Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, Dec 2008)

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 effect 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 effect 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.

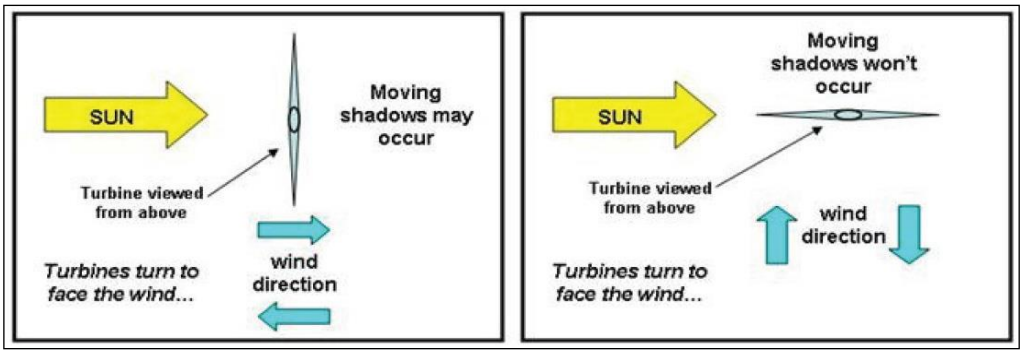


Figure 5-2 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC)

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.

5.2.2.2 Shadow Flicker Prediction Methodology

Shadow flicker occurs only under certain, combined circumstances, as detailed above. Where shadow flicker does occur, it is generally momentary. The DoHPLG 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 Development. Proper siting of wind turbines is key in eliminating the impact of 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 ReSoft WindFarm or WindFarmer (DNV.GL) or AWS OpenWind. The computer modelling of the occurrence and magnitude of shadow flicker is made possible by the fact that the sun rises and sets in the same position in the sky on every day each year.

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

For the purposes of this shadow flicker assessment, the software package ReSoft WindFarm Version 5.0.1.2 has been used to predict the level of shadow flicker associated with the Proposed Development. ReSoft WindFarm is a commercially available software tool that enables developers to analyse, design and optimise proposed wind farms. It allows proposed turbine layouts to be optimised for maximum energy yield whilst taking account of environmental, planning and engineering constraints. According to the UK guidance and methodology produced for the UK Department of Energy and Climate Change, WindFarm is one of the three key computer models used by the industry and it has been shown that the outputs of these packages do not have significant differences between them.[3]

[3] *Parsons Brinckerhoff (2010) Update of UK Shadow Flicker Evidence Base Department of Energy and Climate Change. Department of Energy and Climate Change. Available at:*

5.2.2.2.1 Assumptions and Limitations

Due to the latitude of Ireland shadow flicker impacts are only possible at properties 130 degrees either side of north (i.e. a shadow flicker event can occur within a 260 degree span), as turbines do not cast shadows on their southern side[4]. As such properties located outside of this potential shadow flicker zone (50 degrees wither side of south) will not be impacted. However, in this assessment, all 217 no. properties within 360 degrees of the Proposed Development out to 1.7km were assessed for shadow flicker impact.

At each property, the WindFarm modelling software produced shadow flicker calculations based on 4 No. notional windows facing north, east, south and west, labelled Windows 1, 2, 3 and 4 respectively. The methodology below is standard for all modelling software packages and cannot be manipulated per site i.e. the conservative approach of assuming shadow flicker from the north, south, east and west of each receptor is modelled. The degrees from north value for each window is:

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

Each window measures one-metre-high by one-metre-wide and is assumed to be vertical. The centre height of each window is assumed to be two metres above ground level and no screening due to trees or other buildings or vegetation is assumed. It was not considered necessary or practical to measure the dimensions of every window on every property in the study area. While the actual size of a window will marginally influence the incidence and duration of any potential shadow flicker impact, with larger windows resulting in slightly longer shadow flicker durations, any incidences or durations or shadow flicker can be countered by the measures outlined in Section 5.6.3.2.6 of this chapter.

The following assumptions are considered in software modelling output for shadow flicker:

- The sun is assumed to be in clear cloudless skies at all times 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.
- The wind direction is assumed to be worst case with the turbine rotor always facing the house to present its maximum aspect to receptors in all directions.

These conservative assumptions calculate all potential times during the year that shadow flicker has the potential to occur at each property. In reality however, the sky will not be cloudless 24 hours per day, wind will not blow 24 hours per day, nor will it blow in a constant direction 24 hours per day.

Weather data for this region shows that the sun shines on average for 3.6 hours per day or 30% of the daylight hours per year. This percentage is based on Met Éireann weather station at Mullingar, Co. Westmeath over the 30-year period from 1979-2008 (www.met.ie). The Mullingar met station was closed in 2008. The actual sunshine hours at the Proposed Development site and therefore the percentage of time shadow flicker could actually occur is 30% of daylight hours. Section 5.5 Ballivor Shadow Flicker Assessment lists the annual shadow flicker calculated for each property when the regional average of 30% sunshine is considered, to give a more accurate annual average shadow flicker prediction.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48052/1416-update-uk-shadow-flicker-evidence-base.pdf

[4] *House of Commons ODPM Annual Report and Accounts 2004: Housing, Planning, Local Government and the Regions Committee; Planning Policy Statement 22*
Department of Housing, Planning and Local Government Dec 2019 Draft Revised Wind Energy Development Guidelines. Rialtas Na hÉireann. Available at: https://www.gov.ie/en/publication/9d0f66-draft-revised-wind-energy-development-guidelines-december-2019/

5.3 Baseline Environment- Population

5.3.1 Baseline Population

Information regarding population and general socio-economic data were sourced from the Central Statistics Office (CSO), the County Meath County Development Plan 2021-2027, Westmeath County Development Plan 2021-2027, Fáilte Ireland and the literature and guidelines as listed in section 5.1.2 above.

The study included an examination of the population and employment characteristics of the area. This information was sourced from the Census of Ireland 2016, the most recent census for which a complete dataset is available, also the Census of Ireland 2011, the Census of Agriculture 2020 and from the CSO website (www.cso.ie). Census 2021 was postponed until 2022 due to the COVID-19 global pandemic with data from this census being made available on the CSO website in April 2023. Census information is divided into State, Provincial, County, Major Town, and District Electoral Division (DED) level.

The Proposed Development is located 5 km south-southeast of Delvin in County Westmeath, 4km east of Raharney in County Westmeath and 3.5km west of Ballivor Village, in County Meath. Please refer to Figure 1-1 of Chapter 1: Introduction for the site location map.

In order to assess the population in the vicinity of the Proposed Development, the Study Area for the Population section of this EIAR was defined in terms of the District Electoral Divisions (DEDs) where the proposed wind farm is located.

The site of the Proposed Development lies within 8 No. DEDs: Ballyhealy, Copperalley, Cloghbrack, Killaconnigan, Killyon, Riverdale, Ballynaskeagh and Bracklin, as shown in Figure 5-3. All of these DEDs will collectively be referred to hereafter as the Study Area for this chapter.

The Study Area has a population of 4,841 persons as of 2016 and comprises a total land area of 16,074km^2 (Source: CSO Census of the Population 2016).

The closest dwelling to the proposed Ballivor Wind Farm is located approximately 815m from the nearest proposed turbine (T17), i.e., greater than the recommended setback distance (i.e., 800m, 4 times the tip height of 200m), as per the Draft Revised Wind Energy Development Guidelines December 2019 which has more onerous setback requirements in comparison to the current adopted 2006 Wind Energy Guidelines.

5.3.2 Demographic Trends

In the four years between the 2011 and the 2016 Census, the population of Ireland increased by 3.8%. During this time, the population of Counties Meath and Westmeath grew by 5.9% and 3.02% respectively. Population statistics for the State, County Meath and Westmeath and the Study Area have been obtained from the Central Statistics Office (CSO) and are presented in Table 5-1 below.

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

Area	Population Change		Percentage Population Change
	2011	2016	2011 – 2016
State	4,588,252	4,761,865	3.8%
County Meath	184,135	195,044	5.9%
County Westmeath	86,164	88,770	3.02%
Study Area	4,626	4,841	4.6%

The data presented in Table 5-1 shows that the population of the Study Area increased by 4.6% between 2011 and 2016. This rate of population growth is higher than that recorded at State level and average to the County level. When the population data is examined in closer detail, it shows that the rate of population increase within the Study Area has been unevenly spread through the District Electoral Divisions (DEDs). The highest increase in the population between 2011 and 2016 occurred within the Riverdale and Killaconnigan DEDs, which experienced an 8.2% and 6.7% population increase, respectively. In comparison, the populations of Bracklin and Cloghbrack DEDs decreased by 2.6% and 0.2% during the same time period, respectively. Of the DEDs that make up the Study Area for this assessment, the highest population was recorded in Killaconnigan DED, with 2,234 persons recorded during the 2016 Census. The lowest population was recorded in Bracklin DED, with 259 persons recorded during the 2016 Census.

5.3.3 Population Density

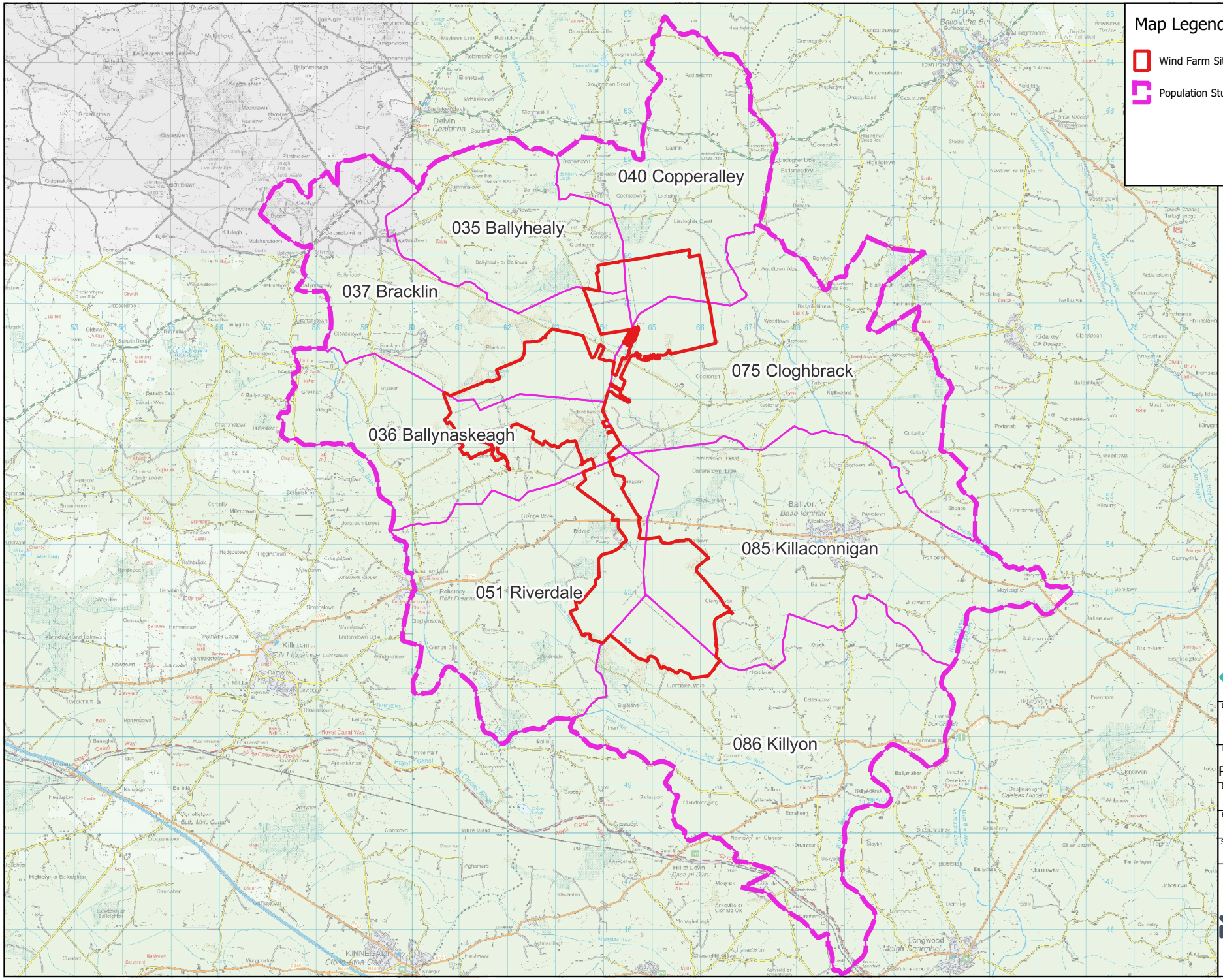
The population densities recorded within the State, County Meath and Westmeath and the Study Area during the 2016 Census are shown in Table 5-2.

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

Area	Population Density (Persons per square kilometre)	
	2011	2016
State	65.57	68.06
County Meath	78.62	83.28
County Westmeath	46.83	48.24
Study Area	28.78	30.12

The population density of the Study Area recorded during the 2016 Census was 30.12 persons per km^2. This figure is considerably lower than the national population densities of 68.06 persons per km^2 and lower than the population densities of Meath and Westmeath which are recorded at 83.28 persons per km^2 and 48.24 persons per $km,^2$ respectively in the 2016 Census.

Similar to the observed population trends, the population density recorded across the Study Area varies between DEDs. Killaconnigan DED which includes Ballivor Village has the highest population density, at 84.98 persons per km^2 and is similar to the overall population density for County Meath. Conversely, Riverdale DED which contains a portion of Raharney Village has a lower population density of 22.12 persons per km^2. Bracklin DED recorded the lowest population density of 14.39 persons per km^2.



Map Legend

- Wind Farm Site Boundary
- Population Study Area (8 no. Electoral Divisions)

N

Drawing Title	Population Study Area
Project Title	Proposed Ballivor Wind Farm
Drawn By: Karen Mulryan	Checked By: Eoin McCarthy
Project No.: 191137	Drawing No.: Figure 5-3
Scale: 1:102,500	Date: 02.02.2023

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5.3.4 Settlement Patterns

The Proposed Development site is located within a rural setting comprising approx. 1,770 hectares of bog which spans approx. 9km north to south and 6km east to west. and straddles the Meath-Westmeath border. The surrounding landscape predominately comprises private turbary, pastoral agricultural, commercial forestry. Historical mapping available indicates that the surrounding landscape comprised small one off housing and farmsteads with villages developing since at least the 19th century (OSI 6" mapping) c. 2.5km or further, from the bog boundaries in a radial pattern around it.

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

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

Area	2011		2016	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
State	1,654,208	2.8	1,697,665	2.8
County Meath	62,201	3.0	64,234	3.0
County Westmeath	30,739	2.8	31,813	2.8
Study Area	1,564	3.0	1,620	3.0

The figures in Table 5-3 show that while the number of households within the State, County and the DEDs increased, the average number of people per household remained the same due to the proportionate increase in population during this period. Average household size recorded within the Study Area during the 2011 and 2016 Censuses are the same as those observed at State and County level during the same time period. Similar to the trends detailed above, the average household size recorded in the Study Area varies between DEDs. Riverdale DED had the highest, with 3.1 persons per household recorded in 2011 and 2016 respectively. Copperalley DED recorded the lowest with 2.7 persons per household recorded in 2011 and 2016.

5.3.5 Age Structure

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

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

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
State	1,006,552	576,452	1,406,291	1,135,003	637,567
County Meath	48,931	22,366	57,254	45,705	20,788
County Westmeath	19,775	10,996	25,103	21,526	11,370

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
Study Area	1,242	636	1,290	1,169	504

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

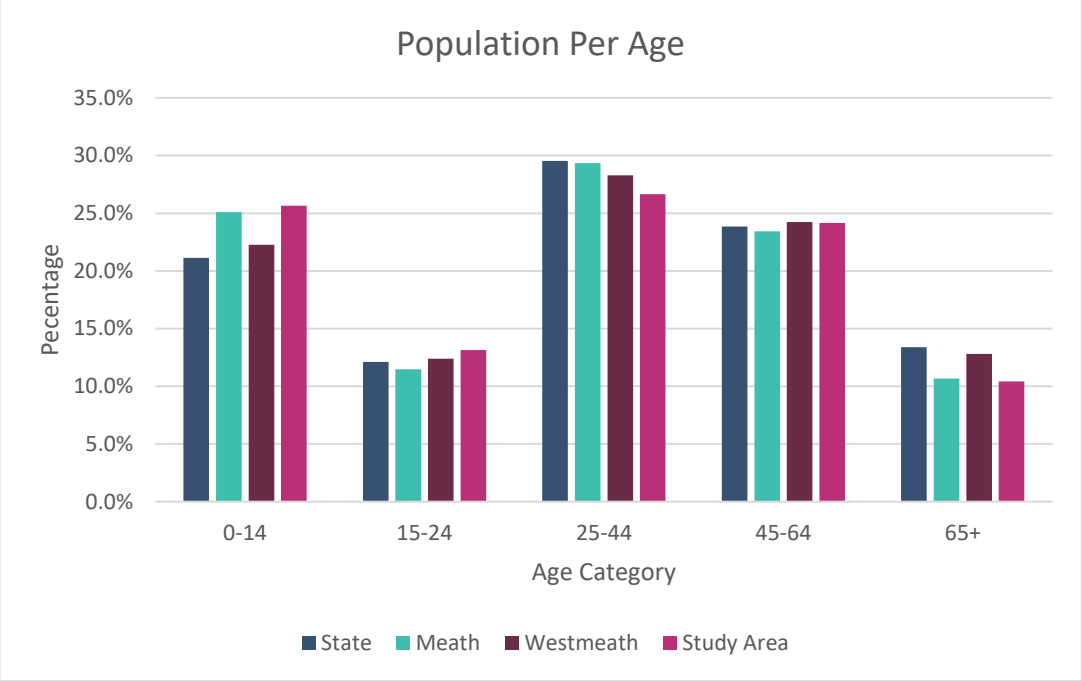


Figure 5-4 Population per Age Category in 2016 (Source: CSO)

5.3.6 Employment and Economic Activity

5.3.6.1 Employment by Socio-Economic Group

Socio-economic grouping divides the population into categories depending on the level of skill or educational attainment achieved. 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 5-5 shows the percentages of those employed in each socio-economic group in the State, Counties Meath and Westmeath and the Study Area during 2016.

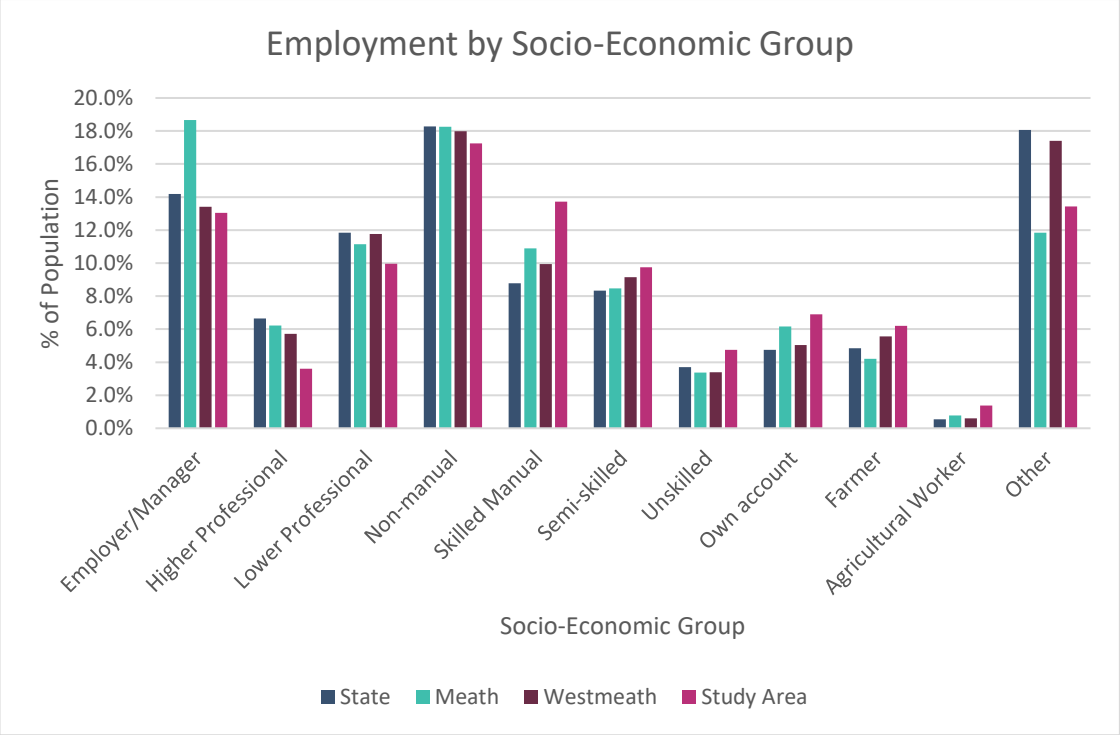


Figure 5-5 Employment by Socio-Economic Group in 2016 (Source: CSO)

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

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.

5.3.6.1.1 Employment and Investment Potential in the Irish Wind Energy Industry

The Sustainable Energy Authority of Ireland *Wind Energy Roadmap 2011-2050*[5] estimated that onshore and offshore wind could create 20,000 direct installation and operation/maintenance jobs by 2040 and that the wind industry would also have an annual investment potential of approximately €6-12 billion by 2040.

A 2014 report *The Value of Wind Energy to Ireland*[6], published by Pőyry, stated that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. In the absence of investment in wind energy by 2030 Ireland will be reliant on natural gas for most of our electricity generation, at a cost of €671 million per annum in fuel import costs.

Siemens, in conjunction with the Irish Wind Energy Association (IWEA, now Wind Energy Ireland), published a report in 2014 titled *An Enterprising Wind: An economic analysis of the job creation potential*

[5] *Sustainable Energy Authority of Ireland 2011, Wind Energy Roadmap to 2050 Available at: https://www.seai.ie/publications/Wind_Energy_Roadmap_2011-2050.pdf*

[6] *Poyry Management Consulting: The Value of Wind Energy to Ireland': A report to Irish Wind Energy Association 2014. Available at: https://windenergyireland.com/images/files/9660bd6b05ed16be59431aa0625855d5f7dca1.pdf*

of the wind sector in Ireland[7], which concluded, *'a major programme of investment in wind could have a sizeable positive effect on the labour market, resulting in substantial growth in employment.'*

The 2014 IWEA report considers the three potential types of direct employment created that can be attributable to wind energy:

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

Wind Energy Ireland (WEI) released a report in March 2021 *Our Climate Neutral Future Zero by 50* [8] in light of the Government's announcement of new, ambitious energy targets in the same month. The report outlines the potential for 50,000 jobs to be created in the renewable energy industry in order to meet the build out requirements to achieve a Net -Zero carbon emissions by 2050. The report estimates that at least 25,000 jobs will be in the onshore and offshore wind energy sector.

The KPMG/WEI joint report '*Economic impact of onshore wind in Ireland*[9] (April 2021) states that the wind sector currently supports 5,130 jobs (not including employment in grid development) with a '*strong foothold in rural Ireland*...[...]... *through its direct and indirect activities and employment, the sector supports payment of labour incomes totalling €225 million'.*

During the construction and decommissioning phases, it is estimated that at peak construction between 100-120 jobs will be created. This in turn will have a knock-on effect on the local economy through the supply of services to the workforce. While at a regional level additional employment will be created in the region through the supply of services and materials (such as stone and concrete) to the wind farm.

As of January 2023, 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.

Economic Value

A 2009 Deloitte report in conjunction with the Irish Wind Energy Association (now Wind Energy Ireland, WEI) titled 'Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy'[10] 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).

[7] *Siemens, IWEA 2014 An Enterprising Wind: An economic analysis of the job creation potential of the wind sector in Ireland. Available at: https://www.esri.ie/system/files/media/file-uploads/2015-07/BKMNEXT250.pdf*
[8] *Wind Energy Ireland, MaREI March 2021 Our Climate Neutral Future Zero by 50. Available at: https://windenergyireland.com/images/files/our-climate-neutral-future-0by50-final-report.pdf*
[9] *KPMG, Wind Energy Ireland April 2021 Economic impact of onshore wind in Ireland. Available at: https://windenergyireland.com/images/files/economic-impact-of-onshore-wind-in-ireland.pdf*
[10] *Deloitte, Irish Wind Energy Association 2009 Jobs and Investment in Irish Wind Energy Powering Ireland's Economy Available at: https://windenergyireland.com/images/files/9660bd5e72bcac538f47d1b02cc6658c97d41f.pdf*

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. Over the period 4.1 GW of wind generation capacity was provided in Ireland between 2000 and 2020 (2018-2020 results being projected from trend) resulting in a total net cost to consumers, over 20 years, of €63 million, equating to a cost of less than €1 per head of population per year since 2000. Further cost benefit analysis noted that wind energy has delivered €2.3 billion in savings in the wholesale electricity market.

The April 2021 KPMG report states that if 2030 construction targets are reached, the onshore wind industry alone will bring an Additional Gross Value (GVA) of €550 million per annum to the Irish economy, will contribute €305 million total payment in incomes across the supply chain and has the potential to contribute approximately €100 millon to local authority rates. Furthermore, it is estimated that €2.7 billion in capital expenditure would be invested in the country through to 2030 if Climate Action Plan targets are reached.

The Ballivor Wind Farm will be built out towards the latter half of the decade, thus contributing to the 2030 targets, providing up 100-120 jobs during the construction period 2-3 permanent jobs for the operational lifetime of the development and an estimated 20 and 40 jobs during decommissioning. Please see Appendix 4-5 for the Decommissioning Plan for the Proposed Development. The project will also result in significant rate payment to both Co. Meath and Co. Westmeath as well as providing approximately €14 million Community Funding for the local area over the lifetime of the project.

5.3.7 Land Use Patterns and Activities

Within the Wind Farm Site Boundary

The land uses within the Proposed Development site are bare cutaway peat, re-vegetation of bare peat, degraded blanket bog, scrub, low woodland, remnants of high bog and a very small area of conifer plantation. Approximately 18.9km of Bord na Móna permanent fixed gauge rail lines can be found in Ballivor, Bracklin and Carranstown Bogs. Existing activities within the site include site management and environmental monitoring as required under IPC Licence P0-501, temporary wind measurement (a single 100m meteorological mast on Lisclogher Bog). Several telecommunication links traverse the site but there is no communication infrastructure e.g. communication towers within the Wind Farm Site Boundary. Please see Chapter 14 Material Assets for further details on this.

Active peat extraction permitted under IPC Licence No. 501 ceased in June 2020. Under IPC Licence, the applicant is required to commence decommissioning and rehabilitation of the Ballivor Bog Group. Part of the decommissioning involves removing previously harvested and stockpiled peat off the bogs. The removal of stockpiled peat will be completed by 2024.

As part of the IPC licence rehabilitation requirements, the applicant is required to produce peatland rehabilitation plans, please see Appendix 6-6. These plans have considered the Proposed Development

footprint and demonstrate that both peatland rehabilitation and renewable energy can coexist harmoniously onsite.

The Peatland Climate Action Scheme (PCAS) which comprises enhanced peatland rehabilitation (above and beyond IPC licence requirements), commenced and was completed at Carranstown East, adjacent to the Wind Farm Site Boundary. Bracklin West, also adjacent to the Wind Farm Site Boundary has been selected for PCAS and it is expected to commence in 2023. This accelerated form of peatland rehabilitation has been undertaken at the recently constructed Cloncreen wind farm.

The PCAS scheme is supported by Government through the Climate Action Fund and Ireland's National Recovery and Resilience Plan administered by the Department of Environment, Climate and Communications (DECC). Please see https://www.bnmpcas.ie/ for details. The National Parks and Wildlife Service (NPWS) acts as the Scheme regulator and there is ongoing engagement with the EPA. This scheme is in addition to the IPC licence requirements and does not form part of the proposed Ballivor Wind Farm application.

Surrounding the Wind Farm Site Boundary

The predominant land use within the Study Area is agriculture. The total area of farmland within the 8 No. DEDs around the wind farm site measures approximately 8,995 hectares, comprising 52.4% of the Study Area, according to the CSO Census of Agriculture 2020.

There are 253 farms located within the 8 DEDs, with an average farm size of 46 hectares. CSO data for 2016 reports that 523 people reported farming as their employment in the Study Area which equates to approximately 11% of the Study Area population. A total of 9,355 and 6,836 reporting farming as their employment for Co. Meath and Westmeath, respectively which equates to 4.7% and 7.7% of the population in their counties, respectively. As demonstrated, farming in the Study Area is over the double the rate of farming in Co. Meath and almost 1.5 times the rate of farming in Co. Westmeath and corresponds to the rural location and landuse of the surrounding area of the Proposed Development site.

Table 5-5 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)
Killaconnigan	42	50.4	57.5	2,527	419.1	2114.9
Riverdale	34	52.2	60.5	2,250	0	1,774.9
Ballynaskeagh	18	37	61.5	1,210	0	666.2
Bracklin	22	66.7	61.5	1,661	0	1,466.6
Ballyhealy	25	24.8	58	1,036	0	619.6
Copperalley	22	53.6	55.5	1,755	145.4	1,178.2
Cloghbrack	34	39.6	65.5	1,747	0	1,348
Killyon	56	43.6	55.5	3,618	104.7	2,442.3
Total	**253**	**46 (average)**	**59.4 (average)**	**15,804**	**669.2**	**11,610.7**

Size of 8 DEDs	16,074 hectares
Total Area Farmed within 8 DEDs	11,610.7 hectares
Farmland as % of DEDs	**72%**

5.3.8 Services

The nearest village to the proposed wind farm site is Ballivor which is located 3.5km to the east in County Meath. The village provides a range of services such as educational, recreational, religious, and retail. Further services are also found in the villages of Delvin and Raharney, 5km northwest and 4km west of the Proposed Development site, respectively.

5.3.8.1 Education

The nearest school to the site of the proposed development is Coolronan National School, located approximately 1.5km southeast of Lisclogher Bog boundary at its closest point. Scoil Columbain is located 2.2km east of the site on the western fringe of Ballivor Village. Columba College in Killucan is the nearest Secondary school located 6km west of Ballivor Bog.

5.3.8.2 Access and Public Transport

The Proposed Development site is accessed via the R156 Regional Road which traverses the centre of the site. The 115C bus travels between Ballivor and Raharney along the R156 through the centre of the site several times a day. The 115C continues to Mullingar from where connections to Athlone, Tullamore, Kells, Portlaoise and Dublin can be made.

5.3.8.3 Amenities and Community Facilities

Most of the amenities and community facilities, including GAA and other sports clubs, youth clubs and recreational areas available in the area are in the nearby settlements of Ballivor, Raharney and Delvin as well as Killucan 6 km to the west. Other amenities in the area include the National Exotic Animal Sanctuary, Clay Target Shooting, Coolronan Raceway Club and the Royal County Model Flying Club.

The nearest marked walkway is the Royal Canal Walk which runs along the Royal Canal 3.3km south of the site. Community Benefit proposals, which would enhance local amenities and community facilities are described in Chapter 4: Description of the Proposed Development.

5.3.9 Tourism and Amenity

5.3.9.1 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. A 2021 publication by Fáilte Ireland titled *Key Tourism Facts 2019* states that during 2019, overseas tourists to Ireland grew by 0.7% to 9.7 million. In 2019, out-of-state (Overseas and Northern Ireland) tourist expenditure amounted to €5.6 billion. With a further €1.8 billion spent by overseas visitors on fares to Irish carriers, foreign exchange earnings were €7.4 billion. Domestic tourism expenditure amounted to €2.1 billion, making tourism a €9.5 billion industry. The Central Statistics Office's official count of direct employment in 'Accommodation and food service activities', a category which includes hotels, restaurants, bars, canteens and catering, was 177,700 in Q3 2019 (7.6% of total employment) and rises to 260,000 when including seasonal and casual employment in the industry.

The Republic of Ireland is divided into seven tourism regions. Table 5-6 shows the total revenue and breakdown of overseas tourist numbers to each region in Ireland during 2019 ('*Key Tourism Facts 2019*, Fáilte Ireland, March 2021).

Table 5-6 Overseas Tourists Revenue and Numbers 2019 (source Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Non Domestic Tourists (000s)
Dublin	€2,305m	6,927
Mid-East/Midlands	€ 400m	1,124
South-East	€282m	995
South-West	€995m	2,373
Mid-West	€480m	1,455
West	€701m	2,056
Border	€411m	1,365
Total	**€5,574 m**	**16,295**

The proposed wind farm site is located within the Mid-East/Midland Region. According to 'Regional tourism performance in 2019' (Fáilte Ireland, March 2021) the Mid-East/Midland Region which comprises Counties Offaly, Laois, Longford, Meath, Westmeath, Kildare, Louth and Wicklow, benefited from approximately 6.35% of the total number of overseas tourists to the country and approximately 6.73% of the associated tourism income generated in Ireland in 2019.

5.3.9.2 Tourism Attractions

There are no tourist attractions pertaining specifically to the wind farm site.

5.3.9.2.1 *Tourism Attractions within the surrounding landscape*

The varied environment of this area of Counties Meath and Westmeath provides many opportunities for walking and cycling, and the Proposed Development will seek to link in with existing regional and local roads to provide local connectivity to the amenity facilities onsite.

The Royal Canal runs approximately east to west just over 3km south of the Proposed Development site boundary. The Canal links the River Liffey at Dublin to the River Shannon near Tarmonbarry and its main water source is Lough Owel via a feeder channel into the canal at Mullingar. The Royal Canal was closed to navigation in 1961. The 145 km tow path along the canal is a popular walking and cycling route.

A Greenways Ireland Route (Royal Canal Greenway to Longford Arms Hotel) follows the Royal Canal before passing through the townland Grehanstown in Westmeath 5.km southwest of the site. It then meets the Royal Canal again at Ballasports County Meath 3.5km south of the site boundary. The Royal Canal is also listed under Blueways Ireland as a waterway suitable for canoeing.

Within the wider landscape there are several tourist attractions such as:

- Delvin Castle: It is believed the Nugent family built Delvin Castle in the 15th century. By the end of the 17th century the castle was uninhabited and roofless. It is believed the lower floor may have been used as a gaol in the late 18th, early 19th century. The castle is located 2.8km north of the development site. The castle interior is not accessible to the public.
- Trim Medieval and Ecclesiastical town, c. 13.km east of the development site:
    - Trim Castle
    - Priory of St John the Baptist.
    - Black Friary.

Donore Castle: this is a three storey tower house with a spiral stairway in Co. Meath built in the mid-15th century. It is not accessible to the public.

The above attractions are assessed in their respective chapters: Chapter 12 Cultural Heritage and Chapter 13 Landscape and Visual Impact.

5.3.9.3 Tourist Attitudes to Wind Farms

5.3.9.3.1 *Scottish Tourism Survey 2016*

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

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

Overall, the conclusion of this study is that published national statistics on employment in sustainable tourism demonstrate that there is no relationship between the development of onshore wind farms and tourism employment at the level of the Scottish economy, at local authority level, nor in the areas immediately surrounding wind farm development.

5.3.9.3.2 *Fáilte Ireland Surveys 2007 and 2012*

In 2007, Fáilte Ireland in association with the Northern Ireland Tourist Board published the results of a survey titled *Visitor Attitudes on the Environment ~(2008/ No. 3)'* which was carried out on 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 Fáilte Ireland survey results indicate that almost 75% of visitors answered that even more wind farms had either no impact or a positive impact on their likelihood to visit Ireland. Furthermore, of those who said more wind farms would be a positive impact on future visits to the island, the key driver is support for renewable energy, followed by potential decreased carbon emissions.

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. However, in looking at wind farm developments in different landscape types, the numbers claiming a positive impact on the landscape due to wind farms were greater than those claiming a negative impact, in all cases.

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

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

The report goes on to state that while there is a generally positive disposition among tourists towards wind development in Ireland, it is important also to take account of the views of the one in seven tourists who are negatively disposed towards wind farms. This requires good planning on the part of the wind farm developer as well as the Local Authority. Good planning has been an integral component of the Proposed Development throughout the site design and assessment processes. Reference has been made to the 'Planning Guidelines on Wind Energy Development 2006' and the 'Draft Revised Wind Energy Development Guidelines December 2019' in addition to 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 5.3.10.

5.3.10 Public Perception of Wind Energy

5.3.10.1 Sustainable Energy Authority of Ireland Survey 2003 and 2017

5.3.10.1.1 *Background*

The results of a national survey entitled 'Attitudes Towards the Development of Wind Farms in Ireland'[11] 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.

5.3.10.1.2 *Findings*

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

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

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

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

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

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

Those with direct experience of a wind farm in the locality are generally impressed with it as an additional feature in the landscape. The report states:

[11] *Sustainable Energy Ireland 2003 Attitudes Towards The Development of Wind Farms in Ireland. Available at: https://mosart.ie/wp-content/uploads/2016/02/Attitudes-Towards-Wind-Farm-Development-Ireland.pdf*

"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.

5.3.10.1.3 Survey Update 2017

Additionally, a survey carried out by Interactions in October 2017 published by the SEAI, show 47% of Irish adults polled are 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' whilst just over two in three cited cheaper electricity.

5.3.10.1.4 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 SEAI 2017 *Attitudes Towards the Development of Wind Farms in Ireland'* report, p. 41 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."

5.3.10.2 Public Perceptions of Wind Power in Ireland Survey 2005

5.3.10.2.1 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.

5.3.10.2.2 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.

5.3.10.2.3 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 pg. 866 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.

5.3.10.3 IWEA Interactions Opinion Poll on Wind Energy 2021

In January 2021 IWEA published the results of their most recent nationwide annual poll on attitudes to wind energy, the *Public Attitudes Monitor*.[12] The results of the opinion poll were published via Wind Energy Ireland, the representative body for the Irish wind industry. The objective of the poll was to 'measure and track public perceptions and attitudes around wind energy amongst Irish adults.'

Between 12th – 18th November 2020, a representative sample of 1,004 Irish adults together with a booster sample of 203 rural residents participated in an online survey. The 2020 results reported that 50% of the nationally representative sample 'strongly favour', 32% 'tend to favour' and 15% 'neither favour nor oppose' wind power. Of the rural population surveyed 42% 'strongly favour', 40% 'tend to favour' and 14% 'neither favour nor oppose' wind power. The survey has been run annually since 2017 and while there has been a marginal decrease in those in favour of wind power nationally during this time (from 85% to 82%) there has been a marginal increase in those in favour from the rural population (from 79% to 82%).

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 view that it as a 'safe resource'.

When questioned about wind energy developments in their local area, 54% of the nationally representative sample either 'favour' or 'tend to favour' such proposals compared to 52% of the rural population reporting the same. There was a high level of agreement with positive benefits concerning wind energy the local area from both the nationwide and rural populations, with over 80% of each group in agreement that it 'reduces CO2 emissions' and is 'good for the environment', with over 75% of each group agreeing that it leads to 'cheaper electricity'. Over 60% of each population group agreed that wind energy 'supports energy independence' and 'creates employment'.

The IWEA November 2020 survey follows the structure of previous national opinion polls on wind energy undertaken since 2017. The 2020 survey results are consistent with previous year's figures and thus indicate that approximately 4 out of 5 Irish adults have continued to support wind energy in recent years.

5.3.10.4 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 syndrome does not adequately explain variations in public attitudes due to the degree of subjectivity involved.

5.3.11 Wind Energy Ireland Public Attitudes Monitor December 2022

Wind Energy Ireland (WEI, formerly IWEA) undertook a survey in 2022 to '*measure and track perceptions and attitudes around wind energy amongst Irish adults'.* The results were published in the Wind Energy Ireland Public Attitudes Monitor December 2022[13] report. A total of 1,017 adults were surveyed along with a supplementary booster sample of 201 rural dwellers. The results are as follows:

[12] *Wind Energy Ireland January 2021 Public Attitudes Monitor. Available at: https://windenergyireland.com/images/files/2032-wei-version-2020-for-media.pdf*
[13] *Wind Energy Ireland December 2022 Public Attitudes Monitor. Available at: https://windenergyireland.com/images/Final_WEI_Annual_Attitudes_Survey_2022.pdf*

- 4 in 5 nationally (80%) are now in favour of wind power. This is an increase of +6% versus last year's results.
- Amongst rural residents, 4 in 5 registered favourable attitudes. This is the highest level recorded since tracking commenced in 2017.
- Almost half (45%) ranked cheaper electricity as the top wind energy benefit with reductions in CO2 cited as the second wind energy benefit.
- The survey prompt '*I don't know of any benefits'* has fallen again, to just 1 in 10 this year.
- Amongst rural residents, reducing negative feedback levels is evident year on year.
- Nationally, 58% said they would be in favour of a wind farm in their area. Again, this marks highest number in favour since tracking began.
- Amongst rural residents just 1 in 10 registered being opposed.

5.3.12 Property Values

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

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

The main conclusion of this study is as follows:

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

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

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

The 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 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 5-2 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 (p.3) are:

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

Although there have been no empirical studies carried out in Ireland on the impacts of wind farms on property prices, the literature described above demonstrates that at an international level, wind farms have not impacted property values in areas near wind farms. 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.

5.3.13 Residential Amenity

Residential Amenity comprises a range of visual, aural and other sensory components. Development can cause effects on one or more components of Residential Amenity, for example effects of noise, dust, access to daylight, vibration, shadow flicker, outlook and visual amenity.[14] 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.

The Proposed Development is located within a rural setting and comprises bare cutaway peat, re-vegetating bare peat, degraded blanket bog, scrub, low woodland, remnants of high bog and a very small area of conifer plantation. The surrounding landscape comprises turbary and agriculture (predominantly pastoral) with some commercial forestry. The closest dwelling to the proposed Ballivor Wind Farm is located approximately 815m from the nearest proposed turbine (T17), i.e., greater than the recommended setback distance (i.e., 800m, 4 times the tip height of 200m) for residential amenity purposes, as per the Draft Revised Wind Energy Development Guidelines December 2019. The majority of receptors within

[14] *Definition source: British Landscape Institute Residential Visual Amenity Assessment (RVAA) Technical Guidance Note 2/19.*

the study area generally comprise one off rural housing and farmsteads and ribbon housing along local roads.

When considering the amenity of residents in the context of a proposed wind farm, there are three main potential impacts of relevance: 1) Shadow Flicker, 2) Noise, and 3) Visual Amenity. Shadow flicker and noise are quantifiable aspects of residential amenity while visual amenity is more subjective. Detailed shadow flicker and noise impact assessments have been completed as part of this EIAR (Section 5.5 refers to shadow flicker, Chapter 11 addresses noise and vibration). A comprehensive landscape and visual impact assessment have also been carried out, as presented in Chapter 13 of this EIAR. Impacts on the local population during the construction, operational and decommissioning phases of the Proposed Development is assessed in relation to each of these key issues and other environmental factors such as noise, traffic, and dust; see Impacts in Section 5.6 below. The impact on residential amenity is then derived from an overall judgement of the combination of impacts due to shadow flicker, changes to land-use and visual amenity, noise, traffic, dust and general disturbance.

5.4 Baseline Environment- Health

5.4.1 Introduction

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 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.

5.4.2 Baseline

Tables 5-7 and 5-8 below details the general health of persons by percentage for the State, County Meath and County Westmeath and the Study Area for the most recent census taken in Ireland, 2016 and 2011, which have data publicly available. In general, the percentage health breakdown for the State, Counties and study area populations are very similar. The Study Area, State and Counties all reported in the range of 90% for a combined 'very good' and 'good' health. The majority of electoral divisions in the study area reported a lower percentage than the State and Counties for those who have a 'bad' and 'very bad' health. Therefore, it can be concluded that those living in the Study Area consider their health to be in a better condition that the State and County average.

Table 5-7 Percentage General Health Breakdown for the State and Counties Meath and Westmeath as reported in the 2016 and 2011 Census. Source www. CSO.ie

	Very Good		Good		Fair		Bad		Very Bad		Not Stated	
	2016	2011	2016	2011	2016	2011	2016	2011	2016	2011	2016	2011
State	59.4%	60.3%	27.6%	28%	8%	8%	1.3%	1.2%	0.3%	0.3%	3.3%	2.2%
Westmeath	58%	59.2%	28.7%	28.8%	8.2%	8.2%	1.3%	1.3%	0.3	0.3%	2.9%	2%
Meath	63%	63.8%	26.48%	26.7%	6.68%	6.4%	1.3%	1%	0.2%	0.2%	2.4%	1.8%

Table 5-8 Percentage General Health Breakdown for the study area as reported in the 2016 and 2011 Census. Source www. CSO.ie

Study Area- Electoral Divisions	Very Good		Good		Fair		Bad		Very Bad		Not Stated	
	2016	2011	2016	2011	2016	2011	2016	2011	2016	2011	2016	2011
Bracklin, Westmeath	60%	59.2%	30%	28.9%	8.5%	6.8%	0.7%	1.1%	0	0	0.4%	1.1%
Ballyhealy, Westmeath	58%	65.7%	31.3%	23%	9%	6.4%	0.7%	2.5%	0	0.4%	1%	1.4%
Copperalley, Westmeath	56%	63%	33.8%	26.7%	6.5%	7%	1.4%	1.8%	0.4%	0	1.1%	1.1%

Cloghbrack, Meath	61.3%	59.6%	28.28%	29.3%	6.9%	7.6%	2%	1.4%	0	0.4%	1.4%	1.8%
Killaconnigan, Meath	65%	66.4%	24%	26.4%	6.7%	5%	1.07%	0.8%	0.13%	0.3%	3%	0.9%
Killyon	63%	62%	27.8%	24.7%	6.8%	7.7%	1%	1.2%	0.4%	0	1%	5%
Riverdale, Meath	67%	63.8%	26%	25.1%	5.4%	9.3%	0.9%	1.17%	0.2%	0.2%	0.4%	0.4%
Ballynaskeagh, Westmeath	67.3%	65.3%	22.3%	24.25%	7%	8.2%	1.7%	1.5%	0	0	1.4%	0.75%

5.4.2.1 Air Quality

5.4.2.1.1 *Dust, NO_2, PM_{10} and PM_{25} and CO_2 Emissions*

Chapter 10 Air and Climate assesses the potential for impact to human health from dust CO2 and other noxious emissions generated by additional vehicles and plant machinery as well as the release of CO_2 through excavations. The assessment considers the construction, operation and decommissioning phases. The assessment concludes that there will be no significant direct or indirect effects during the construction and decommissioning phases while there will be a direct long term moderate positive impact for the operational phase due to the offset of approximately 6,035,010 to 8,717,237 tonnes of CO_2 (against EU Fossil Fuel Comparator (FFC)) from fossil fuel-based electricity generation over the proposed 30-year lifespan of the proposed wind farm. Please see Chapter 9 for further details.

5.4.2.2 Water quality

There is 1 no. mapped PWS (Public Water Supply Scheme) within 3 km of the Ballivor Bog Group. The well was drilled in 1994. Prior to this, the water supply came from the Stonyford River. The Source Protection Area (SPA) for the Ballivor PWS is located to the east of Carranstown and Bracklin Bogs, approximately 1.5 km north of Ballivor village and more than 2km from the boundary of the Ballivor Bog Group. The GSI also map several additional private boreholes and wells in the vicinity of the Ballivor Bog Group. Chapter 9 Hydrology and Hydrogeology assess the potential for impact on public water supply and private wells during the construction, operation and decommissioning phases. The assessment concludes that there will be no significant direct or indirect effects during the three phases of the Proposed Development.

5.4.2.3 Noise and Vibration

Chapter 11 Noise and Vibration assesses the potential for noise and vibration impacts during the construction, operation and decommissioning phases of the Proposed Development. The assessment includes mitigation measured that will be complied with for the duration of the construction and decommissioning phases. concludes that there will be no significant effects. Operational monitoring will be undertaken to ensure the Proposed Development complies with any noise conditions applied to the development if consented.

5.4.2.4 Traffic & Transport

Chapter 14 Material Assets assesses the potential for traffic and transport impacts during the construction, operation and decommissioning of the Proposed Development. The assessment included a study of the

additional traffic generated on the local roads during the construction phase through component and construction materials delivery as well as staff vehicles, and an assessment of potential traffic and transport impacts during the operational phase through amenity and maintenance vehicles. The assessment includes a preliminary Traffic Management Plan for the construction phase and all abnormal loads will be supervised by competent experts and An Gardai. The assessment concluded there will be no significant impacts during any phase of the Proposed Development. Please see Chapter 14 for details.

In addition to increased traffic volumes during the construction phase, it will be required to insert connecting cables (approx. 3m) in the road network between Ballivor Bog and Carranstown Bog (R156) and Lisclogher Bog and Bracklin Bog (local unnamed road). This work will be brief, i.e. undertaken and reinstated in 1-2 days and will require a road opening licence from the local authority prior to commencement.

5.4.2.5 Vulnerability of the Project to/from Major Accidents and Natural Disasters

An assessment of the Proposed Development's vulnerability to and from natural disasters can be found in Chapter 15 Major Accidents and Natural Disasters of this EIAR. A brief discussion can be found below.

5.4.2.5.1 *Pollution/Contamination*

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 both 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. Consequently, 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 impacts on human health. The issue of turbine safety is addressed in Section 5.1.4 above.

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 (nearest being Ecolabs, 18km west of the Proposed Development site) and so there are no potential effects from this source.

There is limited potential for significant natural disasters to occur at the proposed Ballivor Wind Farm site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to flooding and landslides.

5.4.2.5.2 *Flooding*

The site lies outside of the OPW's indicative river and coastal flood zones. In addition, the GSI Groundwater Flood mapping does not record any groundwater flood zones with the site. The Local Authority Strategic Flood Risk Assessment (SFRA) mapping indicates that areas in the northwest of Lisclogher Bog are vulnerable to fluvial flooding. However, site walkovers have revealed that the EPA incorrectly map a river to cross Lisclogher Bog casting doubt on the validity of the flood zones in this area. CFRAM mapping includes modelled flood levels for the 10-year and 100-year flood events. These levels, modelled near Ballivor village, range from 64.19 – 65.34m OD and are well above the current outfall pipe elevations at the site. Therefore, the risk of fluvial flooding along the Ballivor River, located to the east of the site, backing up into the site drainage network is very low.

The main risk of flooding across much of the site is via pluvial flooding due to the low permeability peat soils and subsoils. The surface of the cutover bog contains an extensive network of peat drains with surface water outflows from the bogs. This existing drainage network has reduced the risk of pluvial flooding across much of the site. However, following periods of intense and prolonged rainfall events localised surface water ponding still could occur in places. Flood modelling of Ballivor, Bracklin West, and Carranstown bogs have been completed by Bord na Móna (2020). That study indicates there is significant storage within each of the bog basins to alleviate any flood risk associated with pluvial flooding. The risk of flooding from the Proposed Development is addressed in Chapter 8: Hydrology and Hydrogeology and Appendix 8-1 Flood Risk Assessment.

5.4.2.5.3 *Peat Landslide*

Geological Survey Ireland (GSI) does not have any records of historic landslides within the site or in the surrounding lands in 1988 or otherwise. The closest recorded landslide event (1999) is mapped at Girley Bog, Chamberlainstown, approximately 12km northeast of Lisclogher Bog. Girley Bog is classed as a raised intact bog. "No apparent Impact" is recorded for this event.

The GSI Landslide Susceptibility Map (www.cso.ie).) classifies the probability of a landslide occurring at Ballivor Bog Group as Low. This is due to the sites relatively flat topography.

A Peat Stability Assessment was undertaken at the site in 2021 by Fehily Timoney to assess the susceptibility of the site to peat failure following the principles in Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, Scottish Government, 2017). The findings, which involved analysis of approximately 300 locations, show that the site has an acceptable margin of safety. Slope inclinations across the site range from 2 to 4 degrees and therefore, the flat topography/nature of the terrain on site reflects the low risk of peat failure.

The Peat Stability Assessment concluded that the stability i.e., Factor of Safety (FoS), of the peat slopes for the site has an acceptable value of 1.3 (FoS of less than 1.0 indicates an unstable slope and a FoS of greater than 1.0 indicating a stable slope). Please see Chapter 8 Land Soil and Geology for details

5.4.3 Summary

Chapter 8: Land, Soils and Geology, Chapter 9: Hydrology and Hydrogeology, Chapter 10: Air and Climate, Chapter 11: Noise and Vibration and Chapter 14: Material Assets (Traffic and Transport) provide an assessment of the effects of the Proposed Development on these areas of consideration. Chapter 15 assesses the vulnerability of the project to and from major accidents and natural disasters. 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 in the chapters listed show that the residual impacts are not significant and will not lead to significant effects on any environmental media with the potential to lead to health effects for humans. On this basis, the potential for negative health effects associated with the Proposed Development is imperceptible. Furthermore, the proposed Ballivor Wind Farm is capable of offsetting carbon emissions associated with the burning of fossil fuels. During the operational stage the wind farm will have a long term, moderate positive effect on air quality as set out in Chapter 10 which will contribute to positive effects on human health and assist in Ireland reaching its emissions targets and renewable energy goals.

5.5 Ballivor Wind Farm Shadow Flicker Assessment

Planning permission is being sought for a turbines with a tip height of 200 metres above the top of foundation with a blade length of 85m and a hub height of 115m.

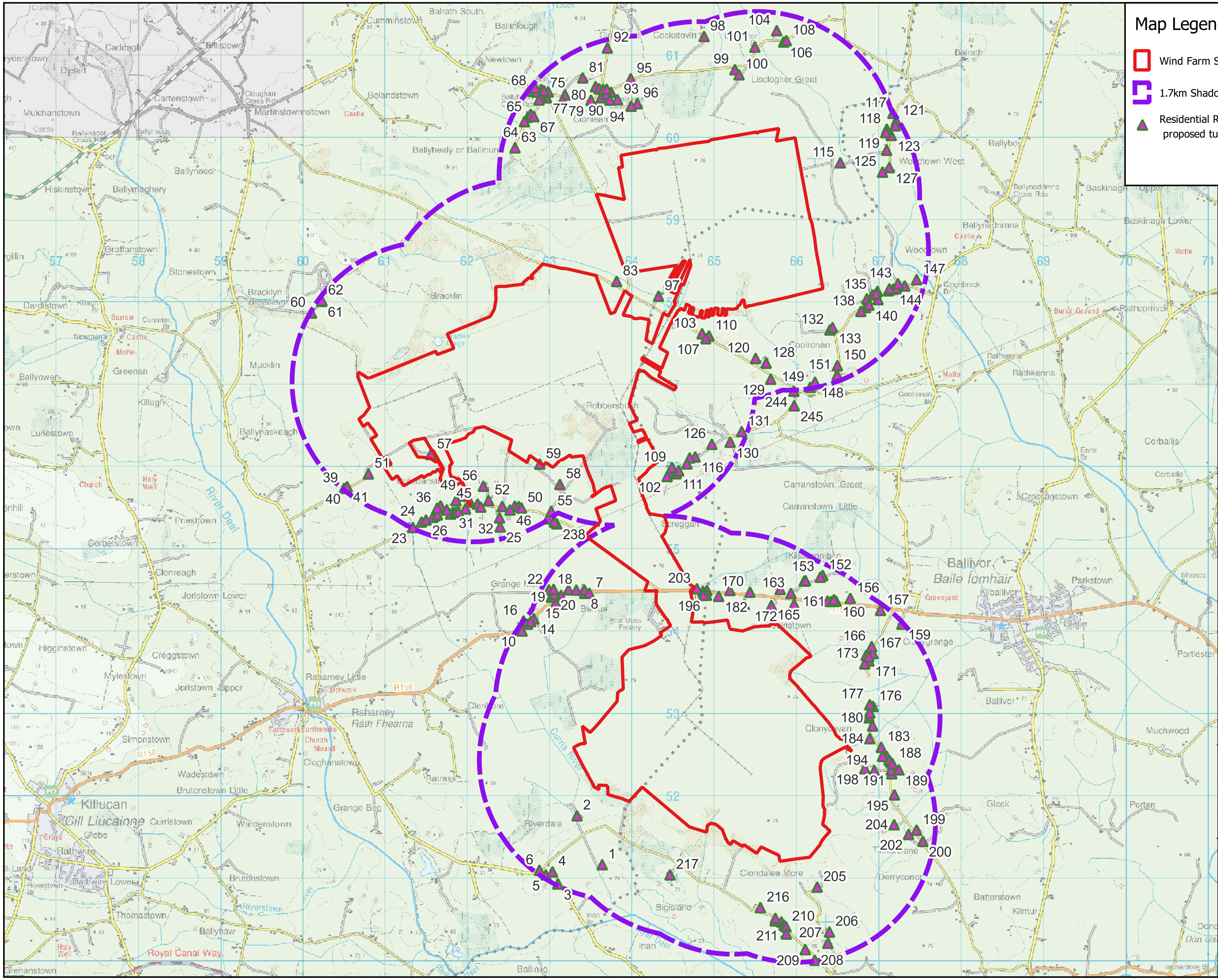
With the benefit of the mitigation measures outlined in Section 5.6.3.2.6, all turbines installed onsite will comply with the current, adopted 2006 DoEHLG guideline thresholds of 30 minutes per day or 30 hours per year or with the revised guidelines, if required, through the use of turbine control software.

5.5.1 Shadow Flicker Study Area

At the outset of the project, during the constraints mapping process detailed in Chapter 3 of this EIAR, all sensitive receptors within 2km of the Wind Farm Site boundary were identified and mapped. In addition, a planning history search to identify properties that may have been granted planning permission, but not yet been constructed, was carried out. These properties were also added to the sensitive receptors' dataset.

The study area for the shadow flicker assessment is ten times rotor diameter from each turbine as set out in the Wind Energy Development Guidelines for Planning Authorities', DoEHLG, 2006. All residential properties located within ten rotor diameters, which is assumed to be 1.7 km, have been included in the assessment. The closest residential property is located 815 m from the nearest proposed turbine location (T17).

There are 217 No. sensitive receptors located within 10 rotor diameters (1.7km) of the proposed turbine locations. No dwellings are located within the 4 times tip height setback distance of each turbine, a measure outlined in the 2019 Draft Revised Guidelines, should these come into force while this project is in the application process. The shadow flicker study area and sensitive receptor locations are shown in Figure 5-6.



Map Legend

- Wind Farm Site Boundary
- 1.7km Shadow Flicker Study Area
- Residential Receptors within 1.7km of the proposed turbines (4 x tip height)

Drawing Title	Shadow Flicker Study Area
Project Title	Proposed Ballivor Wind Farm
Drawn By: Karen Mulryan	Checked By: Eoin McCarthy
Project No.: 191137	Drawing No.: Figure 5-6
Scale: 1:60,000	Date: 02.02.2023

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5.5.2 Daily and Annual Shadow Flicker

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

The model results assume worst-case conditions, including:

- No cloud cover during all daylight hours throughout the year,
- An absence of any screening (vegetation or other buildings),
- That the turbine rotors are facing the property, and
- That the turbine rotors are moving.

The shadow flicker model assumes that daylight hours consist of 100% sunshine. This is a conservative assumption which represents a worst-case scenario. Following the detail provided above on sunshine hours, a sunshine factor of 30% has been applied. Taking these probabilities into consideration, an approximation of the 'estimated actual' annual shadow flicker occurrence has been calculated and is presented in Table 5-9.

The estimated annual levels are then considered in the context of the DoEHLG's Draft Revised Wind Energy Development Guidelines in December 2019 which require that no existing dwelling or other affected property experience shadow flicker as a result of any proposed wind energy development.

Of the 217 No. residential properties modelled, 71 properties experience zero shadow flicker minutes while it is predicted that 146 properties may experience some daily shadow flicker. Based on the 2006 DoEHLG guidelines, the daily threshold of over 30 minutes shadow flicker may potentially be exceeded at 80 properties. The annual threshold of over 30 hours for shadow flicker is predicted to be exceeded at 12 properties once the regional sunshine average factor of 30% has been considered.

It is worth noting that the predicted exceedances of 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 which is what the WindFarm software assumes in its model.

Section 5.6.3.2.6 below details the mitigation measures which will be employed at the potentially affected properties to ensure that the current adopted 2006 DoEHLG guidelines are complied with at any dwelling within the study area. The same mitigation measures also demonstrate that the proposed Ballivor Wind Farm can be operated in accordance with the shadow flicker requirements of the Draft Revised Wind Energy Development Guidelines (2019), i.e. zero shadow flicker occurrences, should they be adopted while the planning application is being determined.

Table 5-9 Maximum Potential Daily & Annual Shadow Flicker – Proposed Ballivor Wind Farm, Co. Meath & Co. Westmeath.

House No.	ITM (Easting)	ITM (Northing)	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 (30%) (hrs:min:sec)	Turbine(s) contributing to Shadow Flicker Exceedance and therefore requiring Mitigation
2	663,271	751,776	848	T10	00:31:12	38:30:00	11:33:00	9
7	663,421	754,481	1,186	T12	00:36:36	32:48:00	09:50:24	12
8	663,364	754,480	1,229	T12	00:35:24	28:42:00	08:36:36	12
9	663,360	754,521	1,258	T12	00:34:48	29:12:00	08:45:36	12
12	663,262	754,519	1,334	T12	00:33:00	23:36:00	07:04:48	12
18	663,167	754,523	1,413	T12	00:31:12	19:48:00	05:56:24	12
79	663,092	760,469	1,306	T22	00:34:12	38:18:00	11:29:24	22
80	663,125	760,537	1,332	T22	00:33:00	35:36:00	10:40:48	22
82	663,441	760,473	1,089	T22	00:36:00	47:18:00	14:11:24	22
83	663,752	758,271	824	T14	01:05:24	132:30:00	39:45:00	14,15,16,19
86	663,565	760,504	1,056	T22	00:31:12	37:30:00	11:15:00	22,23
87	663,588	760,603	1,137	T22	00:30:36	23:06:00	06:55:48	23
88	663,626	760,545	1,069	T22	00:31:48	28:54:00	08:40:12	23
89	663,631	760,607	1,125	T22	00:31:12	22:36:00	06:46:48	23
90	663,670	760,475	987	T22	00:33:00	37:30:00	11:15:00	22,23
91	663,685	760,570	1,072	T22	00:32:24	24:36:00	07:22:48	23
93	663,762	760,481	964	T22	00:35:24	33:18:00	09:59:24	23
94	663,929	760,401	853	T22	00:50:24	84:36:00	25:22:48	23
95	663,924	760,734	1,185	T22	00:31:48	32:42:00	09:48:36	23
96	664,004	760,432	879	T22	00:51:00	86:18:00	25:53:24	23
97	664,262	758,091	957	T19	01:04:12	146:42:00	44:00:36	14,19
103	664,791	757,635	944	T19	00:34:48	39:54:00	11:58:12	13.14

House No.	ITM (Easting)	ITM (Northing)	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 (30%) (hrs:min:sec)	Turbine(s) contributing to Shadow Flicker Exceedance and therefore requiring Mitigation
107	664,835	757,574	988	T19	00:34:12	37:30:00	11:15:00	13,14
110	664,875	757,610	942	T19	00:33:00	35:12:00	10:33:36	13
115	666,471	759,713	831	T25	01:10:12	102:18:00	30:41:24	24,25
125	666,984	759,599	1,278	T25	00:32:24	54:18:00	16:17:24	25
126	664,909	756,291	1,372	T13	00:33:00	38:42:00	11:36:36	13
127	667,066	759,655	1,370	T25	00:30:36	47:54:00	14:22:12	25
132	666,344	757,682	1,087	T20	00:31:12	29:36:00	08:52:48	19
133	666,377	757,710	1,078	T20	00:30:36	33:24:00	10:01:12	19,20
134	666,793	758,058	1,117	T20	00:40:12	45:18:00	13:35:24	20
135	666,863	758,106	1,154	T20	00:38:24	52:00:00	15:36:00	20
136	666,922	758,150	1,187	T20	00:37:12	42:24:00	12:43:12	20
137	666,903	758,120	1,183	T20	00:37:12	49:54:00	14:58:12	20
139	666,778	757,953	1,163	T20	00:34:12	24:48:00	07:26:24	20
140	666,819	757,984	1,179	T20	00:37:48	35:12:00	10:33:36	20
141	666,930	758,050	1,239	T20	00:36:00	47:06:00	14:07:48	20
142	667,056	758,157	1,307	T20	00:33:36	26:48:00	08:02:24	20
143	667,172	758,242	1,388	T20	00:31:12	19:42:00	05:54:36	20
144	667,114	758,177	1,354	T20	00:32:24	23:00:00	06:54:00	20
145	667,157	767,233	1,386	T20	00:31:12	21:24:00	06:25:12	20
162	666,316	754,386	1,319	T02	00:30:36	38:06:00	11:25:48	1
163	665,870	754,479	1,200	T01	00:33:36	32:48:00	09:50:24	1
165	665,910	754,348	1,115	T02	00:36:36	46:18:00	13:53:24	1

House No.	ITM (Easting)	ITM (Northing)	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 (30%) (hrs:min:sec)	Turbine(s) contributing to Shadow Flicker Exceedance and therefore requiring Mitigation
166	666,852	753,832	1,227	T03	00:36:00	59:06:00	17:43:48	2,3
167	666,868	753,748	1,182	T03	00:36:36	52:00:00	15:36:00	2,3
168	666,816	753,710	1,117	T03	00:39:00	67:00:00	20:06:00	2,3
169	666,785	753,727	1,106	T03	00:39:00	75:06:00	22:31:48	2,3
170	665,373	754,494	1,006	T01	00:33:36	24:30:00	07:21:00	12
171	666,818	753,659	1,086	T03	00:39:36	66:00:00	19:48:00	2,3
172	665,633	754,331	946	T01	00:42:00	56:24:00	16:55:12	1
173	666,767	753,623	1,023	T03	00:42:00	71:30:00	21:27:00	2,3
174	665,129	754,515	1,005	T01	00:38:24	46:30:00	13:57:00	12
175	665,305	754,342	844	T01	00:36:36	42:54:00	12:52:12	1,12
176	666,869	753,106	896	T03	00:45:36	84:54:00	25:28:12	2,3,4
177	666,829	753,127	861	T03	00:46:48	98:54:00	29:40:12	2,3,4
178	666,831	753,027	849	T03	00:56:24	107:18:00	32:11:24	2,3,4
179	666,809	752,996	826	T03	01:01:48	113:30:00	34:03:00	2,3,4
180	666,822	752,967	838	T03	01:03:36	115:12:00	34:33:36	2,3,4
181	666,864	752,868	886	T03	01:08:24	119:30:00	35:51:00	2,3,4
182	664,993	754,443	948	T01	00:53:24	65:00:00	19:30:00	12
183	666,969	752,609	1,048	T03	01:00:00	107:30:00	32:15:00	3,4,7
184	666,829	752,714	882	T03	01:12:36	149:12:00	44:45:36	2,3,4,7
185	667,036	752,497	1,152	T03	00:52:12	99:18:00	29:47:24	3,4,7
186	667,063	752,455	1,194	T03	00:49:48	100:48:00	30:14:24	3,4,7
187	667,081	752,431	1,220	T03	00:36:00	82:42:00	24:48:36	3,4,7

House No.	ITM (Easting)	ITM (Northing)	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 (30%) (hrs:min:sec)	Turbine(s) contributing to Shadow Flicker Exceedance and therefore requiring Mitigation
188	667,105	752,410	1,251	T03	00:35:24	79:48:00	23:56:24	3,4,7
189	667,183	752,335	1,355	T03	00:33:00	69:54:00	20:58:12	3,4,7
190	666,984	752,500	1,103	T03	00:53:24	118:36:00	35:34:48	3,4,7
191	667,090	752,333	1,274	T03	00:35:24	79:00:00	23:42:00	3,4,7
192	664,849	754,515	951	T12	01:01:48	54:24:00	16:19:12	12
193	667,097	752,287	1,303	T04	00:34:48	77:30:00	23:15:00	3,4,7
194	666,884	752,323	1,095	T04	00:41:24	91:48:00	27:32:24	3,4,7
195	667,129	752,030	1,247	T07	00:33:36	46:42:00	14:00:36	4,7
196	664,845	754,457	900	T12	01:32:24	78:06:00	23:25:48	12
197	664,801	754,505	917	T12	01:24:00	62:12:00	18:39:36	12
198	666,769	752,349	984	T04	00:41:24	106:24:00	31:55:12	3,4,7
201	664,805	754,455	876	T12	01:40:48	84:00:00	25:12:00	12
202	667,301	751,550	1,381	T07	00:30:36	33:30:00	10:03:00	7
203	664,728	754,535	908	T12	01:26:24	55:48:00	16:44:24	12
204	667,125	751,668	1,197	T07	00:34:48	42:24:00	12:43:12	4,7

5.5.3 Cumulative Shadow Flicker

The cumulative assessment of shadow flicker generated by the Proposed Development and other existing and permitted wind farms with potential to cause cumulative shadow flicker effects was carried out based on the methodology, assumptions and criteria detailed in Section 5.2.2.1.

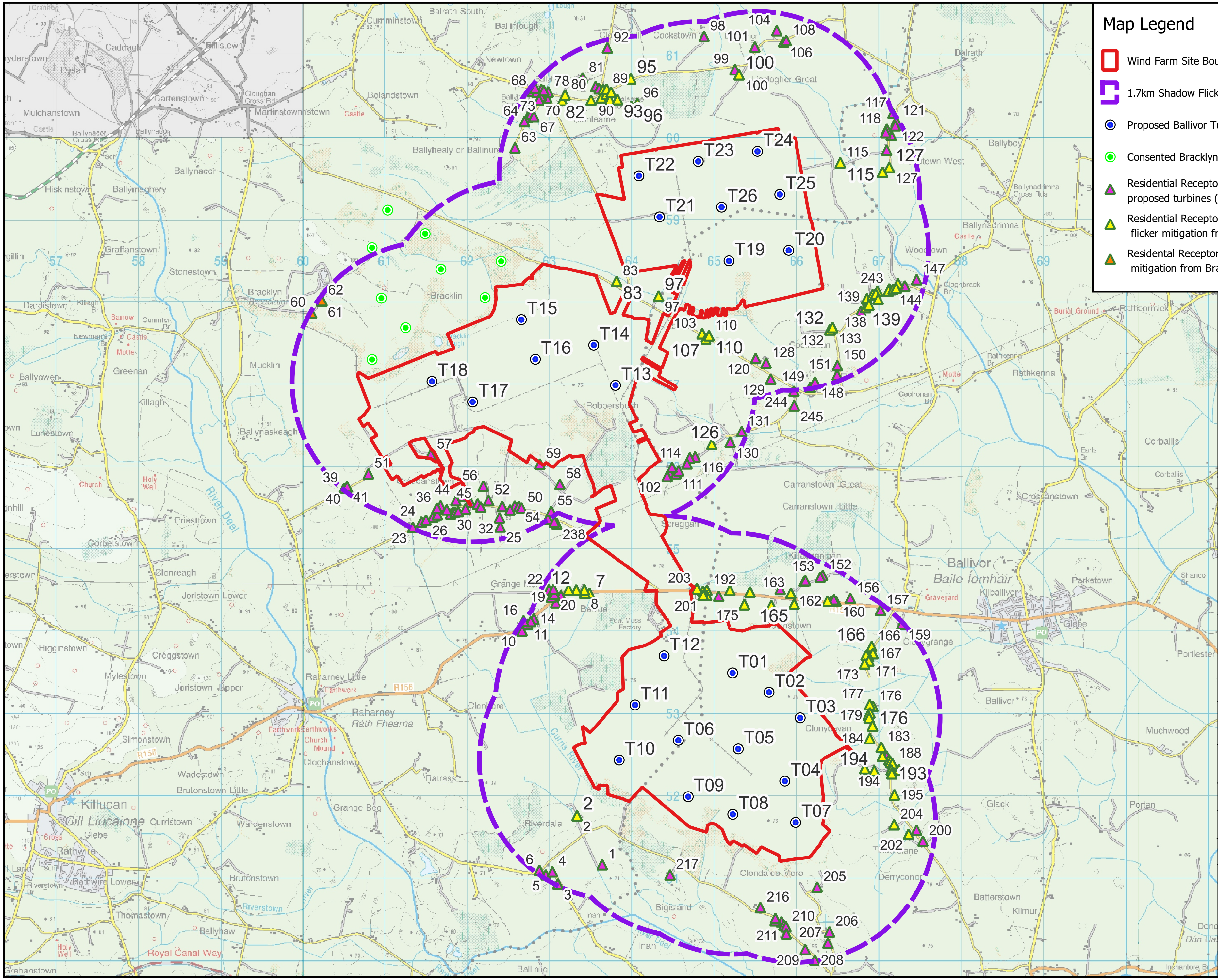
Table 5-10 below shows the potential cumulative shadow flicker impact on residential receptors within the shadow flicker study area from the Proposed Development in combination with other proposed development. A review of all proposed, consented and operational wind farms within 5km was undertaken. As shadow flicker occurs within 10 rotor diameters, including of wind farms outside of 5km is considered extremely unlikely. There is one consented wind farm development within 5km of the site; Bracklyn Wind Farm (PA25M.311565) is a 9-turbine wind farm located adjacent to the proposed Ballivor Wind Farm site boundary.

The cumulative assessment below includes for the most conservative shadow flicker impact. All turbines proposed for Ballivor Wind Farm in addition to all consented Bracklyn wind turbines are assessed.

Of the 217 No. residential properties modelled, 71 properties experience zero shadow flicker minutes while it is predicted that 146 properties may experience some daily shadow flicker. Based on the 2006 DoEHLG guidelines, the daily threshold of over 30 minutes shadow flicker may potentially be exceeded at 83 properties, with three of these properties (H60, H61 and H62) being impacted by Bracklyn Wind Farm alone. The annual threshold of over 30 hours for shadow flicker is predicted to be exceeded at 15 properties once the regional sunshine average factor has been considered, with Bracklyn Wind Farm alone causing exceedances at three of these properties (H60, H61 and H62).

Section 5.6.3.2.6 below details the mitigation measures which will be employed at the potentially affected property to ensure that the current adopted 2006 DoEHLG guideline thresholds for daily or annual shadow flicker are complied with at any dwelling within the study area. The same mitigation measures also demonstrate that the proposed Ballivor Wind Farm can be operated in accordance with the shadow flicker requirements of the Draft Revised Wind Energy Development Guidelines (2019) should they be adopted while the planning application is being determined.

Figure 5-7 illustrates the houses that are potentially impacted by shadow flicker exceedances from Ballivor Wind Farm and the Bracklin Wind Farm.



Map Legend

- Wind Farm Site Boundary
- 1.7km Shadow Flicker Study Area
- Proposed Ballivor Turbines
- Consented Bracklyn Turbines
- Residential Receptors within the 1.7km of the proposed turbines (4 x tip height)
- Residential Receptors that may require shadow flicker mitigation from Ballivor Wind Farm
- Residental Receptors that may require shadow flicker mitigation from Bracklyn Wind Farm

Drawing Title
Receptors that may require Shadow Flicker Mitigation

Project Title
Proposed Ballivor Wind Farm

Drawn By	Checked By
Karen Mulryan	Eoin McCarthy
Project No. 191137	Drawing No. Figure 5-7
Scale 1:60,000	Date 02.02.2023

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Table 5-10 Potential Cumulative Shadow Flicker Impact above WEGS 2006 permitted levels from the Proposed Ballivor Wind Farm and surrounding Wind Farms within 5km.

House No.	ITM (Easting)	ITM (Northing)	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 (30%) (hrs:min:sec)	Turbine(s) contributing to Cumulative Shadow Flicker Exceedance and therefore requiring Mitigation T1-26 = Ballivor T27-35 = Bracklyn
2	663,271	751,776	848	T10	00:31:12	38:30:00	11:33:00	9
7	663,421	754,481	1,186	T12	00:36:36	32:48:00	9:50:24	12
8	663,364	754,480	1,229	T12	00:35:24	28:42:00	8:36:36	12
9	663,360	754,521	1,258	T12	00:34:48	29:12:00	8:45:36	12
12	663,262	754,519	1,334	T12	00:33:00	23:36:00	07:04:48	12
18	663,167	754,523	1,413	T12	00:31:12	19:48:00	5:56:24	12
60	660,052	757,887	1,684	T18	00:36:36	114:42:00	34:24:36	29,30,31
61	660,177	758,029	1,656	T18	00:37:48	190:00:00	57:00:00	29,30,31
62	660,178	758,038	1,661	T18	00:37:12	189:18:00	56:47:24	29,30,31
79	663,092	760,469	1,306	T22	00:34:12	14:18:00	11:29:24	22
80	663,125	760,537	1,332	T22	00:33:00	11:36:00	10:40:48	22
82	663,441	760,473	1,089	T22	00:36:00	23:18:00	14:11:24	22
83	663,752	758,271	824	T14	00:34:12	157:12:00	47:09:36	14,15,16,19,
86	663,565	760,504	1,056	T86	00:31:12	13:30:00	11:15:00	22,23
87	663,588	760,603	1,137	T87	00:30:36	23:06:00	6:55:48	23
88	663,626	760,545	1,069	T88	00:31:48	04:54:00	8:40:12	23
89	663,631	760,607	1,125	T89	00:31:12	22:36:00	6:46:48	23
90	663,670	760,475	987	T90	00:33:00	13:30:00	11:15:00	22,23
91	663,685	760,570	1,072	T91	00:32:24	00:36:00	7:22:48	23
93	663,762	760,481	964	T93	00:35:24	09:18:00	9:59:24	23
94	663,929	760,401	853	T22	00:34:12	84:36:00	25:22:48	23

House No.	ITM (Easting)	ITM (Northing)	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 (30%) (hrs:min:sec)	Turbine(s) contributing to Cumulative Shadow Flicker Exceedance and therefore requiring Mitigation T1-26 = Ballivor T27-35 = Bracklyn
95	663,924	760,734	1,185	T22	00:31:48	08:42:00	9:48:36	23
96	664,004	760,432	879	T22	00:36:00	86:18:00	25:53:24	23
97	664,262	758,091	957	T19	00:34:48	146:42:00	44:00:36	14,19
103	664,791	757,635	944	T19	00:34:48	15:54:00	11:58:12	13,14
107	664,835	757,574	988	T19	00:34:12	13:30:00	11:15:00	13,14
110	664,875	757,610	942	T19	00:33:00	11:12:00	10:33:36	13
115	666,471	759,713	831	T25	00:37:12	102:18:00	30:41:24	24,25
125	666,984	759,599	1,278	T25	00:32:24	06:18:00	16:17:24	25
126	664,909	756,291	1,372	T13	00:33:00	14:42:00	11:36:36	13
127	667,066	759,655	1,370	T25	00:30:36	23:54:00	14:22:12	25
132	666,344	757,682	1,087	T20	00:31:12	05:36:00	8:52:48	19
133	666,377	757,710	1,078	T20	00:30:36	09:24:00	10:01:12	19
134	666,793	758,058	1,117	T20	00:35:24	45:18:00	13:35:24	20
135	666,863	758,106	1,154	T20	00:33:36	52:00:00	15:36:00	20
136	666,922	758,150	1,187	T20	00:37:12	18:24:00	12:43:12	20
137	666,903	758,120	1,183	T20	00:37:12	01:54:00	14:58:12	20
139	666,778	757,953	1,163	T20	00:34:12	24:48:00	7:26:24	20
140	666,819	757,984	1,179	T20	00:31:12	35:12:00	10:33:36	20
141	666,930	758,050	1,239	T20	00:31:12	47:06:00	14:07:48	20
142	667,056	758,157	1,307	T20	00:33:36	00:33:36	00:33:36	20
143	667,172	758,242	1,388	T20	00:31:12	00:31:12	00:31:12	20
144	667,114	758,177	1,354	T20	00:32:24	00:32:24	00:32:24	20

House No.	ITM (Easting)	ITM (Northing)	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 (30%) (hrs:min:sec)	Turbine(s) contributing to Cumulative Shadow Flicker Exceedance and therefore requiring Mitigation T1-26 = Ballivor T27-35 = Bracklyn
145	667,157	767,233	1,386	T20	00:31:12	00:31:12	00:31:12	20
162	666,316	754,386	1,319	T02	00:30:36	00:30:36	00:30:36	1
163	665,870	754,479	1,200	T01	00:33:36	00:33:36	00:33:36	1
165	665,910	754,348	1,115	T02	00:31:48	46:18:00	13:53:24	1
166	666,852	753,832	1,227	T03	00:36:00	59:06:00	17:43:48	2,3
167	666,868	753,748	1,182	T03	00:36:36	52:00:00	15:36:00	2,3
168	666,816	753,710	1,117	T03	00:39:00	67:00:00	20:06:00	2,3
169	666,785	753,727	1,106	T03	00:39:00	75:06:00	22:31:48	2,3
170	665,373	754,494	1,006	T01	00:33:36	24:30:00	7:21:00	12
171	666,818	753,659	1,086	T03	00:39:36	66:00:00	19:48:00	2,3
172	665,633	754,331	946	T01	00:31:12	56:24:00	16:55:12	1
173	666,767	753,623	1,023	T03	00:42:00	71:30:00	21:27:00	2,3
174	665,129	754,515	1,005	T01	00:38:24	46:30:00	13:57:00	12
175	665,305	754,342	844	T01	00:36:36	42:54:00	12:52:12	1,12
176	666,869	753,106	896	T03	00:45:36	84:54:00	25:28:12	2,3,4
177	666,829	753,127	861	T03	00:46:48	98:54:00	29:40:12	2,3,4
178	666,831	753,027	849	T03	00:28:12	107:18:00	32:11:24	2,3,4
179	666,809	752,996	826	T03	00:30:00	113:30:00	34:03:00	2,3,4
180	666,822	752,967	838	T03	00:30:00	115:12:00	34:33:36	2,3,4
181	666,864	752,868	886	T03	00:30:36	119:30:00	35:51:00	2,3,4
182	664,993	754,443	948	T01	00:39:36	65:00:00	19:30:00	12
183	666,969	752,609	1,048	T03	00:32:24	107:30:00	32:15:00	3,4,7

House No.	ITM (Easting)	ITM (Northing)	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 (30%) (hrs:min:sec)	Turbine(s) contributing to Cumulative Shadow Flicker Exceedance and therefore requiring Mitigation T1-26 = Ballivor T27-35 = Bracklyn
184	666,829	752,714	882	T03	00:34:48	149:12:00	44:45:36	2,3,4,7
185	667,036	752,497	1,152	T03	00:31:48	99:18:00	29:47:24	3,4,7
186	667,063	752,455	1,194	T03	00:30:36	100:48:00	30:14:24	3,4,7
187	667,081	752,431	1,220	T03	00:36:00	82:42:00	24:48:36	3,4,7
188	667,105	752,410	1,251	T03	00:35:24	79:48:00	23:56:24	3,4,7
189	667,183	752,335	1,355	T03	00:33:00	69:54:00	20:58:12	3,4,7
190	666,984	752,500	1,103	T03	00:34:48	118:36:00	35:34:48	3,4,7
191	667,090	752,333	1,274	T03	00:35:24	79:00:00	23:42:00	3,4,7
192	664,849	754,515	951	T12	00:43:12	54:24:00	16:19:12	12
193	667,097	752,287	1,303	T04	00:34:48	77:30:00	23:15:00	3,4,7
194	666,884	752,323	1,095	T04	00:41:24	91:48:00	27:32:24	3,4,7
195	667,129	752,030	1,247	T07	00:33:36	46:42:00	14:00:36	4,7
196	664,845	754,457	900	T12	00:54:36	78:06:00	23:25:48	12
197	664,801	754,505	917	T12	00:50:24	62:12:00	18:39:36	12
198	666,769	752,349	984	T04	00:27:36	106:24:00	31:55:12	3,4,7
201	664,805	754,455	876	T12	01:00:36	84:00:00	25:12:00	12
202	667,301	751,550	1,381	T07	00:30:36	33:30:00	10:03:00	7
203	664,728	754,535	908	T12	00:54:00	55:48:00	16:44:24	12
204	667,125	751,668	1,197	T07	00:34:48	42:24:00	12:43:12	4,7

**Turbines 1-26 are part of the proposed Ballivor Wind farm. Turbines 27-35 represent the 9 No. consented 185m turbines of the Bracklyn Wind Farm (PA25M.311565).*

5.6 Likely Significant Effects and Associated Mitigation Measures

The below assessment evaluates the impact (where there is the potential for an impact to occur) on population, employment levels, land-use, tourism, residential amenity and human health during the construction, operation and decommissioning phases, as a result of the Proposed Development.

5.6.1 'Do-Nothing' Scenario

If the Proposed Development were not to proceed, the site would continue to be managed under the requirements of the relevant IPC licence and therefore the ongoing site management and environmental monitoring, peat stockpile removal (due to be completed by 2024), and wind measurement would continue. In addition, if the Proposed Development were not to proceed, the implementation of peatland rehabilitation plans as required under IPC License would occur. Likewise, the PCAS scheme in adjacent Bogs (where selected) would continue to be implemented. These land uses and activities will also continue if the Proposed Development does proceed.

If the Proposed Development were not to proceed, the opportunity to capture part of Meath and Westmeath's valuable renewable energy resource would be lost, as would the opportunity to 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. Furthermore, the opportunity to open up the Wind Farm Site to the public and provide amenity and recreational facilities would be lost.

5.6.2 Construction Phase

5.6.2.1 Population

5.6.2.1.1 *Population Levels*

Those working on the construction phase of the Proposed Development 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

The Proposed Development will have a short-term, slight negative effect on population during the construction phase.

Significance of Effects

There will be no significant effect on population levels.

5.6.2.1.2 *Employment and Investment*

The design, construction, operation and decommissioning of the wind farm will provide employment for technical consultants, contractors and maintenance staff. Up to approximately 100-120 jobs are likely to be created during the construction phase of the Proposed Development. The construction phase of the wind farm will last between approximately 24-30 months and the decommissioning phase will likely last approximately 12 months.

Residual Impact

The employment of local construction workers and the use locally sourced materials will be encouraged. This is typically facilitated by hosting ' Meet the Buyer' events following the conclusion of the procurement process and in advance of the commencement of construction. This will have a short-term significant positive direct impact.

The salaries and wages earned by those employed during the construction phase of the 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 impact on their cash flow. This will have a short-term slight positive indirect impact.

The Proposed Development will result in an influx of skilled people into the area, bringing specialist skills for both the construction and operational phases that could result in the transfer of these skills into the local workforce, thereby having a long-term positive 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. This will have a long-term moderate positive indirect impact. As discussed above, the wind sector currently supports 5,130 jobs (not including employment in grid development) with a with a strong foothold' in rural Ireland.

Commercial rates from the wind farm will contribute significant funds to Meath and Westmeath County Councils to support the provision of public services within these counties. These services include road maintenance, fire services, environmental protection, street lighting, footpath maintenance, etc. along with other community and cultural support initiatives. This will have a long-term slight positive direct impact.

Significance of Effects

There will be a significant positive effect on employment levels during the construction phase and a significant long term effect on investment in the local and wider regions from the payment of commercial rates to the local authorities at the commencement of the construction phase.

5.6.2.1.3 *Land Use Patterns & Activities*

The existing land-uses of site management and environmental monitoring (as required under IPC Licence P0-501), the removal of peat stockpiles (to be complete by 2024) and wind measurement will continue on the site of the Proposed Development. There are also a number of Bord na Móna rail lines that pass through the bogs. The majority of the rail lines will remain unaffected during the construction phase of the Proposed Development. The potential for interference with telecommunication links that traverse the site can only occur during the operational phase of a wind energy development. There are therefore no communication system impacts associated with the construction phase of the Proposed Development.

Since peat extraction ceased at the Bogs in June 2020, the applicant has commenced the decommissioning (peat stockpile removal) as required under IPC licence. Also required under IPC licence is the production of draft peatland rehabilitation plans which are to be agreed with by the EPA prior to their implementation. The draft peatland rehabilitation plans can be found in Appendix 6-6 and consider the wind farms construction and operation. In addition to IPC rehabilitation requirements, Bord na Móna, in conjunction with the EPA, NPWS and DECC have selected various Bog Groups for PCAS. The recently constructed Cloncreen Wind Farm included both IPC peatland rehabilitation and PCAS and has demonstrated both forms of rehabilitation can be carried out in parallel with the construction of a wind farm.

Residual Impact

Due to the small footprint of the Proposed Development infrastructure on a site scale and even more so on a local scale, the residual effect is considered Negative, direct, slight, permanent impact on land use and activities.

Significance of Effects

There will be no significant effect on land use/activities due to the construction phase the Proposed Development. It is considered that the Proposed Development will have no significant effect on the implementation of peatland rehabilitation under IPC, or PCAS (should it occur at the same time as the wind farm construction) during the construction phase as it has been designed to co-exist with these land-uses.

5.6.2.1.4 *Property Values*

As noted in Section 5.3.1.2 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses.

Residual Impact

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

Significance of Effects

There will be no significant effect on property values due to the Proposed Development.

5.6.2.1.5 *Tourism*

Given that there are currently no tourism attractions specifically pertaining to the site there are no impacts on tourism associated with the construction phase of the Proposed Development. With regard to tourist attractions and amenity use around the site, described in Section 5.3.9, traffic management safety measures will be in place, where required. Please see below for Traffic impact mitigation measures and Chapter 14 Material Assets.

Residual Impact

Based on the above it is concluded that there would be a short term, imperceptible impact on tourism in the wider landscape due to the construction phase the Proposed Development.

Significance of Effects

There will be no significant effect on tourism in the wider landscape due to construction phase the Proposed Development.

5.6.2.1.6 *Residential Amenity*

Pre-Mitigation Impacts

There is the potential for impacts on amenity during the construction phase due to air, traffic, noise and vibration emissions, impeded tourism and visitor experience to attractions and visual nuisance due to

additional traffic and plant machinery. These impacts, mitigation measures, residual impacts and significance of effects are discussed above.

Proposed Mitigation Measures

There are no turbines in the Proposed Development that will be located within 800 metres of any residential properties, (i.e. 4 times the tip height of the proposed maximum turbine tip height of 200m) for residential amenity purposes, as per the Draft Revised Wind Energy Development Guidelines December 2019.

All mitigation as outlined 3 above and the corresponding chapters: Chapter 9 Hydrology and Hydrogeology, Chapter 10 Air and Climate, Chapter 11 Noise and Vibration, Landscape and Visual Impact and Chapter 14 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 Development 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 Impact

Please see corresponding sections above and relevant chapters for the residual impact on air, noise and vibration, traffic, tourism, water quality and visual impacts.

Significance of Effects

Please see corresponding sections above and relevant chapters for the significance of effects on air, noise and vibration, traffic, tourism, water quality and visual impacts.

5.6.2.1.7 *Interference with Telecommunication Systems*

There is no potential to interfere with telecommunications systems during the construction phase.

Residual Impact

No Impacts

Significance of Effects

There will be no significant effects related to telecommunications during the construction phase.

5.6.2.2 Health

5.6.2.2.1 *Health and Safety*

Pre-Mitigation Impacts

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

Proposed Mitigation Measures

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

- Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005);
- Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2016 (S.I. No. 36 of 2016);
- S.I. No. 528/2021 - Safety, Health and Welfare at Work (Construction) (Amendment) Regulations 2021 and
- Safety, Health and Welfare at Work (Work at Height) Regulations 2006 (S.I. No. 318 of 2006).

The following measures below are also detailed in Appendix 4-3 Construction and Environment Management Plan and Chapter 17 Schedule of Monitoring and Mitigation Measures.

A Health and Safety Plan covering all aspects of the construction process will address the Health and Safety requirements in detail. This will be prepared on a preliminary basis at the procurement stage and developed further at construction stage.

All hazards will be identified, and risks assessed. Where elimination of the risk is not feasible, appropriate mitigation and/or control measures will be established. The contractor will be obliged under the construction contract and current health and safety legislation to adequately provide for all hazards and risks associated with the construction phase of the project. Safepass registration cards are required for all construction, delivery and security staff. Construction operatives will hold a valid Construction Skills Certificate Scheme card where required. The developer is required to ensure a competent contractor is appointed to carry out the construction works. The contractor will be responsible for the implementation of procedures outlined in the Safety and Health Plan. Public safety will be addressed by restricting site access during construction. Fencing will be erected in areas of the site where uncontrolled access is not permitted. Appropriate warning signs will be posted, directing all visitors to the site manager. Appropriate warning measures including 'goalposts' will be used as appropriate to prevent contact with any overheads lines that traverse the site.

The scale and scope of the project requires that a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) are required to be appointed in accordance with the provisions of the Health & Safety Authority's '*Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006*'.

The PSDP appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to):

- Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project;
- Where possible, eliminate the hazards or reduce the risks;
- Communicate necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the Safety and Health Plan;
- Ensure that the work of designers is coordinated to ensure safety;
- Organise co-operation between designers;
- Prepare a written Safety and Health Plan;
- Prepare a safety file for the completed structure and give it to the client; and
- Notify the Authority and the client of non-compliance with any written directions issued.

The PSCS appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to):

- Development of the Safety and Health Plan for the construction stage with updating where required as work progresses;
- Compile and develop safety file information.
- Reporting of accidents / incidents;
- Weekly site meeting with PSCS;
- Coordinate arrangements for checking the implementation of safe working procedures. Ensure that the following are being carried out:
- Induction of all site staff including any new staff enlisted for the project from time to time;
- Toolbox talks as necessary;
- Maintenance of a file which lists personnel on site, their name, nationality, current Safe Pass number, current Construction Skills Certification Scheme (CSCS) card (where relevant) and induction date;
- Report on site activities to include but not limited to information on accidents and incidents, disciplinary action taken and PPE compliance;
- Monitor the compliance of contractors and others and take corrective action where necessary; and
- Notify the Authority and the client of non-compliance with any written directions issued.

Residual Impact

With consideration of the implementation of the detailed mitigation measures there will be a short-term potential slight negative residual impact on health and safety during the construction phase of the Proposed Development.

Significance of Effects

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

5.6.2.2.2 *Air Quality: Dust, NO_2, PM_{10} and PM_{25} and Co2 Emissions*

Chapter 9 Air and Climate assesses the potential for impact to human health from dust CO2 and other noxious emissions generated by additional vehicles and plant machinery as well as the release of CO_2 through excavations. The assessment considers the construction, operation and decommissioning phases.

Pre-Mitigation Impacts

Potential dust emission sources during the construction phase of the Proposed Development include upgrading of existing access tracks and construction of new access roads, turbine and meteorological mast foundations, temporary construction compounds, and electrical substation. 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 impacts will not be significant and will be relatively short-term in duration. The potential dust impacts that may occur during the construction phase of the Proposed Development are further described in Chapter 10: Air and Climate.

Proposed Mitigation Measures

The majority of aggregate material for the construction of roads and turbine bases will be sourced from the proposed on-site or adjacent borrow pits. It is anticipated that construction grade granular fill and higher quality, surfacing granular fill and sand will be sourced from local, authorised quarries. The

locations of these quarries are shown in Figure 4-22. Vehicles will be inspected upon leaving any off-site quarries. Truck wheels will be washed to remove mud and dirt before leaving the site also. All plant and materials vehicles shall be stored in the compound area or other dedicated areas. Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction of spoil arising. 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 along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads and the temporary 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.

Residual Impact

With the implementation of the above mitigation measures, there will be short-term slight negative impact due to dust emissions from the construction of the Proposed Development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects due to dust , CO_2 and other noxious air emissions from the Proposed Development during construction.

5.6.2.2.3 *Water Quality*

As discussed, there is 1 no. mapped Public Water Supply Scheme within 3 km of the Ballivor Bog Group and its Source Protection Area is located more than 2km from the boundary of the Ballivor Bog Group. Chapter 9 Hydrology and Hydrogeology assess the potential for impact on public water supply and private wells during the construction, operation and decommissioning phases. The assessment concludes that there will be no significant direct or indirect effects during the three phases of the Proposed Development.

Residual Impact

For the reasons given in the above and in Chapter 9 Hydrology and Hydrogeology (separation distances, and prevailing geology, topography and groundwater flow directions), it is considered that the residual effects are be - negative, imperceptible, indirect, long term, in terms of quality or quantity on local groundwater abstractions.

Significance of Effects

For the reasons outlined above, no significant effects on of water quality will occur.

5.6.2.2.4 *Noise and Vibration*

Pre-Mitigation Impacts

There will be an increase in noise levels in the vicinity of the site during the construction phase, as a result of heavy machinery and construction work which has the potential to cause a nuisance to sensitive receptors located closest the Proposed Development site boundary. These impacts will be short-term in duration. The noisiest construction activities associated with wind farm development are excavation and concrete pouring of the turbine bases and the extraction of stone from the borrow pits. Excavation of a

turbine base can typically be completed in one to two days however, and the main concrete pours are usually conducted in one continuous pour, which is done within a matter of hours.

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

Proposed Mitigation Measures

Best practice measures for noise control will be adhered to onsite during the construction phase of the Proposed Development to impacts 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 11 using methods outlined in British Standard BS 5228-1:2014+A1:2019 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.

Residual Impact

With the implementation of the above mitigation measures, there will be a short-term slight negative residual impact due to an increase in noise levels during the construction phase of the Proposed Development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects due to noise emissions from the Proposed Development during construction.

5.6.2.2.5 *Traffic and Transport*

Pre-Mitigation Impacts

It is proposed that the large wind turbine components will exit the M3 at Junction 6 onto the R125 before turning northwest onto the R154 Trim Road. The delivery vehicles will enter Trim town before turning south onto the R161 for approximately 7.5km where it meets the R156. The deliveries will continue west for approximately 11.1km along the R156 through Ballivor Village before reaching the Ballivor Works entrance. The proposed route is described in Chapter 4 of this EIAR. All deliveries of turbine components to the site will only be by way of this proposed turbine delivery route. 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 Development has been carried out by Alan Lipscombe Traffic and Transport Consultants. The full results of the TTA are presented in Section 14.1 of Chapter 14: Material Assets.

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

The insertion of connecting cables (approx. 3m) in the road network between Ballivor Bog and Carranstown Bog (R156) and Lisclogher Bog and Bracklin Bog (local unnamed road) will be completed within 1-2 days under licence and to TII and Eirgrid requirements.

Proposed Mitigation Measures

A traffic management plan will be developed and implemented to ensure any impact is short term in duration and slight in significance during the construction of the Proposed Development. 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 known. Local access to properties will also be maintained throughout any construction works and local residents will be supplied with the number of the works supervisor in order to ensure that disruption will be kept to a minimum.

The cable laying works to the internal bog infrastructure together will be brief (1-2 days), completed with a traffic management plan in place and will follow TII and Eirgrid requirements.

Residual Impact

Once a traffic management plan is implemented for the construction phase of the Proposed Development, 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 on traffic from the Proposed Development during construction.

5.6.2.2.6 *Major Accidents and Natural Disasters*

A risk register has been developed which contains all potentially relevant risks identified during the construction phase of the Proposed Development. Six risks specific to the construction of the Proposed Development have been identified and are presented in Chapter 15 Major Accidents and Natural

Disasters. Six specific risks area assessed: severe weather, flooding, peat stability, traffic incidents, contamination, industrial accidents.

Residual Impact

The impact assessment concludes that the risk of a major accident and/or disaster during the construction phase of the Proposed Development is considered 'low' in accordance with the 'Guide to Risk Assessment in Major Emergency Management' (DoEHLG, 2010). It is considered that when the mitigation and monitoring measures outlined in the CEMP (Appendix 4-3) are implemented there will not be significant residual effect(s) associated with the construction of the Proposed Development.

Significance of Effects

Based on the assessment in Chapter 15, there will be no significant effects to/from Major Accidents and Natural Disasters during the construction phase of the Proposed Development.

5.6.2.2.7 *Shadow Flicker*

Shadow flicker, which occurs during certain weather conditions due to the movement of wind turbine rotor blades, as described in Section 5.2.2.1 of this chapter, occurs only during the operational phase of a wind energy development. There are therefore no shadow flicker impacts associated with the construction phase of the Proposed Development.

5.6.3 Operational Phase

5.6.3.1 Population

The effects set out below relate to the operational phase of the Proposed Development.

5.6.3.1.1 *Population Levels*

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

Residual Impact

No impacts

Significance of Effects

No significance of effects.

5.6.3.1.2 *Employment and Investment*

The operational phase of the Proposed Development will present an opportunity for mechanical, civil, and electrical contractors and craftspeople to become involved with the maintenance and operation of the wind farm. On a long-term scale, the proposed development will create approximately 2-3 jobs during the operational phase relating to the maintenance and control of the wind farm, having a long-term slight positive effect.

Proposed Community Benefit Scheme

In addition to employment during the construction and operational phases of the Proposed Development and annual rates that will be paid to the local authority by the Developer, a range of other benefits associated with the Proposed Development will be provided to the local community through the annual Community Gain Scheme. The aim of this scheme is to provide financial assistance to local communities and not-for-profit organisations around the development.

The Near Neighbour Scheme will offer electricity bill payers living within a prescribed distance of a wind turbine an annual contribution towards their electricity usage. In addition to the electricity contribution payment, the Scheme will also offer participants a contribution towards the completion of energy measures on the property and/or education support. This is in line with existing near neighbour schemes that are active at other Bord na Móna Wind Farms.

The value of the fund for the Community Gain and Near Neighbour Schemes will be directly proportional to the installed capacity and energy produced at the site, which based on current proposals, will be in the region of €14 million over the lifetime of the project.

Residual Impact

With the implementation of the above schemes, there will be a long term positive effect on local communities.

Significance of Effects

Based on the assessment above there will be significant direct and indirect effect on local communities from investment during the operational phase. There will be no significant effect on employment levels during the operational phase.

5.6.3.1.3 *Land use Patterns and Activities*

The footprint of the Proposed Development site, including turbines, roads, substation, etc., will occupy only a small percentage of the total Study Area defined for the purposes of this EIAR. The existing land-uses site management and environmental monitoring as required under IPC Licence P0-501, wind measurement), peat stockpile removal (to be complete by 2024). Peatland rehabilitation measures which have been designed with and around the wind farm in place will be implemented by the operational phase of the wind farm, the benefits of which will continue to grow over years to come. Please see Appendix 6-6. Likewise, the benefits from accelerated rehabilitation or PCAS which has been completed at Carranstown East adjacent to the Wind Farm Site Boundary and has been selected to commence in Bracklin West in 2023, also adjacent to the Wind Farm Site Boundary will also continue during the lifetime of the operational phase.

As such, its small scale relative to the Study Area, its ability to coexist with ongoing site activities and activities within the landscape indicate that the Proposed Development will have no significant impact on other land-uses within the site and the wider area.

Residual Impact

Due to the small footprint of the Proposed Development infrastructure on a site scale and even more so on a local scale, the residual effect is considered Negative, direct, slight, permanent impact on land use and activities during the operational phase. It is considered that there will be an indirect imperceptible long term negative impact on Peatland rehabilitation under IPC within the Wind Farm Site Boundary and no impact on PCAS (adjacent to the Wind Farm Site Boundary), both of which will continue regardless of the operational status of the wind farm.

Significance of Effects

There will be no significant effect on land use/activities due to the construction phase the Proposed Development. It is considered that the Proposed Development will have no significant effect on the continued benefits of peatland rehabilitation under IPC, or PCAS during the operational phase as it has been designed to co-exist with these land-uses.

5.6.3.1.4 *Property Values*

As noted in Section 5.3.12, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses.

Residual Impact

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

Significance of Effects

No significance of effects.

5.6.3.1.5 *Tourism*

Pre-Mitigation Impacts

Currently there are no dedicated amenity walkways within the development area. As part of the Proposed Development design, approximately 28 km of wind farm track which will be open for use as amenity pathways including walkways and cycleways. A further 3.3km dedicated amenity pathways will be constructed/upgraded. Three carparks with a total capacity for 80 cars will be provided although it is anticipated that many locals will walk or cycle to the site. Each carpark will feature bike racks for those who want to cycle to the area and walk the wind farm amenity loops. The amenity tracks and loops will provide a safe visitor experience and open the site up to locals, tourists, trail runners etc. The development of these dedicated amenity pathways will be linked to existing infrastructure into and out of the development area such as the below:

- linkage between Lisclogher East and the local road network to the north of the site.
- Intersection of the internal amenity paths with the existing Old Bog Rail Trail that traverses between Lisclogher and Bracklin bogs in a north-west – south-east orientation.
- Linkage from Bracklin with an existing unsurfaced roadway connecting with the L-1504 road Delvin to Raharney road to the west.
- Linkages from local lane off the Riverdale road to the west of south Ballivor Bog where it meets a dedicated amenity trail.

Proposed Mitigation Impacts

None

Residual Impact

The Proposed Development will have a long-term positive impact on tourism due to the social and recreational benefits associated with the recreational amenity walkways/ paths. The operational wind farm will have no impact on the running or operation of local and regional tourist attractions. Based on the literature review in section 5.3.10 to 5.3.12, the majority of studies indicate that wind farm developments do not deter visitors to tourist attractions or scenic landscapes where turbines are visually evident. As

such, it is considered that the Proposed Development will have a long-term imperceptible negative impact of visitor experience to attractions in the wider landscape.

Significance of Effects

The addition of dedicated recreational and amenity routes for locals and tourists will have a significant positive effect on tourism and recreation in the local area. The visual presence of turbines in the landscape will not have a significant effect on visitor experience to attractions in the wider landscape.

5.6.3.1.6 *Residential Amenity*

Pre-Mitigation Impacts

Potential impacts on residential amenity during the operational phase of the proposed wind farm 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 Development will be capable of meeting all required guidelines in relation to noise thresholds and the shadow flicker thresholds set out in the 2006 DoEHLG Wind Energy Guidelines or 2019 draft Wind Energy Guidelines if adopted. An Air and Climate impact assessment can be found in Chapter 10 which details potential impacts from emissions to air during the construction and operational phase. The visual impact of the Proposed Development is addressed comprehensively in Chapter 13: Landscape and Visual. The Proposed Development has been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within 815 metres of an occupied dwelling. An assessment of roadside screening was carried out for roads within 5km of the proposed turbine locations, with both the methodology and findings of this described in Chapter 13. Many of these roads have intermittent screening, and therefore intermittent views rather than full visibility of the site.

Proposed Mitigation Measures

There are no turbines proposed within 800 metres of any occupied dwellings. The closest dwelling to a proposed turbine location is approximately 815 metres. All mitigation as outlined under noise and shadow flicker in this EIAR will be implemented in order to reduce insofar as possible impacts on residential amenity at properties located in the vicinity of the Proposed Development. Please see Chapter 13 for residential amenity pertaining to visual effects.

Residual Impact

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

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects on residential amenity during the operational phase of the Proposed Development.

5.6.3.1.7 *Interference with Telecommunication Systems*

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The alternating current, electrical generating and transformer equipment associated with wind turbines, like all electrical equipment, also generates its own electromagnetic fields, and this can interfere with broadcast communications. The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting,

for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path. This interference can be overcome by the installation of deflector or repeater telecommunication dishes.

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

Responses were received from Eir, Three, Tetra Ireland, Openeir, Imagine Group, 2RN and Vodafone, all of which outlined that there will be no interference risk from any of the proposed turbines providing the design complies with recommended buffer zones.

Residual Impact

The turbine layout does not overlap with any of the telecom links or clearance zones requested by operators. Therefore, the Proposed Development will have no impact on telecommunications.

Significance of Effects

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

5.6.3.2 Health

5.6.3.2.1 *Health and Safety*

Pre-Mitigation Impact

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, substation and ancillary infrastructure during design, construction, commissioning and operation to ensure the risks posed to staff, landowners and general public are negligible.

Proposed Mitigation Measures

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

Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits. The doors will only be unlocked as required for entry by authorised personnel and will be locked again following their exit.

Signs will be erected at suitable locations such as, amenity access points and carparks, setting out the conditions of public access under the relevant legislation and providing normal hours (and out of hours) contact details. Staff associated with the project will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed, faded, 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. Access for emergency services will be available at all times.

The components of a wind turbine are designed to last up to 30 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.

The Substation, which will be operated by Eirgrid will be locked and fenced off from public access. The substation will be operational remotely and manually 24 hours per day, 7 days a week. Supervisory operational and monitoring activities will be carried out remotely using a SCADA system, with the aid of computers connected via a telephone modem link. The following safety and maintenance procedures will also be adhered.

- Periodic service and maintenance work which include some vehicle movement.
- For operational and inspection purposes, substation access is required.
- Servicing of the substation equipment will be carried out in accordance with the manufacturer's specifications, which would be expected to entail the following:
  - Six-month service – three-week visit
  - Annual service – six-week visit
  - Weekly visits as required.

Residual Impact

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

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects on health & safety during the operational life of the Proposed Development.

5.6.3.2.2 *Noise and Vibration*

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

farms. The consented Bracklyn Wind Farm (PA25M.311565) is the only wind farm within 5km and has been considered as part of the cumulative noise impact assessment. Details of the noise assessment carried out by AWN Consulting are presented in Chapter 11 of the EIAR.

Residual Impacts

For the majority of locations assessed, operation of the proposed turbines will have a slight, negative, long-term effect with the closest receptors having a moderate negative long term impact. The noise assessment notes that these effects should be considered in terms that the effect is variable, and that this assessment considers periods of the greatest potential effect.

Significance of Effects

As stated in the noise assessment in Chapter 11, 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 and not significant.

5.6.3.2.3 *Air Quality: Dust, NO_2, PM_{10} and PM_{25} and CO2 Emissions*

The sources of dust and other emissions generated during the operational phase will be from infrequent visits by maintenance staff in light good vehicles (LGVs) approximately 1-2 visits per month, and private LGVs from tourists who may use the amenity car parks that will be provided to the public so they can enjoy the wind farm paths for walking, running etc.

Renewable Energy Production and Reduction in Greenhouse Gas Emissions

In July 2022, the EPA[15] reported for the 2021 year, the total national greenhouse gas emissions are estimated to have increased by 4.7% on 2020 levels to 61.53 million tonnes carbon dioxide equivalent (Mt CO2eq). This increase in total emissions was driven by increased use of coal and oil for electricity generation and increases in both the Agriculture and Transport sectors. It highlights that transformative measures will be needed to meet National Climate ambitions. The report also states that Emissions in the Energy Industries sector increased by 17.6% or 1.53 MtCO2eq in 2021, attributed to a tripling of coal and oil use in electricity generation as gas fired plant were offline while simultaneously, electricity generated from wind and hydro decreased by 16% and 20% respectively in 2021. As such, the Proposed Development is critical to helping Ireland address these challenges as well as addressing the country's over-dependence on imported fossil fuels. It is estimated that the proposed Ballivor Wind Farm, with a potential installed capacity in the range of 117MW to 169MW will offer significant benefits in terms of renewable energy production and reductions in greenhouse gas emissions by its net displacement of approximately 6,035,010 tonnes to 8,717,237 tonnes of CO_2 per annum (Against EU FFC).

Residual Impacts

Impacts from dust and other emissions to air from private and maintenance on sensitive receptors during the operational phase is considered to be a momentary and imperceptible.

There will be a long-term significant positive impact on CO_2 emissions and energy targets with the implementation of the Proposed Development. As mentioned above, it will have the potential to offset 6,035,010 to 8,717,237 tonnes of CO_2 per annum (against EU FFC) by supplying approximately 70,036 to 101,163 Irish households with electricity per year which otherwise would rely on fossil fuel sources. The carbon offsets resulting from the Proposed Development are described in detail in Chapter 10: Air and Climate.

[15] *EPA (July 2022) - Ireland's Provisional Greenhouse Gas Emissions 1990-2022. https://www.epa.ie/publications/monitoring–assessment/climate-change/air-emissions/EPA-Ireland's-Provisional-GHG-Emissions-1990-2021_July-2022v3.pdf*

Significance of Effects

There will be no significant effect from dust and noxious air emissions from the operational wind farm. There will be a significant positive effect on air quality through the offset of 6,035,010 to 8,717,237 tonnes of CO_2 per annum (against EU FFC) by supplying 70,036 to 101,163 Irish households with renewable energy.

5.6.3.2.4 *Water Quality*

During the operational phase, all permanent drainage controls will be in place and the disturbance of ground and excavation works will be complete. Some minor maintenance works may be completed, such as maintenance of site entrances, internal roads, hardstand areas and amenity pathways. These works would be of a very minor scale and would be very infrequent. During such maintenance works there is a small risk associated with the release of hydrocarbons from site vehicles, although it is not envisaged that any significant refuelling works will be undertaken on site during the operational phase.

Residual Impacts

With the implementation of the proposed wind farm drainage measures as in Chapter 9 Hydrology and Hydrogeology, and based on the post-mitigation assessment of runoff, residual effects are considered to be Negative, imperceptible, indirect, temporary and unlikely effect on water quality.

Significance of Effects

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

5.6.3.2.5 *Traffic*

Major component failures are considered unlikely with the implementation of normal operational and maintenance activities and therefore the presence of Heavy Good Vehicles (HGVs) at the site is considered extremely rare until the decommissioning phase begins. All site visits for maintenance and inspection purposes will be done so via Light Good Vehicles (LGVs) with just one or two visits per month. Likewise, amenity visitors to the site will more than likely use private cars and utilise one of the four amenity car parks located at access points spread around the site to minimise volumes of traffic arriving at one location.

Residual Impacts

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

Significance of Effects

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

5.6.3.2.6 *Shadow Flicker*

Pre-Mitigation Impacts

As indicated in Table 5-9, a total of 80 residential properties 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 per year may be exceeded at 12 properties. However, the prediction modelling

does not take vegetation screening, screening by adjacent buildings or extant window orientation into account. Therefore, in reality, shadow flicker occurrences may be less than predicted. However, excluding these circumstances and relying on the prediction modelling alone, shadow flicker could potentially have a long-term slight negative impact on each sensitive receptor.

Proposed Mitigation Measures

Where daily shadow flicker exceedances have been predicted at buildings by the modelling software, a site visit will be undertaken firstly to determine the level of occurrence, existing screening and window orientation. 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 followed.

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.*

Screening Measures

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

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

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

Wind Turbine Control Measures

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

Wind turbines can be fitted with shadow flicker control units to allow the turbines to be controlled to prevent the occurrence of shadow flicker at properties surrounding the wind farm. The shadow flicker control units will be added to any required turbines and are not cost prohibitive.

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

All predicted incidents of shadow flicker can be pre-programmed into the wind farm's control software. The wind farm's SCADA control system can be programmed to shut down any particular turbine at any particular time on any given day to 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 on the wind farm's met mast, and similarly, and if wind speed and direction is such that a shadow will be cast, the shadow flicker control mechanisms come into effect. The moving blades of the turbine will require a short period of time to cease rotating and as such there may be a very short period (less than 3 to 5 minutes) during which the blades are slowed to a complete halt. The turbines giving rise to shadow flicker may be turned off on different days to prevent excessive wear and tear on any single turbine.

This measure will be utilised at the site of the Proposed Development to prevent incidences of shadow flicker at any house if required. Therefore, the Ballivor Wind Farm could be brought in line with the requirements of the Draft Revised Wind Energy Development Guidelines 2019 should they come into force during the planning application process for this development.

Should a complaint be received within 12 months of commissioning of the wind farm, field investigation/monitoring will be carried out by the wind farm operator at the affected property. Notwithstanding the approach set out above should shadow flicker associated with the permitted development be perceived to cause a nuisance at any home, the affected homeowner is invited to engage with the Wind Farm 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.

Residual Impact

Shadow flicker could potentially have a long-term slight negative impact. However, as the applicant has committed to a curtailment strategy for all turbines that have the potential to cause an exceedance in the existing daily and annual shadow flicker limits at residential properties up to a distance of 10 rotor diameters from the Proposed Development.

Significance of Effects

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

5.6.4 Decommissioning Phase

The wind turbines proposed as part of the Proposed Development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the site may be decommissioned fully. The substation will remain in place as it will be under the ownership of ESB/Eirgrid.

The works required during the decommissioning phase are described in Section 4.11 in Appendix 4-4: Decommissioning Plan. Any impact and consequential effect that occurs during the decommissioning

phase will be similar to that which occurs during the construction phase, however to a lesser extent and lesser duration.

5.6.5 Cumulative Effects

For the assessment of cumulative impacts, any other existing, permitted or Proposed Developments (wind energy or otherwise) have been considered. Further information on projects considered as part of the cumulative assessment including the consented Bracklyn Wind Farm (Planning Reference: PC25M.306261), the Peatland Rehabilitation Plans and PCAS are given in Chapter 2: Background to the Proposed Development. The impacts with the potential to have cumulative effects on human beings are discussed below and in more detail in the relevant chapters: Noise and Vibration Chapter 11), Visual impacts (Chapter 13) and Traffic (Chapter 14). A summary is detailed below.

5.6.5.1 Construction Phase - Population

5.6.5.1.1 *Population Levels*

The assessment above in section 5.6.2 demonstrated that there will be no significant effect on population levels from the Proposed Development during the construction phase. It is therefore considered there can be no cumulative effects with other proposed or consented projects and plans within the Study Area that may be constructed in parallel with the Proposed Development.

5.6.5.1.2 *Employment and Investment*

The assessment above in section 5.6.2 demonstrated that there will be a significant effect on employment levels during the construction phase (estimated to be 24 months) and a significant long term effect on investment in the local and wider regions due to the contributions paid to the Meath and Westmeath County Councils at the commencement of the construction phase. It is therefore considered that there will be a positive short term cumulative effect on employment should the Proposed Development be constructed in parallel with other proposed projects and plans in the Study Area and a positive long term cumulative effect on investment in local and regional infrastructure and communities due to additional commercial rates paid to the local authorities by other proposed or consented projects and plans within the Study Area.

5.6.5.1.3 *Land Use Patterns and Activities*

Due to the small footprint of the Proposed Development infrastructure on a site scale and a local scale, and the continuation of land use and activities onsite and in the wider area, there will be no significant effects on landuse and activities during the construction phase. Therefore, it is considered there will be no cumulative effects on land use and activities should other proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development.

5.6.5.1.4 *Property Values*

The assessment above in section 5.6.2 concludes that there will be no significant effect on property values due to the construction phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on property values should other proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development.

5.6.5.1.5 Tourism

The assessment above in section 5.6.2 concludes that there will be no significant effect on tourism at the site or in the wider landscape due to the construction phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on tourism should other proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development.

5.6.5.1.6 Residential Amenity

Development can cause effects on one or more components of Residential Amenity such as of noise, dust, , vibration, shadow flicker, and visual amenity. These factors are assessed within this EIAR, and summaries are presented in this chapter and their respective chapters. The assessments of noise and vibration, dust and other emissions to air, water quality and visual amenity conclude that there are no significance effects during the construction phase therefore there will be no cumulative effects should other proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development.

5.6.5.1.7 Interference with Telecommunication Systems

As there will be no impacts on telecommunication systems during the construction phase, there will be no cumulative effects should other proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development

5.6.5.2 Construction Phase- Health

5.6.5.2.1 Health and Safety

The assessment above in section 5.6.2 concludes that there will be no significant effect on health and safety at the site due to the construction phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on health and safety should other proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development.

5.6.5.2.2 Air Quality: Dust, NO_2, PM_{10} and PM_{25} and CO2 Emissions

The assessment above in section 5.6.2 concludes that there will be no significant effect on health from dust and other emissions to air due to the construction phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on air quality should other proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development.

5.6.5.2.3 Water Quality

The assessment above in section 5.6.2 concludes that there will be no significant effect on health from a potential water quality impact due to the construction phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on health due to potential water quality impacts should other proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development.

5.6.5.2.4 Noise & Vibration

The assessment above in section 5.6.2 concludes that there will be no significant effect on health from noise and vibration emissions due to the construction phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on health from noise and vibration emissions should other

proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development.

5.6.5.2.5 *Traffic and Transport*

The assessment above in section 5.6.2 concludes that there will be no significant effect on traffic and transport due to the construction phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on traffic and transport should other proposed or consented plans and projects within the Study Area be constructed in parallel with the Proposed Development.

5.6.5.2.6 *Major Accidents and Natural Disasters*

Chapter 15 assesses the potential for impacts from Major Accidents and Natural Disasters to/from the Proposed Development during its construction phase. The Chapter assesses six risks: severe weather, flooding, peat stability, traffic incidents, contamination, industrial accidents and concludes that there will be no significant effects to/from the construction of Proposed Development by such risks. Therefore, it is considered there are no cumulative effects to/from major accidents and natural disasters dur to the construction of other proposed or consented plans and projects within the Study Area parallel to the construction of the Proposed Development.

5.6.5.2.7 *Shadow Flicker*

Shadow Flicker only has the potential to occur from operational wind turbines. Therefore there can be no cumulative effects during the construction phase of the Proposed Development.

5.6.5.3 Operational Phase- Population

5.6.5.3.1 *Population Levels*

The assessment above in section 5.6.3 demonstrated that will be no significant effect on population levels from the Proposed Development during the operational phase. It is therefore considered there can be no cumulative effects with other proposed or consented projects and plans within the Study Area that may be operational alongside the Proposed Development.

5.6.5.3.2 *Employment and Investment*

The assessment above in section 5.6.3 demonstrated that will be a significant long term positive effect on local communities due to the financial investment in the local area from the Proposed Development during its operational phase. It is therefore considered there will be a positive long term cumulative effect on local communities with other proposed or consented projects and plans within the Study Area that may be operational alongside the Proposed Development.

5.6.5.3.3 *Land Use Pattern and Activities*

The small footprint of the Proposed Development relative to the site and local scale, and the continuation of land use and activities onsite and in the wider area, there will be no significant effects on landuse and activities during the construction phase. Therefore, it is considered there will be no cumulative effects on land use and activities should other proposed or consented plans and projects within the Study Area be operational alongside the Proposed Development.

5.6.5.3.4 *Property Values*

The assessment above in section 5.6.3 concludes that there will be no significant effect on property values due to the operation of the Proposed Development. Therefore, it is considered there will be no cumulative

effects on property values should other proposed or consented plans and projects within the Study Area be operational alongside the Proposed Development.

5.6.5.3.5 *Tourism*

The assessment above in section 5.6.3 concludes that there will be no significant effect on tourism at the site or in the wider landscape due to the operation of the Proposed Development. Therefore, it is considered there will be no cumulative effects on tourism should other proposed or consented plans and projects within the Study Area be operational alongside the Proposed Development.

5.6.5.3.6 *Residential Amenity*

As there are no significant effects relating to residential amenity from noise, emissions and shadow flicker from the operation of the Proposed Development, there will be no cumulative effects should other proposed or consented plans and projects within the Study Area be operational alongside the Proposed Development. Please see Chapter 13 for residential amenity pertaining to visual effects. However, there will be positive long term effects on air quality due to the offset of approximately 6,035,010 to 8,717,237 tonnes of CO_2 per annum (against EU FFC) into the atmosphere from the Proposed Development and should the consented Bracklyn Wind Farm (PA25M.311565) become operational, cumulatively, both projects will have a positive long term effect on air quality.

5.6.5.3.7 *Interference with Telecommunication Systems*

As there are no significant effects relating to telecommunication systems from then operation of the Proposed Development, there will be no cumulative effects should other proposed or consented plans and projects within the Study Area be operational alongside the Proposed Development.

5.6.5.4 Operational Phase- Health

5.6.5.4.1 *Health and Safety*

The assessment above in section 5.6.3 concludes that there will be no significant effect on health and safety at the site due to the operation of the Proposed Development. Therefore, it is considered there will be no cumulative effects on health and safety should other proposed or consented plans and projects within the Study Area be operational alongside the Proposed Development.

5.6.5.4.2 *Air Quality: Dust, NO_2, PM_{10} and PM_{25} and CO2 Emissions*

The assessment above in section 5.6.3 concludes that there will be no significant effect on health from dust and other emissions to air due to the operation of the Proposed Development. The assessment also concludes that there will be a significant long term positive effect on air quality through the offset of approximately 6,035,010 to 8,717,237 tonnes of CO_2 per annum (against EU FFC) by supplying approximately 70,036 to 101,163 Irish households with electricity per year which otherwise would rely on fossil fuel sources. The Proposed Development will also assist the country in reaching its renewable energy targets.

Should the project be operational alongside the consented Bracklyn Wind Farm (PA25M.311565), it is considered there will be positive cumulative effects on air quality, renewable energy targets and the offset of fossil fuels to power Irish homes.

5.6.5.4.3 Water Quality

The assessment above in section 5.6.3 concludes that there will be no significant effect on health from a potential water quality impact due to the construction phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on health due to potential water quality impacts should other proposed or consented plans and projects within the Study Area be operational in parallel with the Proposed Development.

5.6.5.4.4 Noise & Vibration

The assessment above in section 5.6.2 concludes that there will be no significant effect on health from noise and vibration emissions due to the operation phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on health from noise and vibration emissions should other proposed or consented plans and projects within the Study Area be operational in parallel with the Proposed Development.

5.6.5.4.5 Traffic and Transport

Section 14.1 of Chapter 14 Material Assets concludes that there will be no significant effect on traffic and transport due to the operation phase of Proposed Development. Therefore, it is considered there will be no cumulative effects on traffic and transport should other proposed or consented plans and projects within the Study Area be operational in parallel with the Proposed Development.

5.6.5.4.6 Major Accidents and Natural Disasters

Chapter 15 concludes that there will be no significant effects to/from major accidents and natural disasters due to the operation of the Proposed Development. Therefore, it is considered there will be no cumulative effects from major accidents and natural disasters to/from other proposed or consented plans and projects in the Study Area.

5.6.5.4.7 Shadow Flicker

As outlined in Table 5-10, 83 residential receptors may be impacted by shadow flicker from the proposed Ballivor Wind Farm in combination with permitted wind farms within 5km of the development site, with three of these properties impacted by the consented Bracklyn Wind Farm (PA25M.311565). The monitoring and subsequent mitigation measures as outlined in Section 5.6.3.2.6 will be implemented to ensure any dwelling which may be impacted by shadow flicker as a result of the proposed Ballivor Wind Farm will be in compliance with the thresholds set out in the 2006 DoEHLG Wind Energy Guidelines and if adopted, the 2019 Draft Revised Wind Energy Development Guidelines.

5.7 Summary of Significant Effects

Table 5-11 below provides a summary of significant effects on the population and human health in the Study Area of the Proposed Development. In some cases such as 'Investment' and 'Air and Climate' the positive effects from the Proposed Development may reach further than the Study Area (e.g. 70,036 to 101,163 Irish households can be provided with renewable energy from the Proposed Development which reaches significantly further than the Study Area) and the investment the local authorities make into the wider region from the commercial rates provided by the applicant prior to the commencement of the construction Phase.

Table 5-11 Summary of Significant Effects

Receptor	Construction Phase	Operational Phase	Decommissioning Phase	Cumulative	
				Construction	Operation
Population Levels	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Employment & Investment	Employment: Significant effect, short term Investment- Significant effect, long term	Employment: No significant effects Investment- Significant effect, long term	No significant effects	Employment: positive short term cumulative effect Investment: positive long term cumulative effect	Employment: No cumulative effects Investment: positive long term cumulative effect
Landuse Patterns and Activities	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Property Values	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Tourism	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Residential Amenity (air, water, noise & vibration , traffic, visual)	No significant effects	No significant effects for water, noise & vibration , traffic, visual Significant positive effect on air quality	No significant effects	No cumulative effects	No cumulative effects for water, noise & vibration , traffic, visual Positive cumulative effects on air quality with other wind farms e.g. consented Bracklyn Wind Farm (PA25M.311565)

Interference with telecoms	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Health & Safety	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Air Quality	No significant effects	Significant positive effect on air quality	No significant effects	No cumulative effects	No cumulative effects with non-wind projects Positive cumulative effects with Bracklyn Wind Farm (PA25M.311565)
Water Quality	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Noise & Vibration	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Traffic & Transport	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Major Accidents & Natural Disasters	No significant effects	No significant effects	No significant effects	No cumulative effects	No cumulative effects
Shadow Flicker	N/A	No significant effects	No significant effects	No cumulative effects	No cumulative effects