5. POPULATION AND HUMAN HEALTH

5.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses the potential significant effects of the Proposed Project 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.

For the purposes of this EIAR:

- The '**Proposed Wind Farm'** refers to the 9 no. turbines and supporting infrastructure which is the subject of this Section 37E application.
- The '**Proposed Grid Connection'** refers to the 110kV substation and supporting infrastructure which will be the subject of a separate Section 182A application.
- The '**Proposed Project'** comprises the Proposed Wind Farm and the Proposed Grid Connection, all of which are located within the EIAR Study Boundary (the '**Site**') and assessed together within this EIAR.

Please see section 1.1.1 of this EIAR for further details. A detailed description of the Proposed 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. Please see Chapter 16 for further details.

5.1.1 Statement of Authority

This section of the EIAR has been prepared by Gráinne Griffin with support of Karen Mulryan, of MKO and reviewed by Michael Watson. Gráinne is an Environmental Scientist with MKO with over 2 years' experience in the environmental consultancy sector. Gráinne has experience in report writing, including Appropriate Assessments, Natura Impact Statements, feasibility studies and EIA screening reports and EIAR chapters including Population and Human Health chapters for large-scale renewable energy developments. Karen is an Environmental Scientist with MKO with over 7 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 manages EIAR applications of various scales including SID applications across Ireland. Karen has experience in report writing, including the production of EIAR Population and Human 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 Health – Health in Ireland: Key Trends 2022;
- 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);
- Department of the Environment, Heritage and Local Government Draft Wind Energy Development Guidelines (2019);
- Environmental Impact Assessment of National Road Schemes- A practical Guide, National Roads Authority/ Transport Infrastructure Ireland, Revision 1, November 2008;
- Fáilte Ireland EIAR Guidelines for the Consideration of Tourism and Tourism Related Projects, July 2023.
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports' (EPA, 2022)
- 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;
- Institute for Environmental Management and Assessment (2017) Health In Environmental Impact Assessment: A Primer for a Proportionate Assessment;
- Institute for Environmental Management and Assessment (2022) Determining Significance for Human Health in Environmental Impact Assessment;
- Central Statistics Office (CSO): Census of Ireland 2016; Census of Ireland 2022; Census of Agriculture 2020;
- Tipperary County Development Plan 2022-2028;
- The World Health Organisation (WHO) Environmental Noise Guidelines for the European Region (WHO, 2022 Update) https://www.who.int/

5.1.3 Scoping

Chapter 2 Section 2.6 of this EIAR describes the scoping and consultation exercise undertaken for the Proposed Project.

Health Service Executive

A scoping response was received from the Health Service Executive (HSE) on 15th November 2022. The HSE requested a shadow flicker assessment is undertaken to identify any Sensitive Properties which may be impacted by shadow flicker and noted that the assessment must include all proposed mitigation measures, including air quality due to the nature of the proposed construction works, generation of airborne dust has the potential to have significant impacts Sensitive Properties. The response stated that a Construction Environmental Management Plan (CEMP) should be included in the EIAR which details dust control and mitigation measures. The HSE further stated that the Environmental Impact Assessment should examine all likely significant impacts and provide the following information for each:

- Description of the receiving environment;
- The nature and scale of the impact;
- An assessment of the significance of the impact;
- Proposed mitigation measures;
- Residual impacts.

Directive 2014/52/EU has an enhanced requirement to assess likely significant impacts on Population and Human Health. It is the experience of the Environmental Health Service (EHS) that impacts on human health are often inadequately assessed in EIAs in Ireland. It is recommended that the wider determinants of health and wellbeing are considered in a proportionate manner when considering the EIA. Guidance on wider determinants of health can be found at www.publichealth.ie

The HSE advised that in addition to any likely significant negative impacts from the Proposed Project, any positive likely significant impacts should also be assessed.

The Environmental Health Service (EHS) recommends that the following matters are included and assessed in the EIAR:

- Public Consultation
- Decommissioning phase of the proposed wind farm
- Siting and location of turbines
- Noise & Vibration
- Shadow Flicker
- Air Quality
- Surface and Groundwater Quality
- Geological Impacts
- Ancillary facilities
- Cumulative impacts

Irish Water

Irish Water provided a response to a scoping request on the 1st of November 2022, outlining the measures for consideration in the scope of an Environmental Impact Assessment (EIA). This includes steps to avoid any adverse effects on Irish Water's Drinking Water Source(s) during both the construction and operational phases of the development, as well as an assessment of potential impacts on nearby public water supply infrastructure. A follow-up data request was sent to Irish Water on the 20th of June 2023,

specifically seeking information on water distribution and sewer networks at the Site. The result of this request indicates that are no underground water or sewerage networks within the footprint of the Proposed Wind Farm. A data request sent to Irish Water on the 19th of June 2023 which indicates that a water main runs along the R433 which will be crossed by the Proposed Grid Connection underground cabling route. Mains valves are located approx. 5m from the proposed underground cable route also.

Fáilte Ireland

A scoping response was received from Fáilte Ireland on the 10th of October 2023 and provided the 'Fáilte Ireland's Guidelines for the Treatment of Tourism in an EIA', to inform the preparation of the Environmental Impact Assessment for the Proposed Project. The report provides guidance for those conducting Environmental Impact Assessment and compiling an Environmental Impact Assessment Report (EIAR), or those assessing EIARs, where the project involves tourism or may have an impact upon tourism (see Section 5.6.3.1.9 and Section 5.6.3.1.10 for further detail). These guidelines are non-statutory and act as supplementary advice to the EPA EIAR Guidelines outlined in section 2 of the guidance document, including some of the key requirements for an EIAR under the current guidance:

- Project description;
- assessment of alternatives considered;
- baseline assessment;
- assessment of effects;
- cumulative impacts
- interaction of impacts;
- mitigation & monitoring; and
- residual impacts

5.1.4 Health and Safety

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 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 'infrasound's' 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."

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.

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 12 of this EIAR: Noise and Vibration for details.

9. *'The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomized Crossover Study in Noise-Sensitive Health Adults' Woolcock Institute for Medical Research, New South Wales, Australia*[1]

When considering the effects of health regarding noise sensitivity generated from the Proposed Project, an analysis of a recent study by the Woolcock Institute for Medical Research, New South Wales, Australia.

The purpose of this study was to examine the potential health effects of audible sound and inaudible infrasound has on noise sensitive adults over a period of 72 hours. Sufferers of wind turbine syndrome (WTS) have attributed their ill-health and particularly their sleep disturbance to the signature of infrasound. On this basis, the objectives of the study were to test the effects of 72 hours of infrasound exposure on human physiology, particularly sleep. The results of the study are outlined below:

- All staff and participants were asked whether they were able to differentiate in any way between infrasound and sham infrasound (the control), and none of them were able to.
- The study found that 72 hours of the simulated wind turbine infrasound (~90dB pk re 20 µPa) in controlled laboratory conditions did not worsen any measure of sleep quality compared with the same speakers being present but not generating infrasound (sham infrasound).

- The study found no evidence of that 72 hours of exposure to a sound level of ~90dB pk re 20 µPa of simulated wind turbine infrasound in double-blind conditions perturbed any physiological or psychological variable.
- None of the participants in the study who were exposed to infrasound developed what could be described as Wind Turbine Syndrome.
- This study suggests that the infrasound component of Wind Turbine Syndrome is unlikely to be a cause of any ill-health or sleep disruption, although this observation should be independently replicated.

5.1.4.2 Turbine Safety

Turbines pose no threat to the health and safety of the general public. The 2006 WEDGs and the 2019 draft WEDGs 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 2006 WEDGs and the 2019 draft WEDGs state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. Modern turbine blades are composite structures with no bolts or separate components; therefore, danger is minimised. Furthermore, the proposed wind turbines will be fitted with anti-vibration sensors which will detect any imbalance caused by icing of the blades. These sensors will cause the turbine to wait until the blades have been de-iced prior to beginning operation. As such, turbines are designed in such a way that ice throw/projection is not a significant risk. Furthermore, the Site (and the State) falls within the International Energy Agency (IEA) Ice Class 1 category[2], which correlates to a *Low* icing frequency.

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

5.1.4.3 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)[3] provides further practical information on EMF. Please see Appendix 5-2 for details. Further details on the potential impacts of electromagnetic interference to telecommunications and aviation are presented in Chapter 15: Material Assets.

[2] *Wind Power Icing Atlas (WIceAtlas) – IEA Ice Class 1 Category for Ireland (map). Available at: https://vtt.maps.arcgis.com/apps/instant/minimalist/index.html?appid=6d93b5e284104d54b4fb6fd36903e742*
[3] *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 2022. 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 Proposed Project (i.e., Proposed Wind Farm and Proposed Grid Connection infrastructure) is located, namely Drom, Killavinoge, and Templetouhy, but it also refers to county and national statistics.

5.2.2 Human Health

This human health analysis section was assessed using guidelines set out in section 5.1.2 above.

The World Health Organisation's (WHO) defines health as: "*A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*".[4]

National Guidance

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

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

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

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*

[4] *World Health Organisation Constitution Available at: https://www.who.int/about/governance/constitution*

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'.*

IEMA Guidance 2017

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

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

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

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

- *better consideration of health in existing impact assessments other than HIA;*
- *dedicated HIA;*
- *and integrated forms of impact assessment."*

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

EIA Significance Matrix for Human Health, IEMA Guidance 2022

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

5.2.3 Shadow Flicker

5.2.3.1 Background

The assessment methodology in this chapter follows the current adopted guidance for shadow flicker in Ireland is derived from the 2006 WEDGs and the 'Best Practice Guidelines for the Irish Wind Energy Industry' (Irish Wind Energy Association, 2012).

Shadow Flicker is only relevant to the Proposed Wind Farm; shadow flicker is not emitted from any infrastructure pertaining to the Proposed Grid Connection.

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 the Site. The frequency of occurrence and the strength of any potential shadow flicker impact depends on several factors which are listed *in the Update of UK Shadow Flicker Evidence Base Department of Energy and Climate Change*[5] report and repeated in the 2019 draft WEDGs.

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:***

[5] *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*

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

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

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

At distances of greater than approximately 500m between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the shadow cast by the turbine is longer. The 2006 WEDGs, 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.

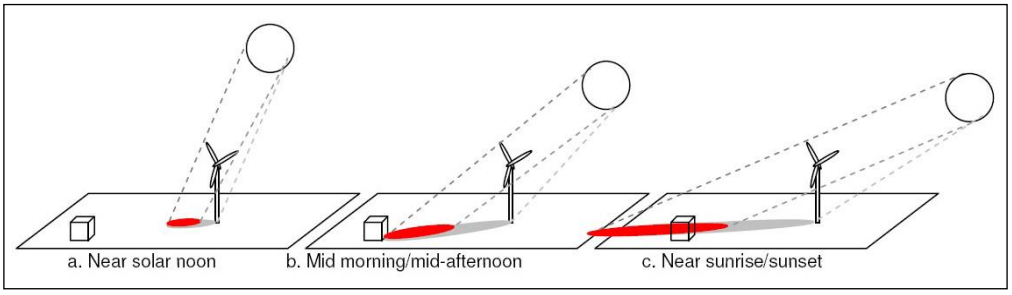


Figure 5-1 Shadow-Prone Area as Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, Dec 2008)

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.

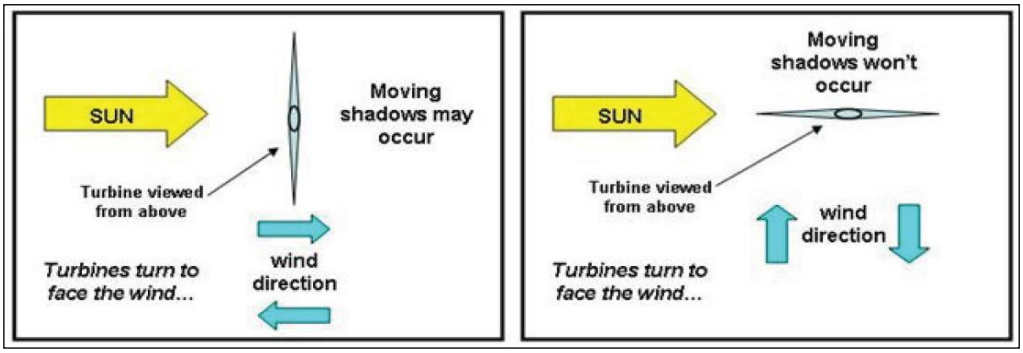


Figure 5-2 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environment Power LLC)

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.

All turbines installed on-site will comply with the daily and annual shadow flicker recommended thresholds of 30 minutes and 30 hours, respectively as set out in the 2006 WEDGs. However, the proposed turbines can be brought in line with the 2019 draft WEDGs shadow flicker recommendation through the use of turbine control software, should this draft guidance be brought into effect.

5.2.3.2 Guidance

The current adopted guidance for shadow flicker in Ireland is derived from the 2006 WEDGs and the 'Best Practice Guidelines for the Irish Wind Energy Industry' (Irish Wind Energy Association, 2012). The 2006 WEDGs state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Therefore, the study area adopted for the shadow flicker assessment is10 rotor diameters of the proposed turbine locations (i.e. for the Proposed Project, this is assumed at 1.63 km based on a rotor diameter of 163 metres).

The 2006 WEDGs recommend that shadow flicker at neighbouring offices and dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year or 30 minutes per day.

Although the 2006 WEDGs threshold applies to properties located within 500 metres of a proposed turbine location, for the purposes of this assessment, the thresholds of 30 hours per year or 30 minutes per day have been applied to all properties located within ten rotor diameters of the proposed turbines (as per IWEA guidelines, 2012).

The 2006 WEDGs guidelines are currently under review. The DoHPLG released the 2019 draft WEDGs which were released for public consultation in December 2019. The consultation period closed February 2020; however, no update or final guidelines was released. The 2019 draft WEDGs 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 2019 draft WEDGs 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 WEDGs. However, it should also be noted the proposed turbines can be brought in line with the requirements of the 2019 draft WEDGs through the implementation of the mitigation measures outlined in Section 5.6.3.2.6.

5.2.3.3 Shadow Flicker Prediction Methodology

Shadow flicker occurs only under certain, combined circumstances, as detailed above. Where shadow flicker does occur, it is generally momentary. The 2006 WEDGs 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. 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 5.0.2.2 has been used to predict the level of shadow flicker associated with the Proposed Wind Farm. ReSoft WindFarm is a commercially available software tool that enables developers to analyse, design and optimise wind farm designs. It allows proposed turbine layouts to be optimised for maximum energy yield whilst taking account of environmental, planning and engineering constraints. 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.[6]

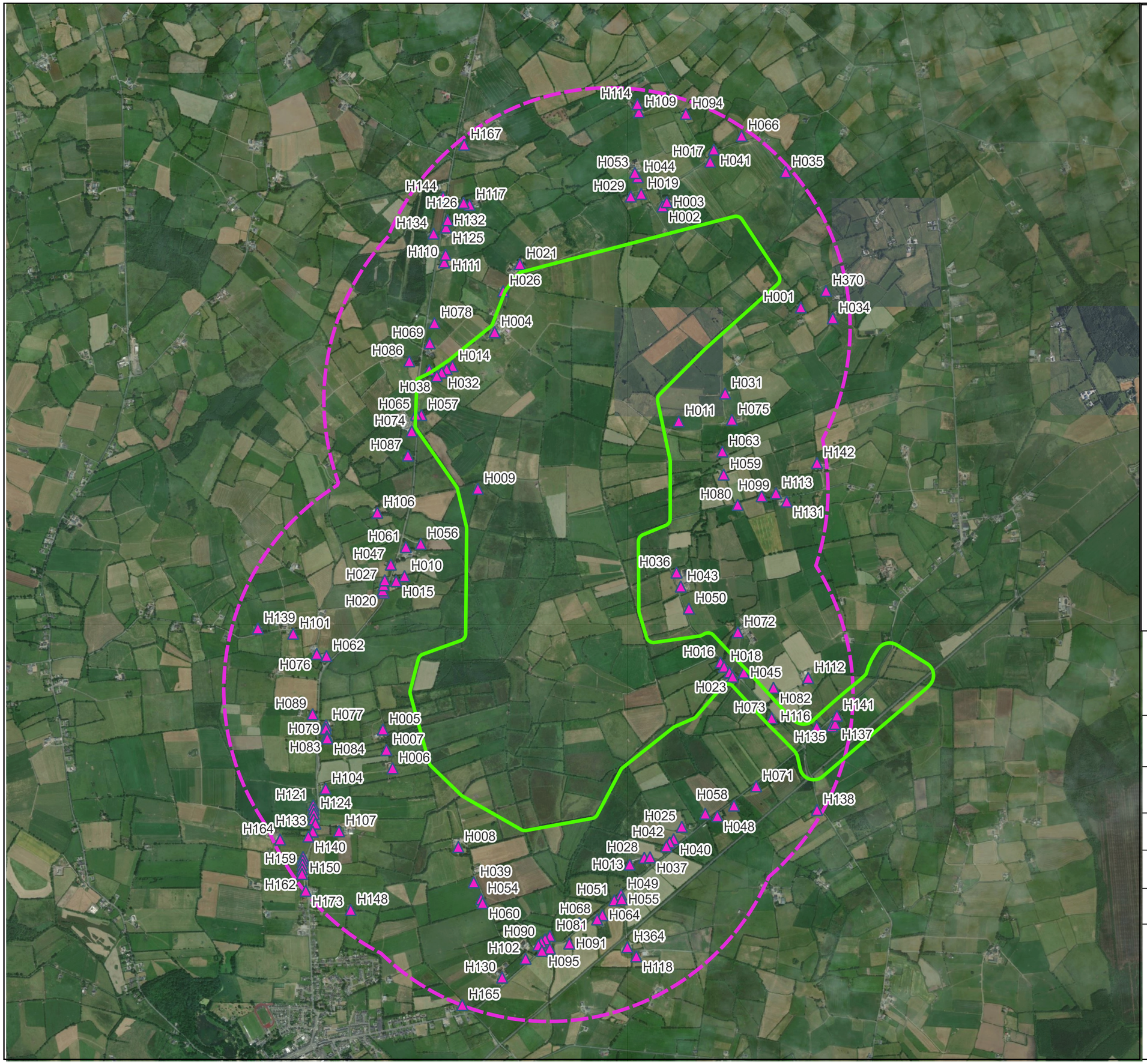
5.2.4 Shadow Flicker Study Area

At the outset of the project, during the constraints mapping process detailed in Chapter 3 of this EIAR, all sensitive properties within 2km of the Site were identified and mapped. In addition, a planning history

[6] *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*

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 properties' dataset.

The Shadow Flicker Study Area for the shadow flicker assessment is ten times rotor diameter (163m rotor diameter x 10 = 1.63km) in accordance with the 2006 WEDGs. There are 140 sensitive properties located within 1.63 km of the proposed turbine locations. The Shadow Flicker software modelled these 140 sensitive properties for potential shadow flicker impact. Of these, a total of 110 properties are theoretically predicted to experience shadow flicker. The Shadow Flicker Study Area and sensitive property locations are shown in Figure 5-3.



Map Legend

- EIAR Study Area
- Sensitive Properties
- 1.63km Shadow Flicker Study Area

Drawing Title

Shadow Flicker Study Area

Project Title

Borrisbeg Renewable Energy Development

Drawn By	Checked By
GG	KM
Project No. 220310	Drawing No. Figure 5-3
Scale 1:25000	Date 2023-11-02

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

5.2.4.1.1 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[7]. 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 140 no. properties within 360 degrees of the proposed turbine locations out to 1.63km were assessed for shadow flicker impact.

At each property, and or the purposes of this shadow flicker assessment, the software package ReSoft WindFarm Version 5.0.2.2 has been used to predict the level of shadow flicker associated with the Proposed Wind Farm. 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 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 during all daytime hours, wind will not blow at all times, nor will it blow in a constant direction during times when shadow flicker may occur. The total annual shadow flicker calculated for each property assumes 100% sunshine during daytime hours, as referred to above. However, weather data for this region shows that the sun shines on average for 26.46% of the daylight hours per year. This percentage is based on Met Éireann data recorded at Birr, the nearest meteorological station, over the 30-year period from 1979 to 2008 (www.met.ie). The actual sunshine hours at the Site, and therefore the percentage of time shadow flicker could actually occur is 26.46% of the predicted hours. Table 5-11 below lists the annual shadow flicker calculated for each property when the regional average of 26.46% sunshine is taken into account, to give

[7] *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/

a more accurate annual average shadow flicker prediction. Table 5-11 below also outlines whether a shadow flicker mitigation strategy is required for each property to mitigate potential exceedances of the daily and/or annual threshold figure.

5.3 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 Tipperary County Development Plan 2022-2028, 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 2022, the most recent census for which a complete dataset is available, also the Census of Ireland 2016, the Census of Agriculture 2020 and from the CSO website (www.cso.ie). Census information is divided into State, Provincial, County, Major Town, and District Electoral Division (DED) level.

5.3.1.1 Receiving Environment

The Site is located approximately 11km south of Roscrea Town and approximately 2.5km northeast of Templemore town centre, in County Tipperary. Please refer to Figure 1-1 of Chapter 1: Introduction for the Site Location map. The N62 National Road runs north-south along the western boundary of the Site. The Site measures approximately 650 hectares. The Proposed Wind Farm falls within the townlands of Borrisbeg Skehanagh, Ballycahill, Clonmore, Eastwood, Knockanroe, Graffin, and the Proposed Grid Connection falls within the townlands of Clonmore and Strogue. The Site landuse predominantly comprises a mix of pastoral agriculture and private forestry. The surrounding landuse predominantly comprises pastoral agriculture, and commercial and residential use along local roads and within Templemore town. Existing access is via farm entrances off the N62 to the west, the L-3248 to the north and the L-70391 to the east.

In order to assess the population in the vicinity of the Site, the 'Study Area' for the population section of this EIAR was defined in terms of the District Electoral Divisions (DEDs). The Site lies within three (3) No. DEDs: Drom, Killavinoge, and Templetouhy, as shown in Figure 5-4. These DEDs will collectively be referred to hereafter as the Study Area for this chapter. The Study Area has a population of 2,499 persons as of 2022. This includes Drom (1,218 persons), Killavinoge (484 persons), and Templetouhy (797 persons). The total land area of the Study Area totals 89.07km^2 and comprises Drom 47.0km^2, Killavinoge 22.7km^2, and Templetouhy 42.0km^2.

There are 61 Sensitive Properties located within 1 km (including one derelict property) of the proposed turbine locations. The closest involved Sensitive Property is located over 610m from the nearest proposed turbine (T6) and the closest third-party Sensitive Property is located greater than 750m from the nearest proposed turbine (T3), i.e. over the recommended 4x tip height setback (740m) and over the minimum recommended setback for properties involved in the project (500m). There are 6 no. sensitive properties within 100m of the Proposed Grid Connection, 5 of which also fall within 1km of the proposed turbines.

For the shadow flicker assessment, which is further detailed in Section 5.6 below, the Shadow Flicker Study Area is defined as ten times rotor diameter from each turbine in accordance with the 2006 WEDGs. The Shadow Flicker Study Area for this assessment is 1.63 kilometres based on a rotor diameter of 163 metres and is further detailed in Section 5.6.2.2.13 below. There are 140 no. Sensitive Properties identified within the 1.63km Shadow Flicker Study Area.

The Site is located within an area 'Open for Consideration' for wind energy development as detailed in the Tipperary Renewable Energy Strategy 2016 which is the current Renewable Energy Strategy under the 2022-2028 Tipperary County Development Plan.

5.3.2 Demographic Trends

The recently published Census of 2022 shows that the population of Tipperary grew by 5% to 167,895 since the 2016 Census. Moreover, the number of people in the county rose by 8,342 between April 2016 and April 2022. Over the same period, Ireland's population grew by 8% from 4,761,865 to 5,149,139. Population statistics for the State, County Tipperary 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 2016 – 2022 (Source: CSO)

Area	Population Change		Percentage Population Change
	2016	2022	2016– 2022
State	4,761,865	5,149,139	8%
County Tipperary	159,533	167,895	5%
Study Area	2,447	2,499	2%

The data presented in Table 5-1 shows that the population of the Study Area increased by 2% between 2016 and 2022. This rate of population growth is less 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 2016 and 2022 occurred within the Killavinoge and Drom DEDs, which experienced, and 4.5% and 4% population increase, respectively. In comparison, the populations of Templetouhy DED, which decreased by 2.4% during the same time period. Of the DEDs that make up the Study Area for this assessment, the highest population was recorded in Drom DED, with 1,218 persons recorded during the 2022 Census. The lowest population was recorded in Killavinoge DED, with 462 persons recorded during the 2022 Census.

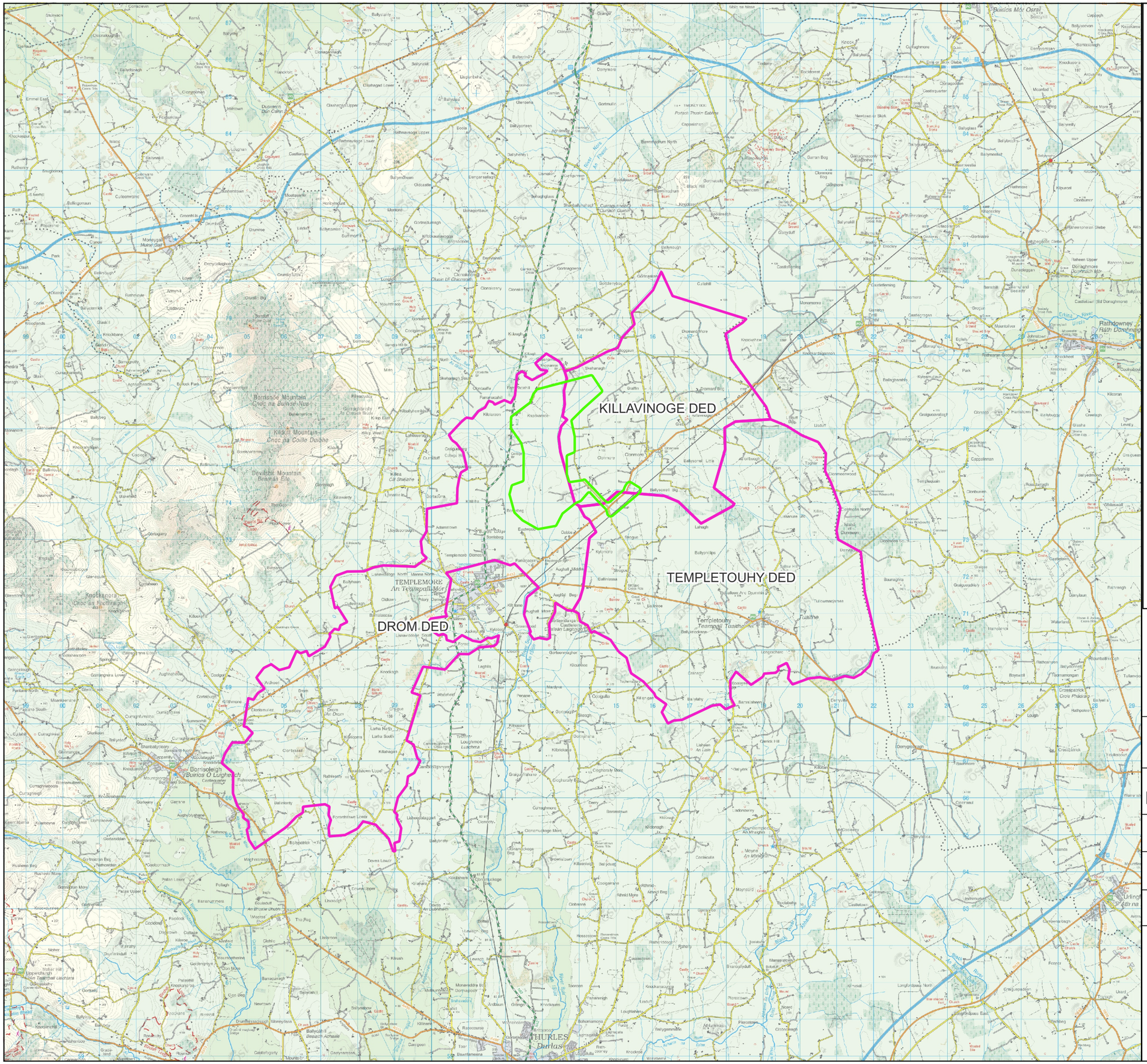
5.3.3 Population Density

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

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

Area	Population Density (Persons per square kilometre)	
	2016	2022
State	68.06	71.47
County Tipperary	39.47	39.52
Study Area	27.47	28.06

The population density of the Study Area recorded during the 2022 Census is 28.06 persons per km^2 which is considerably lower than the national population densities of 71.47 persons per km^2 and lower than the population density of County Tipperary, recorded at 39.52 persons per $km,^2$ respectively. Similar to the observed population trends, the population density recorded across the Study Area varies between DEDs. Drom DED has the highest population density, at 25.91 persons per km^2. Killavinoge DED has a lower population density of 21.32 persons per km^2. Templetouhy DED recorded the lowest population density with a total of 18.98 persons recorded in the townland.



Map Legend

- EIAR Study Boundary
- Borrisbeg Population Study Area

Drawing Title

Population Study Area

Project Title

Borrisbeg Renewable Energy Development

Drawn By	Checked By
GG	KM
Project No.	**Drawing No.**
220310	Figure 5-4
Scale	**Date**
1:100,000	2023-07-05

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

5.3.4 Household Statistics

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

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

Area	2016		2022	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
State	1,697,665	2.8	1,841,152	2.74
County Tipperary	59,276	2.7	62,232	2.67
Study Area	843	2.68	877	2.92

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 2016 and 2022 Censuses are the similar 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. Drom DED recorded 3.04 persons per household recorded in 2022. Killavinoge recorded the highest with 3.14 persons per household in 2022. Templetouhy DED recorded the lowest with 2.57 persons per household recorded in 2022 respectively.

5.3.5 Age Structure

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

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

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
State	19.66%	12.52%	27.62%	25.12%	15.08%
County Tipperary	19.83%	11.84%	18.28%	26.56%	17.48%
Study Area	19.52%	14.04%	20.20%	29.22%	17.02%

County Tipperary's population in April 2022 was comprised of 167,895. The average age of Tipperary's population in April 2022 was 40.3 years, compared with 38.6 years in April 2016. Nationally, the average age of the population was 38.8, up from 37.4 in April 2016. The number of people aged 65 and over continues to grow. This age group increased by 20% to 29,356 in Tipperary, and by 22% to 776,315 at a national level since 2016. 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 45-64 age category.

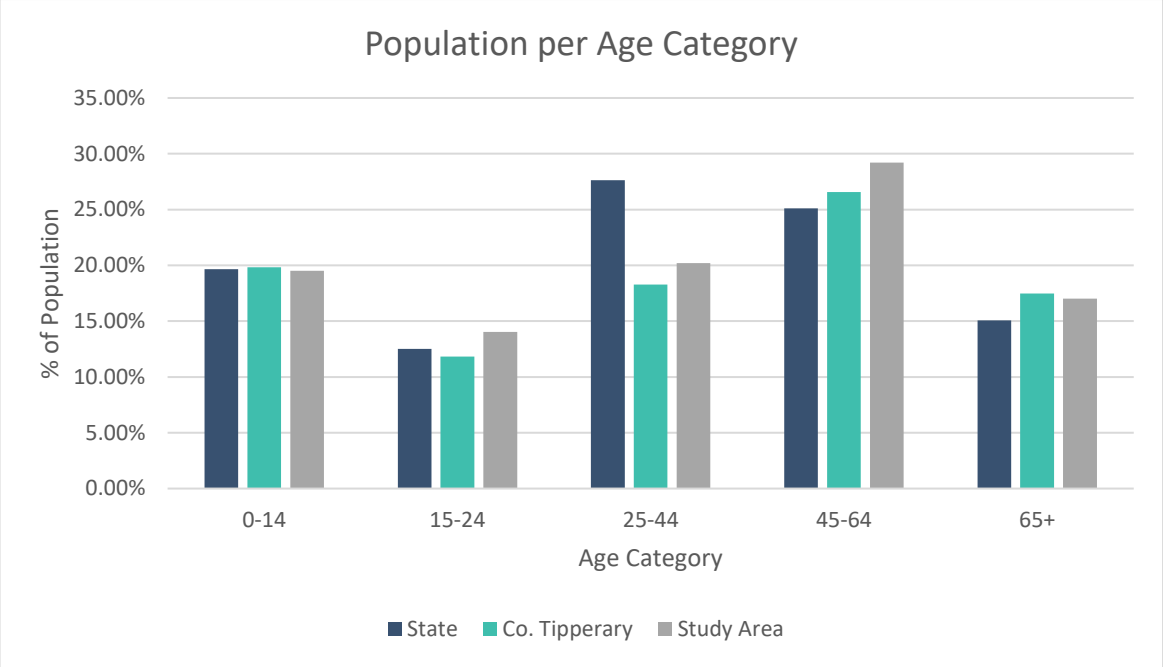


Figure 5-5 Population per Age Category in 2022 (Source: CSO)

5.3.6 Employment and Economic Activity

5.3.6.1 Economic Status

The labour force consists of those who can work, i.e., those who are aged 15+, out of full-time education and not performing duties that prevent them from working. There were 73,207 people (aged 15 and over) at work in Tipperary, an increase of 9,735 people (+15%) between 2016 and 2022. Nationally, there were 313,656 additional people (+16%) at work. This figure is further broken down into the percentages that were at work, seeking first time employment or unemployed. It also shows the percentage of the total population aged 15+ who were *not* in the labour force, i.e., those who were students, retired, unable to work or performing home duties.

Table 5-5 Economic Status of the Total Population Aged 15+ in 2022 (Source: CSO)

Status		Republic of Ireland	County Tipperary	Study Area
% of population aged 15+ who are in the labour force		**61.18%**	**58.93%**	**55.88%**
% of which are:	At work	91.67%	92.29%	93.78%
	First time job seeker	1.36%	1.17%	6.96%
	Unemployed	6.96%	6.54%	5.39%
% of population aged 15+ who are not in the labour force		**38.82%**	**41.07%**	**44.12%**
% of which are:	Student	28.60%	24.66%	29.95%
	Home duties	16.96%	16.95%	16.38%
	Retired	40.96%	43.44%	43.03%
	Unable to work	11.79%	13.7%	9.90%
	Other	1.69%	1.26%	0.73%

Overall, the principal economic status of those within the labour force living in Study Area is lower than that recorded at State and County level, with between 0 to 5% average difference apparent. Of those who were not in the labour force during the 2022 Census, the highest percentage of the population in the Study Area was in the 'Retired' category, which is the same as figures recorded at national and County level that show 'retired' as the highest category.

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.

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*[8] 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*[9], 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 of the wind sector in Ireland*[10], 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:

1. *Wind Energy Industry Employment:*
    a. *Installation*
    b. *Development*
    c. *Planning*
    d. *Operation and Maintenance*
    e. *Investor activity*
2. *Electricity Grid Network Employment*
3. *Potential Wind Turbine Manufacturing Employment*

Wind Energy Ireland (WEI) released a report in March 2021 *Our Climate Neutral Future Zero by 50* [11] 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.

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

[9] *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*
[10] *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*
[11] *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*

The KPMG/WEI joint report '*Economic impact of onshore wind in Ireland*[12] (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 jobs will be created for both the Proposed Wind Farm and Proposed Grid Connection combined. 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 Proposed Project.

At the time of writing, it is reported on WindEnergyIreland.com that 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.[13] 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'[14] states that the construction and development of wind energy projects across the island of Ireland would involve approximately €14.75 billion of investment from 2009 up to 2020, €5.1 billion of which would be retained in the Irish economy (€4.3 billion invested in the Republic of Ireland and €0.8 billion in Northern Ireland).

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

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

A 2019 report by Baringa, 'Wind for a Euro: Cost-benefit analysis of wind energy in Ireland 2000-2020', has analysed the financial impact for end consumers of the deployment of wind generation in Ireland over the period 2000-2020. The report calculates how the costs and benefits for consumers would have differed if no wind farms had been built. 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 (AGV) of €550 million per annum to the Irish economy, will contribute €305 million total payment in incomes across the supply chain and has the

[12] *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*
[13] *As reported windenergyireland.com. Installed capacity as of May 2022*
[14] *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*

potential to contribute approximately €100 million 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 Proposed Project, will, if consent is granted, contribute to the economic value that renewable energy brings to the country. It will be built out towards the latter half of the decade, thus contributing to the 2030 targets. Furthermore, the Proposed Project will have significant economic benefits (see Section 5.3.6.1.1 for further details). At a national level, Ireland currently has one of the highest external dependencies on imported sources of energy, such as coal, oil and natural gas when compared with other EU Member States. As detailed in the SEAI Report '*Energy in Ireland 2022*', Ireland has a high import dependence on oil and gas and is essentially a price-taker on these commodities. The report states that in 2020 and 2021, oil and coal imports more than tripled and notes that this is at odds with the sectoral emission ceilings for electricity in the 2021-2025 and 2026-2030 carbon budgets.

5.3.7 Land Use Patterns and Activities

The land uses within the Site is predominantly located within agricultural areas and pastures. The primary surrounding land use within the population Study Area is that of agricultural and residential/commercial. The total area of farmland within the three DEDs, around the Site, measures approximately 11,168.59 hectares, comprising 82% of the Study Area, according to the CSO Census of Agriculture 2020. There are 220 farms located within the three DEDs, with an average farm size of 41.7 hectares. This is slightly lower than the average 42.2-hectare farm size for Co. Tipperary. Table 5-6 shows the breakdown of farmed lands within the three DEDs. Pasture accounts for the largest proportion of farmland, followed by Rough Grazing.

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

DED	No of holdings	Average size (hectares)	Median age of holder	Livestock units	Total Cereals (hectares)	Average farmed (hectares)
Drom	101	41.1	57	8,050	184.8	4,154
Killavinoge	50	42.1	59	4,284	0	2,105.7
Templetouhy	69	41.9	55	5,743	66.5	2,891
Total	**220**	**41.7 (average)**	**57 (average)**	**18,077**	**251.3**	**3,050.23 (average)**
Size of 3 DEDs			11,168.59 hectares			
Total Area Farmed within 3 DEDs			9,150.7 hectares			
Farmland as % of DEDs			**82%**			

5.3.8 Services

The Site is located approximately 2.5km east of Templemore. Other settlement areas in the wider region include Roscrea Town, approximately 11km to the north of the Site. Both centres provide retail, recreational, educational, and religious services.

5.3.8.1 Education

The nearest primary school is Clonmore National School and is approx. 1.8km east of the Site. Beyond that is St. Mary's National School Templemore approx. 2km southwest of the Site and St. Colmcille's National School also in Templemore 3km to the southwest. The nearest secondary school is located in Templemore – Our Lady's College is 2km to the southwest. The Technological University of the Shannon (Thurles campus) (third-level education) is located approximately 14km south of the Site and the Mary Immaculate College (Thurles campus), approximately 15km south of the Site. The Garda College is located in Templemore, approximately 2km to the southwest.

5.3.8.2 Access and Public Transport

The Site is currently accessible via entrances of a number of local roads. There is a private farm access off the L-3248, approx. 60m east of the N62 in the northwest of the Site. The L-7039 and L-70391 run through the Site with private farm access into the Site from both of these roads. Furthermore the proposed underground grid connection runs through the L7039 for approx. 870m and crosses the R433 and L-7038. Access to the end masts and new proposed road through third party leading to the masts can be gained via the L-7038.

There are three local bus services are provided by Local Link – Tipperary through private bus operators. Bernard Kavanagh & Sons provides transport between Nenagh to Templemore on a daily basis on bus route no.395. They also provide transport between Roscrea and Urlingford, stopping at Templemore, on bus route no.812. Aidan Johnston Coach hire provides transport between Tipperary town and Maynooth, stopping at Templemore, on bus route no.UM16. The nearest train station to the Site is the Templemore train station 2.58km southeast of the Site providing connections with Dublin Heuston, Limerick, Ennis, Cork and Tralee.

5.3.8.3 Amenities and Community Facilities

There are no amenity or community facilities located within or adjacent to the Site, however there are several in the surrounding area. Located 1.8 to 2km away from the Site is the Michael Fennel Park, an athletics track, and Town Park are situated where BT Harps FC, Templemore Athletics Club and J K Brackens GAA Club play respectively. Amenities and community facilities, including other sports clubs, youth clubs, recreational areas and water sport activities are located in Thurles and Roscrea.

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. The most recent publication by Failte Ireland pertaining to domestic and international tourism volumes for Ireland was published in 2021 for the year 2019. *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 5-7 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 5-7 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 Mid-West Region, in which the Site of the Proposed Project is located, comprises Counties Clare, Limerick and North Tipperary. This Region benefited from approximately 9% of the total number of overseas tourists to the country and approximately 9% of the total tourism income generated in Ireland in 2019.[15]

Table 5-8 presents the county-by-county breakdown of overseas tourist numbers and revenue to the West Region during 2017 (‘*2017 Topline Tourism Performance By Region, Fáilte Ireland, August 2018*)[16]. There is no published County by County tourism breakdown for 2018 to 2022 to date). As can be observed North Tipperary had a tourism revenue of at €69 million.

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

County	Revenue Generated by Overseas and domestic Tourists (€m)	No. of Overseas Tourists (000s)
Clare	244	1,111
North Tipperary	69	301
Limerick	307	931

15 Failte Ireland Key Tourism Facts 2019, March 2021. Available at: https://www.failteireland.ie/FailteIreland/media/WebSiteStructure/Documents/3_Research_Insights/4_Visitor_Insights/KeyTourismFacts_2019.pdf?ext=.pdf

16 2017 Topline Tourism Performance By Region, Fáilte Ireland, August 2018. Available at: https://www.failteireland.ie/FailteIreland/media/WebSiteStructure/Documents/3_Research_Insights/2_Regional_SurveysReports/2017-topline-regional-tourism-performance.pdf?ext=.pdf

5.3.9.2 Tourism Barometer: Strategic Research and Insight September 2023

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

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

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

5.3.9.3 Tourism Attractions

There are no tourist attractions within or adjacent to the Site.

5.3.9.3.1 *Tourism Attractions within the surrounding landscape*

The nearest identified tourist attraction is the Devil's Bit, a popular hiking and walking trail, is located c. 4km to the west of the Site.

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

- Glen of Aherlow – a picturesque valley located in southern County Tipperary and is located c. 50km south of the Site.
- Lár na Páirce Museum –the first GAA museum in the country located in Thurles and is located c. 15km south of the Site.
- Mountain ranges including: the Galty mountains (located c. 53km south of the Site), Silvermine Mountains (located c. 25km west of the Site) and Knockmealdown mountains (located c. 61km south of the Site) – important centres for walking, cycling and adventure related activities.

- Brú Ború Cultural Centre – the centre contains impressive theatre and craft shop, 'Sounds of History' cultural exhibition, restaurant, café, bar facility, South Tipperary genealogy suite, conference facilities and is located c. 31km south of the Site).
- Rock of Cashel - an ancient royal Site of the Kings of Munster and first attained importance as a fortress and is located c. 31km south of the Site).

Archaeological sites and monuments are part of Irish national heritage and are recognised tourist attractions across the country. National Monuments within 10km of the nearest turbine are listed below. Please see Chapter 13 Archaeology and Cultural Heritage for further details.

- Timoney Stones – comprises of a large group of standing stones in the townlands of Cullaun and Timoney Hills and is located c. 8.5km northeast of the nearest proposed turbine, T1.
- Errill Church – a late medieval church located in County Laois and is located c. 8.7km northeast of the nearest proposed turbine, T1.
- Motte and Bailey Enclosure – two monuments subject to a Preservation Order (4/2008) are located in Moatquarter, Co. Tipperary over 9.5km to the north-west of the nearest proposed turbine, T1.
- Tower House (Rathnaveoge Castle) – the tower house at Rathnaveoge, Co. Tipperary is located c. 8.9km north-west of the nearest proposed turbine, T1.
- Ringfort and 4/1984 Motte (The Motte, Cloncannon) - Ringfort (PO no. 1/1996) is located c. 9.4km north-west of the nearest proposed turbine, T2. The nearby motte (PO no. 4/1984) is situated c. 9.6km north-west of T6.
- Tower House (Loughmoe Castle) – the tower house at Tinvoher is located c. 6.6km south of the nearest proposed turbine, T9.

5.3.9.4 Tourist Attitudes to Wind Farms

5.3.9.4.1 *Scottish Tourism Survey 2021*

BiGGAR Economics carried out an independent study in 2021, 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. The Study, an update to a 2016 study of the same name, aimed to empirically establish a connection between the expansion of onshore wind farms and the tourism sector in Scotland. Both tourism-related employment and the onshore wind industry demonstrated growth over the decade leading up to 2019, as well as during the specific 2015 to 2019 period that was the focus of this investigation.

When examining trends at the local authority level, the study revealed no discernible correlation between the increase in the number of wind turbines and the levels of employment in tourism-related sectors.

Additionally, the research delved into potential localized effects by scrutinizing trends in tourism-related employment in the immediate vicinity of 16 wind farms established between 2015 and 2019 and re-evaluating earlier case studies involving 28 wind farms constructed between 2009 and 2015. In the majority of cases, it was found that tourism-related employment in the vicinity of wind farms exceeded the overall trend for Scotland and the specific local authority area in which the wind farm was situated.

Drawing from a substantial evidence base encompassing 44 recently developed wind farms, this study concluded that there was no observable relationship between tourism employment and the development of wind farms, neither on a macroeconomic scale within the Scottish economy, nor within the immediate locality of wind farm sites.

5.3.9.4.2 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 Project throughout the Site design and assessment processes. Reference has been made to the 2006 WEDGs and the 2019 draft WEDGs in addition to IWEA (now WEI) 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'[17] 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

[17] *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*

built in their area. Four per cent were against the development. The reasons cited by those who expressed themselves in favour of the wind farm included the fact that wind energy is clean (78%), it would provide local jobs (44%), it would help develop the area (32%) and that it would add to the landscape (13%).

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

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

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

5.3.10.1.3 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 Projects 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*.[18] 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.

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

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[19] report. A total of 1,017 adults were surveyed along with a supplementary booster sample of 201 rural dwellers. The results are as follows:

- 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 and Wind Farms

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.

[19] *Wind Energy Ireland December 2022 Public Attitudes Monitor. Available at: https://windenergyireland.com/images/Final_WEI_Annual_Attitudes_Survey_2022.pdf*

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 5-3 of this EIAR.

The report presents the main findings of a research project estimating the impact on house prices from wind farm developments. It is based on analysis of over 500,000 property sales in Scotland between 1990 and 2014. The key findings from the study (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 Site would not impact on the property values in the area.

5.3.13 Property Values and Grid Infrastructure

In February 2016, Eirgrid conducted an *Investigation into the Potential Relationship between Property Values and High Voltage Overhead Transmission Lines in Ireland.*[20] The purpose of the study is to present a framework to better assess the potential impact, if any, of High Voltage Overhead Transmission Lines (HVOTLs) on the value of properties in close proximity to overhead electricity transmission infrastructure. A review of the existing literature on this topic reveals that the preferred methodology for quantifying impacts on sales values is by using a hedonic price regression model. This requires access to a dataset containing a significantly large number of property transactions. To be suitable for analysis by the model the following information was required:

- sale prices,
- property characteristics (e.g. property type, size, number of bedrooms, year property
- built) and,
- the property address/location, which is used to determine the distance from the
- property to nearby lines and support structures.

A dataset of this sort was not publicly available in Ireland and, therefore, primary research was required. The approach followed in this study involved gathering transaction data directly from estate agents. The data collection and subsequent statistical regression analysis was limited to residential properties and agricultural land. However, the results from the regression analysis were supplemented by the findings of the survey of estate agents. The survey of estate agents was designed to obtain their designed to obtain their professional opinion on the impact of HVOTLs on property values. The estate agent survey also included different types of commercial property i.e., retail, offices and industrial.

The results showed that:

- Where negative impacts were found, the impact of pylons was larger than the impact from the transmission lines, thus emphasising the visual component.
- Where an impact was found the effect diminished rapidly with distance from the HVOTLs. The impact from HVTOLs disappears in the region of 150-200 metres.
- Where negative impacts were found there is evidence to suggest that the impacts generally decrease with the passage of time. In some cases no impacts were evidenced after ten years with vegetation grown likely contributing to this decrease.
- There is evidence that properties close to HVOTL Rights of Way appreciate at the same rate as properties located away from HVOTLs.
- Estate agents reported that there was no impact from 110 kV lines on 55% of agricultural land with an average (median) of zero change was recorded for the 110 kV line.
- Estate agents reported that there was no impact from 110 kV lines on 41% of residential properties.

Statistical analysis of the sales data for both residential and rural properties showed that prices paid were associated with features of the properties such as location, size and year of sale of the property. Additional information related to HVOTLs was then added into each of these models in order to determine (a) whether the added HVOTL information assisted further in explaining the difference in price between properties and (b) if so, what the size of that impact was. This study, at a 95% confidence level, did not find a statistically significant negative impact from HVOTLs in close proximity to either residential or farm properties.

[20] *Eiergrid 2016* Investigation into the Potential Relationship between Property Values and High Voltage Overhead Transmission Lines in Ireland *Available at: https://www.eirgridgroup.com/Site-files/library/EirGrid/FINAL-Part-1-Property-Valuation-Report-Doc.-Version-1.0-23.02.16.pdf*

In May 2016, Eirgrid conducted a literature review and evidence-based field study on the effects of high voltage transmission development on patterns of settlement and land use. The objections of *EirGrid Evidence Based Environmental Studies Study 9: Settlement and land use*[21] were to:

- To gather information on patterns of settlement and land use near to existing transmission infrastructure.
- To establish the effects of existing transmission infrastructure on patterns of settlement and land use.
- To review land use planning policy in various Development Plans to determine whether any policy change has arisen as a result of the construction and operation of existing transmission projects.

A literature review of transmission projects from around the world was carried out, including review of Environmental Impact Assessments (EIAs). To investigate effects of transmission projects on patterns of land use and settlement, 31 case studies were chosen; 17 with existing overhead line (OHL) circuits, 10 with substations and 4 in construction. Sites were located in rural, rural/urban and urban areas. Land uses included agricultural, commercial and amenity. Four control Sites had no infrastructure. Coexistence, development density, planning policy and planning application history were all investigated. Planning and land use policy over the last twenty years was reviewed to see if it has influenced, or been influenced, by recent programmes of transmission infrastructure development. This study has established no evidence of any significant impact arising from the construction or existence of transmission infrastructure in terms of patterns of settlement and land use; however, transmission infrastructure can be a local physical constraint on development.

5.3.14 Residential Amenity

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

The Proposed Project is located within a rural setting in north Tipperary, approximately 11km south of Roscrea Town and approximately 2.5km northeast of Templemore town centre. The N62 National Road runs north-south along the western boundary of the Site. Land use currently comprises a mix of pastoral agriculture and private forestry. The surrounding land use predominantly comprises pastoral agriculture, and commercial and residential use along local roads and within Templemore town. Existing access is via farm entrances off the N62 to the west, the L-3248 to the north and the L-7039 to the east.

There are 61 Sensitive Properties located (including one derelict) within 1 kilometre of the proposed turbine locations. Of these 61 Sensitive Properties, 7 no. are involved landowners.

All non-involved sensitive properties are located at a minimum of 740m from any turbine, i.e., 4 times the tip height of 185m). There are 7 involved Sensitive Properties located at a minimum of 610m or greater, from any proposed turbine location. The turbine locations adhere to the 2006 WEDGs and the 2019 draft WEDGs in relation to turbine setback, a minimum 500m set back from sensitive properties and a minimum setback of four times the tip height of the proposed turbines with a reduced setback of a minimum of 500m for sensitive properties involved with the Proposed Project.

On the 21st of December 2022, the Department of the Environment, Climate and Communications published the 'Climate Action Plan 2023' (CAP) which states that new wind energy guidelines will be drafted in 2023 and finalised in 2024. Notwithstanding this, however, due to the timelines associated with

[21] *EirGrid (2016) Evidence Based Environmental Studies Study 9: Settlement and land use Literature review and evidence based field study on the effects of high voltage transmission development on patterns of settlement and land use Available at: https://www.eirgridgroup.com/Site-files/library/EirGrid/EirGrid-Evidence-Based-Environmental-Study-9-Settlement-and-Landuse.pdf*

the planning process for renewable energy projects and the commitment within the CAP to publish new draft guidelines in 2023 and final guidelines 2024, it is possible that the new guidelines may be adopted during the consideration period for the current planning application for the Proposed Wind Farm. Without benefit of the final 2024 guidelines, it is considered that since noise emissions and shadow flicker are controllable via inbuilt technologies, the Proposed Wind Farm is capable of compliance with any future guideline limits in this regard. Furthermore, it is considered that 4 times turbine tip height set back from non-involved sensitive properties has become an industry established accepted separation distance for visual amenity purposes.

When considering the amenity of residents in the context of a Proposed Project, 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 12 addresses noise and vibration). A comprehensive landscape and visual impact assessment have also been carried out, as presented in Chapter 14 of this EIAR. Impacts on the local population during the construction, operational and decommissioning phases of the Proposed Project is assessed in relation to each of these key topics 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

Table 5-9 and Table 5-10 below details the general health of persons by percentage for the State, County Tipperary and the Study Area for the most recent census taken in Ireland, 2016 and 2022, which have data publicly available. In general, the percentage health breakdown for the State, County and study area populations are very similar. The Study Area, State and County all reported in the range of 80-90% 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 County 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. In 2022, 83% of people in Tipperary stated that their health was good or very good compared with 87% in 2016. This is a similar trend to the national figures, which also showed a 4% decrease in the good/very good categories, from 87% to 83%.

Table 5-9 Percentage General Health Breakdown for the State and County Tipperary as reported in the 2016 and 2022 Census. Source www. CSO.ie

	Very Good		Good		Fair		Bad		Very Bad		Not Stated	
	2016	2022	2016	2022	2016	2022	2016	2022	2016	2022	2016	2022
State	59.4%	53.2%	27.6%	29.7%	8%	8.6%	1.3%	1.4%	0.3%	0.3%	3.3%	6.7%
Tipperary	57.6%	52.2%	29.1%	31%	9.1%	9.6%	1.4%	1.6%	0.2%	0.4%	2.3%	5.2%

Table 5-10 Percentage General Health Breakdown for the study area as reported in the 2016 and 2022 Census. Source www. CSO.ie

Study Area- Electoral Divisions	Very Good		Good		Fair		Bad		Very Bad		Not Stated	
	2016	2022	2016	2022	2016	2022	2016	2022	2016	2022	2016	2022
Drom	64.7 %	61.5 %	26.6 %	27%	6.3%	6.7%	0.5 %	1.3 %	0.08 %	0.2 %	1.6 %	3.3 %
Killavinoge	64.5 %	62.7 %	25.3 %	28.8 %	5.6%	6.5%	1.2 %	1.3 %	0.2%	0%	3%	0.8 %
Templetouhy	56.9 %	52.7 %	28.5 %	31.7 %	10.9 %	11.8 %	1.8 %	1.6 %	0.2%	0.4 %	1.4 %	1.8 %

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 Quality and Chapter 11 Climate assess the potential for impact to human health from dust, CO_2 and other noxious emissions generated by additional vehicles and plant machinery as well as the release of CO_2 through excavations. The assessments consider the construction, operation and decommissioning phases. The assessments conclude that the residual effects from the construction and decommissioning phases of the Proposed Project are not significant. Please see Chapter 10 and Chapter 11 for further details.

5.4.2.2 Water quality

There are no underground water or sewerage networks within the Site. The Templemore Public Water Scheme and Source Protection Area are located approximately 1.2km west of any proposed infrastructure on the opposite side of the N62. The Site does not fall within the Templemore urban wastewater catchment. The GSI also map several additional private boreholes and wells in the vicinity of the Site. Chapter 9 Hydrology and Hydrogeology assess the potential for impact on public water supply and private wells during the construction, operation and decommissioning phases.

5.4.2.3 Noise and Vibration

Chapter 12 Noise and Vibration assesses the potential for noise and vibration impacts during the construction, operation and decommissioning phases of the Proposed Project. The assessment includes mitigation and monitoring measures that will be complied with for the construction, operation, and decommissioning phases.

5.4.2.4 Traffic and Transport

Chapter 15 Material Assets assesses the potential for traffic and transport impacts during the construction, operation and decommissioning of the Proposed Project. 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 from maintenance vehicles. The assessment includes a Traffic Management Plan for the construction phase and all abnormal loads will be supervised by competent experts and An Garda Síochána.

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

A risk assessment of the Proposed Project's vulnerability to and from natural disasters can be found in Chapter 17 Major Accidents and Natural Disasters of this EIAR. A brief discussion can be found below.

5.4.2.5.1 *Pollution/Contamination/Fire*

A wind farm is not a recognised source of pollution. Should a major accident or natural disaster occur the potential sources of pollution on-site during both the construction, operational and decommissioning phases are limited. Sources of pollution with the potential to cause 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 Proposed Project 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. 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 Proposed Project is not regulated by or connected to or close to, any Site regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations i.e., SEVESO sites and so there are no potential effects from this source.

There is low potential for significant natural disasters to occur at the Site. Ireland is a geologically stable country with a mild temperate climate. The Proposed Project has low potential to cause natural disasters or major accidents. As detailed in Section 8.3.5 in Chapter 8 Land Soil and Geology, while there are sections of peat identified within the Site on the published soils map (www.epa.ie) and published subsoils maps (www.gsi.ie), very shallow peat was only encountered at some locations:

- up 0.8m deep of peat was found along the proposed access road to turbine T9 including at the turbine location itself where 0.7m of peat was encountered.
- shallow peat of up to 0.2m was found along the proposed access roads to turbine locations T6 and T7, but not at the turbine locations themselves.
- All other probes carried out at the proposed infrastructure locations encountered mineral soil.

Peat is not designated in this area and is significantly degraded due to the agricultural land improvement The Site is relatively flat and is not a peatland Site and so there is low/no potential for peat slides or landslides. Any risks associated with flooding, impacts on infrastructure, accidents etc are addressed in the sections below.

5.4.2.5.2 *Flooding*

The River Suir flows through the east of the Site and the Eastwood River flows through the west and it is in a zone which is susceptible to flooding. The Site is under the OPW Maintenance of Arterial Drainage Scheme.

Indicative flood maps produced by the OPW show flooding potential at a number of locations throughout the Site. The Site drainage district is under the control of the local authority. Outside the Arterial Drainage and Drainage District Schemes, landowners who have watercourses on their lands have a responsibility for their maintenance. The National Indicative Fluvial (NIF) mapping (Figure 4.4) indicates that the site falls within the 1% and 0.1% Annual Exceedance Probability (AEP) flood zones. Further details regarding this aspect are provided in Chapter 9 Hydrology and Hydrogeology, specifically in Section 9.3.6.

5.4.2.5.3 *Stability/Landslide*

The GSI Landslide database (www.gsi.ie) shows no historical records of landslides near the Site or in the surrounding area. The GSI Landslide Susceptibility Map (www.gsi.ie) assesses the likelihood of a landslide happening at a specific location. According to the map, the probability of a landslide occurring at the Site is categorized as Low. This is attributed to the localized and shallow nature of the peat, as well as the flat topography, which collectively result in a very low risk of peat instability or sliding. Thus, there is limited potential for significant natural disasters occurring at the site. Ireland, being geologically stable with a mild temperate climate, has limited potential for such events. The possible natural disasters are confined to flooding, fire, and landslide occurrences. Further details on the risk of instability and potential failures, particularly landslides, are discussed in Chapter 8 on Land, Soils, and Geology. This chapter concludes that the site maintains an acceptable margin of safety, making it suitable for wind farm development.

5.4.2.6 Health Baseline Summary

Chapter 8: Land, Soils and Geology, Chapter 9: Hydrology and Hydrogeology, Chapter 10: Air Quality, Chapter 11: Climate, Chapter 12: Noise and Vibration and Chapter 15: Material Assets (Traffic and Transport) provide an assessment of the effects of the Proposed Project on these areas of consideration. Chapter 16 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, operation and decommissioning phases 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 above show that the residual effects will not lead to significant effects on any environmental media with the potential to lead to health effects for humans. The Noise and Vibration assessment concludes the residual effects for Sensitive Properties will range from not significant to imperceptible for the operational phase. Furthermore, the Wind Farm noise emissions and shadow flicker are controllable via inbuilt technologies, and it will comply with the conditions imposed should it receive a grant. Likewise, the vulnerability the project to/from potential for natural disasters has been assessed as low risk for all phases.

On this basis, the potential for negative health effects associated with the Proposed Project during all phases is considered to be not significant. Furthermore, the Proposed Project is capable of offsetting carbon emissions associated with the burning of fossil fuels. During the operational stage the Proposed Wind Farm will have a long term, moderate positive effect on air quality as set out in Chapter 10 Air Quality which will contribute to positive effects on human health.

5.5 Shadow Flicker Assessment Results

5.5.1 Daily and Annual Shadow Flicker

The software package ReSoft WindFarm Version 5.0.2.2 was used to model the predicted daily and annual shadow flicker levels in significant detail, identifying the predicted daily start and end times, maximum daily duration and the individual turbines predicted to give rise to shadow flicker.

The model results assume worst-case conditions, including:

- 100% sunshine during all daylight hours throughout the year,
- 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 maximum 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 26.46% 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 5-11.

The predicted maximum daily and annual shadow flicker levels are then considered in the context of the 2006 WEDGs daily threshold of 30 minutes per day and annual threshold of 30 hours per year. If there is a predicted exceedance of the threshold limits at any property, the turbines that contribute to the exceedance are also identified.

The 2006 WEDGs recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 minutes per day or 30 hours per year. As detailed in Section 5.5.1 there are no Sensitive Properties less than 610 metres of the proposed turbine locations.

The predicted shadow flicker levels have been modelled for all 140 Sensitive Properties located within 1.63km (10 x 163m rotor diameter) of the proposed turbine locations. The predicted shadow flicker model results indicate:

- 30 Sensitive Properties are theoretically predicted to experience zero shadow flicker;
- 110 Sensitive Properties are theoretically predicted to experience some shadow flicker;
    - Of the 110 Sensitive Properties, 86 Sensitive Properties are theoretically predicted to experience shadow flicker that exceeds the 2006 WEDGs. It should be noted that 8 of these 86 Sensitive Properties are involved landowners. Please see Table 5-11 below for details.
- The annual threshold of over 30 hours for shadow flicker (2006 WEDGs) is predicted to be exceeded at 13 Sensitive Properties once the regional sunshine average factor of 26.46% has been considered.
- Appendix 5-4 of this EIAR contains the shadow flicker results for the 140 houses, i.e. including the Sensitive Properties experiencing zero or less than the 2006 WEDGs threshold for daily and annual shadow flicker.

Figure 5-6 illustrates the houses that are potentially impacted by shadow flicker exceedance from Proposed Wind Farm.

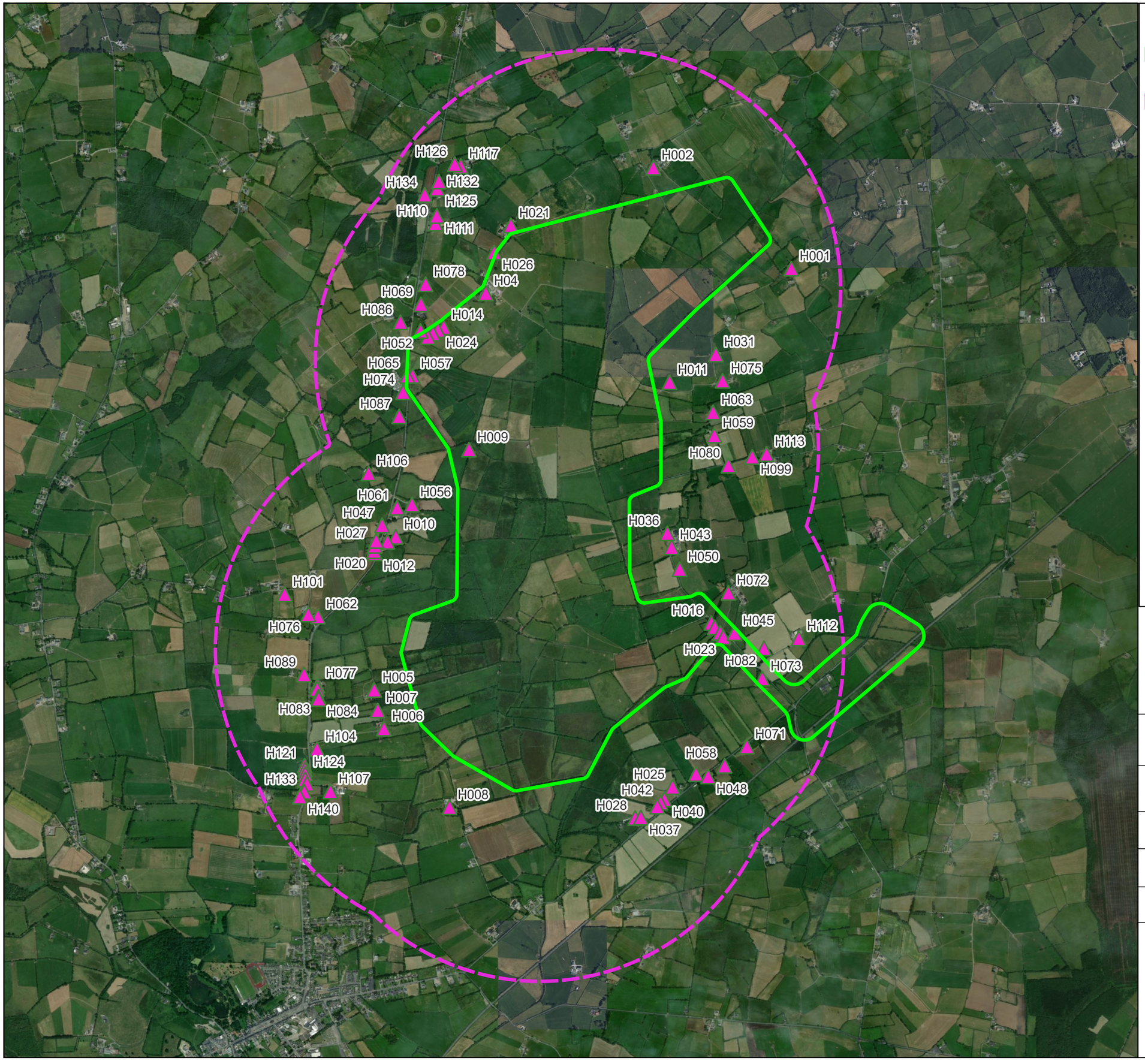
It is worth noting that the predicted exceedance of shadow flicker listed in Table 5-11 is considered conservative and in reality, the occurrence and/or duration of shadow flicker at these properties is likely to be eliminated or significantly reduced as the following items are not considered by the model:

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

Section 5.6 below details the mitigation measures which will be employed at the potentially affected properties to ensure that the current adopted 2006 WEDGs are complied with at any property within the Shadow Flicker Study Area. The same mitigation measures also demonstrate that the proposed turbines can be operated in accordance with the shadow flicker requirements of the 2019 draft WEDGs, i.e. zero shadow flicker occurrences, should they be adopted as currently proposed, while the planning application is being determined.

5.5.2 Cumulative Shadow Flicker

There are no proposed, permitted, or operational wind farms within 5km of the Site. The nearest turbine is 7.9km to the southeast (Lisheen 1/2 Wind Farm) with Bruckana and Ballinaveny over 9km to the southeast and west, respectively. Due to the separation distance between the proposed turbines and all surrounding proposed, permitted, or operational wind farms (i.e., when applying a 10-x rotor diameter study area to all other wind farms within 10km, the respective study areas do not overlap with the Study Area), there is no potential cumulative shadow flicker effects.



Map Legend

- EIAR Study Area
- Sensitive Properties
- 1.63km Shadow Flicker Study Area

Drawing Title

Sensitive Properties theoretically predicted to experience Shadow Flicker that exceeds the 2006 WEDGs

Project Title

Borrisbeg Renewable Energy Development

Drawn By	Checked By
GG	KM
Project No. 220310	Drawing No. Figure 5-6
Scale 1:25,000	Date 2023-12-12

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

Table 5-11 Potential Daily & Annual Shadow Flicker exceedances – Proposed Borrisbeg Wind Farm, Co. Tipperary

House ID	ITM Coordinates (Easting)	ITM Coordinates (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 (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required
1	614722	676870	1,303	T01	00:30:36	14:31:12	3:50:30	T01	Yes
2	613783	677556	899	T01	00:31:12	15:15:36	4:02:15	T01	Yes
4*	612643	676702	659	T02	00:57:36	141:49:48	37:31:33	T01, T02	Yes
5*	611884	674005	614	T06	01:06:00	174:57:36	46:17:29	T06, T07, T09	Yes
6*	611950	673742	696	T07	01:00:36	124:26:24	32:55:29	T07, T09	Yes
7*	611908	673866	668	T06	01:17:24	131:06:00	34:41:13	T06, T07, T09	Yes
8	612396	673207	758	T09	00:47:24	37:19:12	9:52:27	T09	Yes
9	612529	675639	748	T03	00:52:48	135:49:12	35:56:09	T03, T04	Yes
10	612031	675046	868	T06	00:38:24	103:10:12	27:17:49	T03, T04, T05, T06	Yes
11	613893	676097	773	T03	00:52:12	128:27:00	33:59:09	T02, T03, T04	Yes
12	611890	674934	852	T06	00:49:48	110:51:00	29:19:45	T04, T05, T06	Yes
14	612357	676471	790	T02	00:49:12	101:45:36	26:55:26	T01, T02, T03	Yes
15	611974	675012	866	T06	00:43:48	97:06:00	25:41:28	T04, T05, T06	Yes
16	614177	674460	762	T08	00:51:00	131:39:36	34:50:06	T04, T05, T08	Yes
18	614201	674431	777	T08	00:49:48	125:25:12	33:11:03	T04, T05, T08	Yes
20	611883	674949	868	T06	00:48:36	106:35:24	28:12:07	T04, T06	Yes
21	612814	677164	751	T01	00:53:24	56:07:48	14:51:04	T01	Yes
22	614238	674393	805	T08	00:48:00	116:59:24	30:57:13	T04, T05, T08	Yes
23	614259	674364	821	T08	00:47:24	111:42:36	29:33:24	T04, T05, T08	Yes
24	612317	676451	823	T02	00:47:24	91:23:24	24:10:49	T01, T02, T03	Yes

25	613914	673345	956	T09	00:59:24	54:19:48	14:22:29	T09	Yes
26	612701	676980	767	T01	00:51:00	79:23:24	21:00:19	T01, T02	Yes
27	611889	674985	893	T06	00:45:00	98:24:00	26:02:06	T04, T06	Yes
28	613659	673134	831	T09	00:32:24	17:54:36	4:44:19	T09	Yes
30	614073	673433	1,025	T08	00:53:24	36:34:48	9:40:42	T09	Yes
31	614208	676286	899	T01	00:47:24	131:52:12	34:53:26	T01, T02, T03	Yes
32	612283	676428	851	T02	00:46:12	84:03:00	22:14:18	T01, T02, T03	Yes
33	611897	675018	915	T06	00:42:36	91:55:12	24:19:14	T04, T06	Yes
36	613878	675070	768	T04	00:51:00	113:53:24	30:08:00	T04, T05, T08	Yes
37	613698	673137	860	T09	00:40:12	27:53:24	7:22:45	T07, T09	Yes
38	612250	676404	879	T02	00:44:24	78:06:00	20:39:50	T01, T02, T03	Yes
40	613858	673260	935	T09	00:55:12	77:05:24	20:23:48	T07, T09	Yes
42	613831	673238	920	T09	00:54:00	73:43:12	19:30:18	T07, T09	Yes
43	613907	674975	769	T05	00:51:00	135:07:12	35:45:02	T04, T05, T08	Yes
45	614335	674391	901	T08	00:43:12	102:16:12	27:03:32	T04, T05, T08	Yes
46	613809	673212	913	T09	00:52:12	66:27:36	17:35:03	T07, T09	Yes
47	611938	675124	981	T06	00:34:12	72:23:24	19:09:11	T04, T05, T06	Yes
48	614155	673417	1,089	T08	00:49:12	31:28:48	8:19:45	T09	Yes
50	613962	674826	774	T05	01:12:00	188:13:48	49:48:09	T04, T05, T08	Yes
52	612199	676446	937	T02	00:42:00	70:00:36	18:31:25	T01, T02, T03	Yes
56	612141	675265	982	T04	00:40:12	71:07:48	18:49:11	T03, T04, T05	Yes
57*	612145	676140	974	T02	00:40:48	98:24:36	26:02:16	T01, T02, T03	Yes
58	614268	673489	1,116	T08	00:31:48	16:13:12	4:17:30	T09	Yes
59	614198	675735	927	T03	00:42:36	107:45:00	28:30:32	T02, T03, T04	Yes
61	612040	675244	1,044	T06	00:36:36	58:49:12	15:33:46	T03, T04, T05	Yes
62	611501	674504	960	T06	00:41:24	44:57:36	11:53:44	T06, T07	Yes
63	614189	675892	949	T03	00:41:24	88:34:48	23:26:12	T02, T03, T04	Yes

65	612109	676141	1,009	T02	00:39:36	93:31:48	24:44:47	T02, T03	Yes
69	612202	676627	990	T02	00:40:12	74:50:24	19:48:05	T01, T02	Yes
71	614419	673620	1,156	T08	00:45:00	53:59:24	14:17:05	T08	Yes
72*	614294	674665	946	T08	00:42:00	74:46:48	19:47:08	T04, T05, T08	Yes
73	614524	674082	1,090	T08	00:36:36	53:26:24	14:08:22	T08	Yes
74	612080	676029	1,055	T02	00:38:24	95:06:00	25:09:43	T02, T03, T04	Yes
75	614254	676107	1,036	T01	00:37:12	91:27:36	24:11:56	T01, T02, T03	Yes
76	611435	674518	1,027	T06	00:38:24	39:36:36	10:28:49	T06, T07	Yes
77	611498	674034	967	T06	00:42:00	63:31:48	16:48:32	T06, T07	Yes
78	612234	676764	1,023	T02	00:39:36	70:48:00	18:43:57	T01, T02	Yes
79	611496	674010	975	T06	00:42:00	64:13:48	16:59:39	T06, T07	Yes
80	614293	675530	1,021	T03	00:39:00	100:42:00	26:38:37	T02, T03, T04, T05	Yes
82	614536	674288	1,090	T08	00:36:36	37:01:48	9:47:51	T08	Yes
83	611504	673959	983	T06	00:42:00	68:10:48	18:02:21	T06, T07	Yes
84	611506	673944	986	T06	00:42:00	69:25:12	18:22:03	T06, T07	Yes
86	612063	676505	1,083	T02	00:36:36	53:51:36	14:15:02	T02	Yes
87	612054	675865	1,124	T02	00:36:36	96:23:24	25:30:11	T02, T03, T04	Yes
89	611407	674109	1,041	T06	00:38:24	41:54:00	11:05:10	T06, T07	Yes
99	614456	675589	1,180	T03	00:33:36	64:37:48	17:06:00	T03	Yes
101	611275	674655	1,219	T06	00:33:00	29:15:00	7:44:21	T06	Yes
104*	611495	673603	1,156	T06	00:36:36	63:03:00	16:40:55	T06, T07	Yes
106*	611846	675477	1,316	T04	00:30:36	74:13:48	19:38:24	T04	Yes
107	611586	673315	1,204	T07	00:36:00	56:28:12	14:56:28	T07	Yes
110	612300	677176	1,212	T01	00:33:36	49:50:24	13:11:13	T01,T02	Yes
111	612310	677228	1,223	T01	00:33:36	44:04:12	11:39:37	T01	Yes
112	614772	674355	1,330	T08	00:30:15	24:34:48	6:30:12	T08	Yes
113	614553	675609	1,277	T03	00:31:12	40:25:12	10:41:40	T03	Yes

117	612473	677567	1,269	T01	00:33:36	31:54:36	8:26:34	T01	Yes
121	611411	673490	1,287	T07	00:32:24	47:52:12	12:39:56	T07	Yes
123	611413	673462	1,295	T07	00:32:24	43:22:12	11:28:30	T07	Yes
124	611415	673432	1,304	T07	00:32:24	39:17:24	10:23:44	T07	Yes
125	612313	677413	1,306	T01	00:31:48	24:15:00	6:24:58	T01	Yes
126	612432	677580	1,308	T01	00:32:24	28:36:00	7:34:01	T01	Yes
128	611414	673395	1,320	T07	00:31:48	35:41:24	9:26:35	T07	Yes
129	611426	673366	1,321	T07	00:32:24	35:22:12	9:21:30	T07	Yes
132	612324	677462	1,323	T01	00:31:48	19:46:48	5:14:00	T01	Yes
133	611408	673312	1,361	T07	00:31:12	26:51:36	7:06:24	T07	Yes
134	612228	677371	1,359	T01	00:30:36	32:18:36	8:32:55	T01	Yes
140	611378	673278	1,404	T07	00:30:36	26:24:00	6:59:06	T07	Yes

**Potential Daily & Annual Shadow Flicker exceedances at involved landowner properties and therefore will most likely not require turbine curtailment.*

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 Project.

5.6.1 'Do-Nothing' Scenario

If the Proposed Project were not to proceed, the Site will continue to function as it does at present, with no changes made to the current land-use and potential for impacts on population and human health through the construction, operation and decommissioning of the Proposed Project would not occur.

If the Proposed Project were not to proceed, the opportunity to capture part of Tipperary'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 by 2030 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.

If the Proposed Project were not to proceed, the opportunity to retore a segment of the Eastwood River by improving channel stability, instream habitat and establishing a natural wooded riparian buffer would be lost. Please see Appendix 6-4 Biodiversity Management and Enhancement Plan for details.

5.6.2 Construction Phase

5.6.2.1 Population

5.6.2.1.1 *Population Levels*

Proposed Wind Farm

Pre-Mitigation Impacts

Those working on the construction phase of the Proposed Wind Farm (turbines and associated foundations and hard-standing areas, Meteorological Mast, Access Roads, Temporary Construction Compound, Underground Cabling, Site Drainage, Tree Felling, Temporary Borrow Pit and River Restoration works, and all ancillary works and apparatus), 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.

Proposed Grid Connection

Pre-Mitigation Impacts

Those working on the construction phase of the Proposed Grid Connection 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.

5.6.2.1.2 *Employment and Investment*

Proposed Wind Farm

Pre-Mitigation Impacts

The design, construction, operation and decommissioning of the Proposed Wind Farm will provide employment for technical consultants, contractors and maintenance staff. As discussed, it is proposed to construct the wind farm and grid connection concurrently which would require approximately 100 employees in total, with an estimated 80 jobs focussing on the construction phase of the Proposed Wind Farm. The construction phase of the wind farm will last between 18- 24 months and the decommissioning phase will likely last approximately 6-9 months.

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

Proposed Grid Connection

Pre-Mitigation Impacts

The design, construction and operation of the Proposed Grid Connection will provide employment for technical consultants, contractors and maintenance staff. As discussed, it is proposed to construct the wind farm and grid connection concurrently which would require approximately 100 employees in total, with an estimated 20 jobs focusing on the construction phase of the Proposed Grid Connection. Construction of the Grid Connection infrastructure is estimated to last approximately 9 months of the overall 18-24month construction timeframe.

Residual Impact

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

Significance of Effects

The significance of effects on employment levels and local investment during the construction phase will be slight.

5.6.2.1.3 Land Use Patterns & Activities

Proposed Wind Farm

Pre-Mitigation Impacts

Current land use within the Wind Farm footprint area comprises agriculture, small scale forestry and local road use. Current landuse in the wider landscape comprises of agricultural, commercial, and residential/ commercial activities.

There is no potential for impact on residential and commercial land use in the area. During the construction phase there may be slight interference with agricultural practices where farm practises may be redirected to other fields temporarily. The existing farm access off the L-3248 will be closed permanently; however, farming access through the new construction entrance will be permitted as and when required.

Proposed Grid Connection

Pre-Mitigation Impacts

The current land use and activities at the Proposed Grid Connection footprint comprises pastoral agriculture and transport/access along the local road network. Grazing stock at the substation, compound and end mast footprint will temporarily be relocated during the construction phase and local temporary traffic disruptions are likely along the L7039; however, once the construction of each element is complete, agricultural practises can return in the areas surrounding the onsite infrastructure and traffic flow will resume as normal.

The proposed works will be rolling in nature; approx. 100m will be constructed along the L-7039 at any one time. it is estimated that approx. 20.5 days will be required to lay the underground grid connection cable in the local road.

With respect to the traffic volumes that will be generated during the construction of the underground electrical cabling route, it is estimated that there will be approximately 14 daily return trips made by a truck transporting materials and construction staff to and from the Site. By its nature the impacts of these additional trips will therefore be temporary and slight.

Mitigation and Monitoring

The following measures will be adhered for the Proposed Project. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

- The construction of the proposed grid route through the L-7039 local road will be undertaken in a rolling construction method with 100m of road constructed and back filled each day providing access in the evenings and night hours along the grid route.
- A Traffic Management Plan, agreed with the Local Authority, will be in place for the construction phase of the grid route.
- Local access for residents living along the grid route will not be closed for the construction phase as there are alternative access roads into the area.
- Farm access into the Site will be permitted as and when required.

Residual Impact

Due to the small footprint of the above ground elements of the Proposed Project 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 a Negative, direct, slight short term impact on activities.

Significance of Effects

The effect on land use/activities due to the construction phase the Proposed Project Infrastructure is not significant.

5.6.2.1.4 *Property Values*

Proposed Wind Farm

Pre-Mitigation Impacts

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

Proposed Grid Connection

Pre-Mitigation Impacts

As noted in Section 5.3.13 above, the conclusions from available international literature indicate that 95% of property values (residential and agricultural) show no correlation with the presence of grid infrastructure in the area, with opinions on nearby grid infrastructure diminishing over time. In some cases, property values were demonstrated to increase however, causation with grid infrastructure cannot be determined.

Residual Impact

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

Significance of Effects

The effect on property values due to the Construction of the Proposed Project is imperceptible.

5.6.2.1.5 *Tourism*

Proposed Wind Farm

Pre-Mitigation Impacts

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 Wind Farm.

The Site has some rural aesthetic qualities given the relative lack of buildings and infrastructure present on the Site. It is mostly flat agricultural farmland fields defined by vegetated field boundaries; however, these views are common throughout the local area and due to the Sites intensive agricultural land-use, it is noted that the landscape has been subject to substantial levels of human interference and modification. Views from within the Site are generally contained given the surrounding flat landscape and the treelines

and hedgerows present on Site. With regard to tourist attractions and amenity use surrounding 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 15 Material Assets.

Proposed Grid Connection

Pre-Mitigation Impacts

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 substation, compound and end masts. Furthermore, these proposed structures are located on private property therefore no entrance to tourists is currently or will be permitted. There are no tourist attractions located along the proposed underground grid connection cabling route. As the proposed underground grid connection cabling route is not located at a cul de sac, tourists seeking to travel to various attractions in the wider landscape during the construction phase, can utilise other routes and therefore will not be impacted by the rolling construction phase of the grid route on the L7039. However, should tourists want to utilise this portion of the L7039, the laying of cables will be carried out in a rolling nature at an average rate of 100m of cable being constructed in one day, it is estimated that this section of the underground electrical cabling route, including the HDD works will take 20.5 days to complete. The location of the construction will be transient in nature with the extent of the section of road closed kept to a minimum.

Residual Impact

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

Significance of Effects

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

5.6.2.1.6 *Residential Amenity*

Proposed Wind Farm

Pre-Mitigation Impacts

The potential for impacts on residential amenity are discussed in Section 5.3.14 above. There is the potential for impacts on residential amenity during the construction phase of the Proposed Wind Farm due to air, traffic, noise and vibration emissions due to additional traffic and plant machinery.

Proposed Grid Connection

Pre-Mitigation Impacts

There is potential for impacts on residential amenity dur the construction of the Proposed Grid Connection. The proposed underground grid connection cabling route will be located within 870m of local road (L7039) which has the potential to give rise to local traffic disruptions.

Mitigation and Monitoring Measures

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

5.6.2.2 Health

The following impact assessment is produced in accordance with the IEMA Health impact assessment sensitivity, magnitude and EIA significance tables reproduced as Tables 5-1 to 5-4 above in section 5.2.2.

5.6.2.2.1 *Health and Safety*

Proposed Wind Farm

Pre-Mitigation Impacts

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

Proposed Grid Connection

Pre-Mitigation Impacts

The construction of the Proposed Grid Connection will include working under existing 110kV lines which may impact on electrical infrastructure and supply in the area and along a local road which may give rise to traffic impacts. Furthermore, working in the cavity of power lines and traffic flow is potential health and safety hazard for construction workers.

Mitigation and Monitoring Measures

The Proposed Wind Farm 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. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of 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.
- Goal posts will be established under the 38kV overhead line for the entirety of the construction phase of the Proposed Wind Farm.
- The suitability of machinery and equipment for use near power lines will be risk assessed.
- All staff will be trained on operating voltages of overhead electricity lines running the Site. All staff will be trained to be aware of the risks associated with overhead lines. All contractors that may visit the Sites are made aware of the location of lines before they come on to Site.
- Barriers will run parallel to the overhead line at a minimum horizontal distance of 6 metres on plan from the nearest overhead line conductor wire.
- When activities must be carried out beneath overhead lines, e.g., component delivery or substation construction, a Site-specific risk assessment will be undertaken prior to any works. The risk assessment must take into account the maximum potential height that can be reached by the plant or equipment that will be used prior to any works. Overhead line proximity detection equipment will be fitted to machinery when such works are required.
- Information on safe clearances will be provided to all staff and visitors.
- Signage indicating locations and health and safety measures regarding overhead lines will be erected in canteens and on Site.
- All staff will be made aware of and adhere to the Health & Safety Authority's 'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) (Amendment) Regulations 2021'. This will encompass the use of all necessary Personal Protective Equipment and adherence to the Site Health and Safety Plan.

Proposed Grid Connection specific mitigation measures

- The construction of the Grid Connection will be in phases along the proposed grid route. Prior to commencing grid connection works in the agricultural fields in the townland of Strogue, goal posts will be established under the 110k overhead line for the remainder of the grid connection of the construction phase. The goal posts will not exceed a height of 4.2 metres, unless specifically agreed with ESB Networks.
- The suitability of machinery and equipment for use near power lines will be risk assessed.
- All staff will be trained on operating voltages of overhead electricity lines running the Site. All staff will be trained to be aware of the risks associated with overhead lines. All contractors that may visit the Sites are made aware of the location of lines before they come on to Site.

- Barriers will run parallel to the overhead line at a minimum horizontal distance of 6 metres on plan from the nearest overhead line conductor wire.
- When activities must be carried out beneath overhead lines, e.g., component delivery or substation construction, a Site-specific risk assessment will be undertaken prior to any works. The risk assessment must take into account the maximum potential height that can be reached by the plant or equipment that will be used prior to any works.
- Overhead line proximity detection equipment will be fitted to machinery when such works are required.

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 2013*'.

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 slight negative residual effect on health and safety during the construction phase of the Proposed Project.

Significance of Effects

Based on the assessment above the effects on health and safety during the construction phase of the Proposed Project are considered to be short term slight significant.

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

Pre-Mitigation Impacts

Proposed Wind Farm

Potential dust and exhaust emission sources during the construction phase of the Proposed Wind Farm include upgrading of existing access tracks and construction of new access roads, turbine and meteorological mast foundations, temporary construction compound. The proposed borrow pit located in the townland of Knockanroe will require the use of construction machinery and plant, thereby giving rise to dust and exhaust emissions. The borrow pit location is approx. 250m from the nearest involved landowner and approx. 350m from the nearest non-involved landowners. The construction of the spoil management areas will require the use of construction machinery and plant, thereby giving rise to dust and exhaust emissions. As part of the Proposed Wind Farm, it is proposed to restore a segment of the Eastwood River channel with a view to improving stability of the channel and restoring in stream habitat. Please see Appendix 6-4 for details. The construction of the new channel and backfilling of the old will require the use of an excavator thereby giving rise to dust and exhaust emissions.

An increase in dust and exhaust emissions has the potential to cause a nuisance to Sensitive Properties 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 have a short-term, slight, negative impact on air quality. The potential dust impacts that may occur during the construction phase of the Proposed Wind Farm are further described in Chapter 10: Air Quality.

Pre-Mitigation Impacts

Proposed Grid Connection

Potential dust and exhaust emission sources during the construction phase of the Proposed Grid Connection include upgrading of existing access tracks and construction of the substation, new access road, temporary construction compound and end mast foundations. The entry and exit of construction vehicles from along the L-7039/1 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 have a short-term, slight, negative impact on air quality. The potential dust impacts that may occur during the construction phase of the Proposed Wind Farm are further described in Chapter 10: Air Quality.

Mitigation and Monitoring Measures

The following mitigation measures will be implemented during the construction of the Proposed Project. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

- Sporadic wetting of loose stone surface will be carried out during the construction phase to minimise movement of dust particles to the air. In periods of extended dry

weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff.

- All plant and materials vehicles shall be stored in dedicated areas within the Site.
- Turbines and construction vehicles will be transported to the Site on specified haul routes only.
- Construction materials for the Proposed Wind Farm and Proposed Grid Connection will be sourced locally from licenced quarries and transported on specified haul routes only.
- The agreed haul route roads adjacent to the Site will be regularly inspected for cleanliness and cleaned as necessary.
- The roads adjacent to the Site entrances will be checked weekly or damage/potholes and repaired as necessary.
- Waste material will be transferred to a licensed /permitted Materials Recovery Facility (MRF) by a fully licensed waste contractor where the waste will be sorted into individual waste streams for recycling, recovery or disposal. The MRF facility will be local to the Site to reduce the amount of emissions associated with vehicle movements
- A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-3).

Residual Impacts

With the implementation of the above measures for this phase construction phase, residual impacts on air quality from exhaust emissions associated with construction activities and machinery are considered to be a short-term imperceptible negative impact.

Significance of Effects

The effects on air quality from exhaust emissions during the construction phase of the Proposed Project are considered to be imperceptible.

5.6.2.2.3 *Water Quality*

Pre-Mitigation Impacts

Proposed Wind Farm

The construction phase ground works and use of plant on site may give rise to the potential release of suspended solids and hydrocarbons into surface and groundwaters. There are no underground water or sewerage networks at the Proposed Wind Farm infrastructure locations. The Templemore Public Water Scheme and Source Protection Area are located approximately over 1.2km west of any infrastructure, on the opposite side of the N62. The GSI map several additional private boreholes and wells in the vicinity of the Proposed Wind Farm. Chapter 9 Hydrology and Hydrogeology assess the potential for impact on public water supply and private wells during the construction phase. The pre-mitigation impact on water quality is assessed as Indirect, negative, moderate, temporary, likely effect.

Pre-Mitigation Impacts

Proposed Grid Connection

The Templemore Public Water Scheme and Source Protection Area are located approximately over 2km west of any proposed grid connection infrastructure, on the opposite side of the N62. A water main runs along the R433 which will be crossed by the Proposed Grid Connection underground cable route. Mains valves are located approx. 5m from the Proposed Grid Connection underground cable route also. The GSI also mapped several additional private boreholes and wells in the vicinity of the Proposed Grid Connection. Chapter 9 Hydrology and Hydrogeology assess the potential for impact on public water supply and private wells during the construction phase. The pre-mitigation impact on water quality is assessed as Indirect, negative, moderate, temporary, likely effect.

Mitigation and Monitoring Measures

A bespoke drainage design which includes but is not limited to interceptor drains, check dams, swales and ponds, will be implemented at the Site.
Chapter 9 details all best practise and mitigation measures to minimise the potential for entrainment of suspended sediment ss or potential hydrocarbon leak. Please see chapter 9 for details and Chapter 18 for a full list of Mitigation and Monitoring measures for the Proposed Project.

Residual Impact

With the implementation of the drainage design and all mitigation measures listed in Chapter 9 Hydrology and Hydrogeology (separation distances, and prevailing geology, topography and groundwater flow directions), it is considered that the residual effects are to be short-term imperceptible negative impact on water quality.

Significance of Effects

The effects on water quality during the construction phase of the Proposed Project are considered to be imperceptible.

5.6.2.2.4 *Noise and Vibration*

Proposed Wind Farm

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 Properties located closest the Site. This will be a short-term, very low sensitivity and low magnitude of change human health. 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 Wind Farm are further described in Chapter 12: Noise and Vibration.

Proposed Grid Connection

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 Properties located closest the Proposed Grid Connection works. This will be a short-term, very low sensitivity and low magnitude of change on human health due to increased noise levels from construction. The noisiest construction activities associated with the construction activities are excavation and concrete pouring of the substation and end mast foundations.

Mitigation and Monitoring Measures

Best practice measures for noise control will be adhered to on Site during the construction phase of the Proposed Project to impacts associated with this phase of the development. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

- No plant used on Site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on Site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Chapter 12 using methods outlined in British Standard 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 impact on health due to an increase in noise levels during the construction phase of the Proposed Project

Significance of Effects

For the reasons outlined above, the effects on human health due to due to noise emissions from the Proposed Project during construction will be slight.

5.6.2.2.5 Traffic and Transport

Proposed Wind Farm

Pre-Mitigation Impacts

It is proposed that the large wind turbine components will be delivered from Dublin Port to the Wind Farm Site via the M7, exiting at Junction 22 onto the N62 heading southwards for approximately 9.4km before reaching the proposed new turbine component entrance at the northwest of the Site adjacent to the N62–L-73248 junction. All deliveries of turbine components to the Site will follow this route. The proposed route is described in Chapter 4 of this EIAR. Non-turbine construction traffic e.g., Heavy Goods Vehicle (HGV) and Light Goods Vehicle (LGV) movements involved in the delivery of construction materials to the Site utilise the proposed construction entrance located off the L-3248, north of the turbine component entrance.

This will have a temporary slight negative effect on traffic users on the delivery routes with the impact forecast to be moderate on the short section of the L-3248 leading to the main access junction.

Proposed Grid Connection

Pre-Mitigation Impacts

Materials to construct the substation will be delivered to the Site via the L-7039 which runs along the eastern boundary of the Site. This may have a negative and temporary impact on existing road users, which will be minimised with the implementation of the mitigation measures included in the proposed traffic management plan.

The underground grid connection works will be brief (c. 20.5 days), completed with a traffic management plan in place and will follow TII and Eirgrid requirements. The grid route trenches will be excavated in a rolling manner, approx. 100m per day and backfilled each evening.

By its nature the effects of these additional trips and diversions on the network will be transient, will be temporary and will be slight.

Mitigation and Monitoring Measures

A complete Traffic and Transportation Assessment (TTA) of the Proposed Project has been carried out by Alan Lipscombe Traffic and Transport Consultants. The full results of the TTA are presented in Section 15.1 of Chapter 15: Material Assets. The 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 Project. Prior to commencement of any works, the occupants of dwellings in the vicinity of the proposed works will be contacted and the scheduling of works will be made 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. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

Residual Impact

Once a traffic management plan is implemented for the construction phase of the Proposed Project, there will be a short-term slight negative impact on local road users.

Significance of Effects

Based on the assessment above the effects on traffic from the Proposed Project during construction will be slight.

5.6.2.2.6 *Major Accidents and Natural Disasters*

Proposed Wind Farm

Pre-Mitigation Impacts

A risk register has been developed which contains all potentially relevant risks identified during the construction phase of the Proposed Wind Farm. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the construction phase have been identified and are presented in Chapter 16 Major Accidents and Natural Disasters. As outlined in Section 16.4.1 of this EIAR, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during construction is identified as 'Contamination' of the Site and risk of 'Fire/Explosion' during construction.

Proposed Grid Connection

Pre-Mitigation Impacts

A risk register has been developed which contains all potentially relevant risks identified during the construction phase of the Proposed Grid Connection. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the construction phase have been identified and are presented in Chapter 16 Major Accidents and Natural Disasters. The risk register concludes that there is low potential for significant natural disasters to occur at the Proposed Grid Connection. As outlined in Section 16.4.1 of this EIAR, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during construction is identified as 'Contamination' of the Site and risk of 'Fire/Explosion' during construction.

Residual Impact

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

Mitigation and Monitoring Measures

- The Proposed Project is designed and will be constructed in line with current best practice and, as such, mitigation against the risk of major accidents and/or disasters will be embedded through the design. In accordance with the provision of the European Commission '*Guidance on the preparation of Environmental Impact Assessment Reports'* 2017, a Risk Management Plan will be prepared and implemented on site to ensure an effective response to disasters or the risk of accidents. The plan will include sufficient preparedness and emergency planning measures.
- Please refer to chapter 18 Schedule of Mitigation and Monitoring Measures which details all proposed mitigation and monitoring measures for the construction, operation and decommissioning of the Proposed Project.
- Potential effects associated with contamination during construction, operation and decommissioning are addressed fully in Chapter 8 Land Soil and Geology and Chapter

9 Hydrology and Hydrogeology of this EIAR. The mitigation measures outlined therein to protect environmental receptors as well as the procedures and measures described in the Construction and Environmental Management Plan (CEMP) will ensure that the risk from these sources is low.

- A CEMP has been prepared for the Proposed Project and is included in Appendix 4-3 of this EIAR. Upon a grant of planning permission for the Proposed Project, the CEMP will be updated prior to the commencement of the development. The CEMP will be a live document maintained by the contractor that will work to ensure that potential risks of major accident and/or disaster are identified, avoided and mitigated, as necessary. Refer to Appendix 4-3 for the CEMP that sets out the minimum standards to be employed by the contractor.

Residual Impact

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

Significance of Effects

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

5.6.2.2.7 *Shadow Flicker*

Proposed Wind Farm

Pre-Mitigation Impacts

Shadow flicker, which occurs during certain weather conditions due to the movement of wind turbine rotor blades, as described in Section 5.2.2.2 of this chapter, can only occur during the operational phase of a wind energy development. There are therefore no shadow flicker impacts associated with the construction phase of the Proposed Wind Farm or the construction or operational phase of the Proposed Grid Connection.

5.6.3 Operational Phase

5.6.3.1 Population

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

5.6.3.1.1 *Population Levels*

Proposed Wind Farm

Pre-Mitigation Impacts

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

Proposed Grid Connection

Pre-Mitigation Impacts

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

Residual Impact

No Residual impacts.

Significance of Effects

No significance of effects.

5.6.3.1.2 *Employment and Investment*

Proposed Wind Farm

Pre-Mitigation Impacts

The operational phase of the Proposed Wind Farm 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 Wind Farm will create approximately 2-3 jobs involving during the operational phase relating to the maintenance and control of the wind farm, having a long-term slight positive effect.

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

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

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

Should the Proposed Project be developed under the current RESS T&C's, as a 63MW development it would attract a community contribution in the region of almost €400,000/year for the local community (estimated based on an average energy yield). The value of this fund would be directly proportional to the electricity generated by the wind farm. Under the current RESS T&Cs, the following is the recommended breakdown of the fund:

- **Direct payments** – to those living closest to the Proposed Wind Farm. A minimum €1,000 payment per annum for houses within 1km of the Proposed Project.
- **Support for local groups** – A minimum of 40% per year would be available for local groups, clubs and not for profit organisations that provide services in the local area. This would include services for the elderly, local community buildings, and the development of sporting facilities such as all-weather playing pitches etc.
- **Administration costs** – a maximum of 10% per year will be made available for the administration and governance costs of the fund.

- **Energy Efficiency** – The remaining balance of this community benefit fund would be available for the development of energy initiatives to benefit people living in the local area. This is to be provided to not-for-profit community enterprises each year.

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

Should the Proposed Project not be developed under RESS, the Applicant is committing that for each megawatt hour (MWh) of electricity produced by the wind farm, the project will contribute €1 into a community fund for the entire operational life of the Proposed Project. This would equate to an estimated annual fund of almost €200,000 (using the same formula as above), which across the 30-year operational lifespan would result in funding in the order of €6 million to the local community which is a substantial contribution.

The number and size of grant allocations will be decided by a Community Fund liaison committee with various groups and projects benefiting to varying degrees depending on their funding requirement.

Commercial rates from the wind farm will contribute significant funds to the Tipperary County Council to support the provision of public services within this county. 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.

Proposed Grid Connection

Pre-Mitigation Impacts

During the operational phase, the 110kV substation will be under the operation of Eirgrid where representatives will be required to undertake maintenance visits. This will have a long-term imperceptible positive effect on employment. Payment of commercial rates by the Developer to the local authorities will have a long-term benefit for the local area during the operational phase due to the reinvestment of these funds into local projects e.g., road maintenance, green spaces etc.

As mentioned above in relation to the Proposed Wind Farm, the Proposed Grid Connection indirectly facilitates the Community Benefit Fund intended for the local community.

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. The effects on employment levels during the operational phase will be not significant.

5.6.3.1.3 *Land use Patterns and Activities*

Proposed Wind Farm

Pre-Mitigation Impacts

The footprint of the Proposed Wind Farm will occupy only a small percentage of the Site; 1.1% or 7.3ha hectares of an overall 650-hectare Site. Farming and forestry practices will not be impacted during the operational phase.

As such, its small scale relative to the Site and Population Study Area combined with its ability to coexist with ongoing Site activities and activities within the landscape indicate that the Proposed Wind Farm will not impact significantly on other land-uses within the Site and the wider area.

Proposed Grid Connection

Pre-Mitigation Impacts

The Proposed Grid Connection's footprint (1.17ha) is limited to a small percentage of the Site (0.18%) and overall Population Study Area. During the operational phase, farming practises will resume around the substation and end mast footprint and traffic movements on the L-7039 will resume as normal. The small scale of the substation and end mats relative to the Site and Population Study Area, its ability to coexist with ongoing Site activities and activities within the landscape indicate that the Proposed Grid Connection infrastructure 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 Project infrastructure (combined 8.47ha or 1.3%) on a Site scale (650ha) 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.

Significance of Effects

The effect on land use/activities due to the operational phase the Proposed Project will be slight.

5.6.3.1.4 *Property Values*

Proposed Wind Farm

Pre-Mitigation Impacts

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.

Proposed Grid Connection

Pre-Mitigation Impacts

As noted in Section 5.3.13, the conclusions from available international literature indicate that property values are not significantly impacted by the positioning of grid infrastructure.

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 Project.

Significance of Effects

No significance of effects.

5.6.3.1.5 *Tourism*

Proposed Wind Farm

Pre-Mitigation Impacts

There are no tourism attractions within or adjacent to the Site that could be impacted by the operation of the Proposed Wind Farm. The nearest notable tourist attraction is the Devils Bit Mountain trail. As outlined in Chapter 14, the Devils Bit Mountain is recognised as a Secondary Amenity Area in County Tipperary and is located to the west of the Site. There will be an effect on the setting and character of this landscape receptor.

Proposed Grid Connection

Pre-Mitigation Impacts

There are no tourist attractions within the vicinity of the Proposed Grid Connection. It is considered that the substation, will be read in the landscape as an ancillary part of the wind farm development and therefore will not deter visitors to tourist attractions or scenic landscapes where turbines are visually evident. The end masts will blend in with adjacent existing 110kV masts, thus no new landuse is introduced. The grid connection cable route will be contained underground As such, the Proposed Grid Connection it will have no operational impact on tourism.

Residual Impact

Based on the literature review in section 5.3.9-5.3.11, 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 Project will have a long-term imperceptible negative impact of visitor experience to attractions in the wider landscape.

Significance of Effects

The effect on tourism in the wider landscape due to operation phase the Proposed Project will be imperceptible.

5.6.3.1.6 *Residential Amenity*

Proposed Wind Farm

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 Project will be capable of meeting all required guideline limits in relation to noise and the shadow flicker set out in the 2006 WEDGs or 2019 draft WEDGs if adopted. The noise and vibration assessment is detailed in Chapter 12. It should be noted that the Proposed Wind Farm will be brought in line with the noise thresholds imposed on the development by the consenting authority should the application be granted. The visual impact of the Proposed Wind Farm is addressed in Chapter 14: Landscape and Visual. The turbine locations have been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within 740 metres of non-involved Sensitive Properties, achieving the recommended four times turbine setback for visual amenity purposes.

Pre-Mitigation Impacts

Proposed Grid Connection

Potential impacts on residential amenity during the operational phase of the substation farm could arise primarily due to noise and changes to visual amenity. Detailed noise modelling has been carried for the proposed substation, please see below and Chapter 12 Noise and Vibration for details. The visual impact of the Proposed Grid Connection, specifically the substation and end masts is addressed in Chapter 14: Landscape and Visual. The substation is sited over 100m from nearby Sensitive Properties and will be further screened by hedgerows bordering the field and roadside vegetation, as well as vegetation surrounding nearby properties. The proposed end masts are located within a landscape of low sensitivity and appear only as additional towers within an existing electricity line. The Proposed Grid Connection electrical cabling route is located underground; therefore, no visual effects are deemed to arise from this element.

Mitigation and Monitoring Measures

- There are no turbines proposed within a minimum of 740 metres (4x tip height) of non-involved Sensitive Properties.
- All mitigation as outlined under Noise (Chapter 12), shadow flicker (Section 5.5) and visual (Chapter 14) 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 Project.
  A 2.6m high palisade fence will be erected around the substation which will be painted RAL 6005 (green) to help blend the substation infrastructure in with the surrounding rural landscape. Please see Chapter 14 for residential amenity pertaining to visual effects.
- Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

Residual Impact

The Proposed Project has been designed in accordance with best practise measures set out in the 2006 WEDGs and 2019 draft WEDGs in terms of setbacks for visual amenity. Furthermore, the Proposed Project can be brought inline to meet shadow flicker and noise thresholds imposed as part of a planning consent. The residual effect is considered to be a negative, moderate, long-term impact residential amenity with a significant residual effect for a small number of Sensitive Properties located within 1km who have open views of the Proposed turbines.

Significance of Effects

Based on the assessment above there will be a moderate effect on residential amenity during the operational phase and a significant effect for a small number of Sensitive Properties.

5.6.3.2 Health

5.6.3.2.1 *Health and Safety*

Proposed Wind Farm

Pre-Mitigation Impact

Rigorous safety checks and continued maintenance are conducted on the turbines and ancillary infrastructure during operational phase to ensure there are no health and safety risks posed by the Proposed Wind Farm. This will have a potential long-term, slight impact on health and safety during the operation phase. Any waste generated at the Site will be managed in accordance the Waste Management Act 1996 and under the relevant EU legislation.

Proposed Grid Connection

Pre-Mitigation Impact

Rigorous safety checks and continued maintenance are conducted on the substation and ancillary infrastructure during design, construction, commissioning and operation to ensure the risks posed to staff and landowners are negligible. This will have a potential long-term, slight impact on health and safety during the operation phase.

Mitigation and Monitoring Measures

The following mitigation measures will be implemented during the operation of the Proposed Wind Farm to ensure that the risks posed to staff and landowners remain imperceptible throughout the operational life of the Proposed Project. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of mitigation and monitoring measures for the proposed for the Proposed Project.

- 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.
- 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.
- 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
- 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.

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 30-35 years and are equipped with a number of safety devices to ensure safe operation during their lifetime. During the operation of the wind farm regular maintenance of the turbines will be carried out by the turbine manufacturer or appointed service company. A project or task specific Health and Safety Plan will be developed for these works in accordance with the Site's health and safety requirements.

Residual Impact

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

Significance of Effects

Based on the assessment above the effects on health and safety during the operational life of the Proposed Project will be imperceptible.

5.6.3.2.2 *Noise and Vibration*

Proposed Wind Farm

Pre-Mitigation Impact

An assessment of the operational wind turbine noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Chapter 12: Noise and Vibration. The predicted noise levels associated with the Proposed Wind Farm will be within best practice noise criteria curves recommended in the 2006 WEDGs, therefore, it is not considered that a significant effect is associated with the Proposed Wind Farm.

Proposed Grid Connection

Pre-Mitigation Impact

The predicted noise level from the operation of the substation at the nearest Sensitive Property is 31 dB $L_{Aeq,T}$. This level of noise is considered low, and it is concluded that there will be no significant noise emissions from the operation of the substation.

Mitigation and Monitoring

Please see Chapter 12 section 12.6 for noise and vibration mitigation and monitoring proposed for the Proposed Project. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of mitigation and monitoring measures for the proposed for the Proposed Project.

Residual Impacts

The predicted residual operational turbine noise effects at the closest noise sensitive locations range from not significant to imperceptible. Please see Chapter 12 Noise and Vibration for details.

Significance of Effects

As stated in the noise assessment in Chapter 12, it has been demonstrated that the relevant national guidance in relation to noise associated with proposed wind turbines can be satisfied. The effects are considered not significant.

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

Proposed Wind Farm

Pre-Mitigation Impact

The Proposed Wind Farm will require daily visits of maintenance staff in LGVs and the infrequent generation of small volumes of hydrocarbon waste. The Proposed Wind Farm will generate electricity from a renewable source, contributing to a positive impact on air quality. Over the envisaged 30-year lifespan of the Proposed Wind Farm it is expected to effectively reduce carbon dioxide emissions that would have occurred if the same energy were generated by traditional fossil fuel plants. This is a long-term Moderate Positive effect on Air Quality.

Pre-Mitigation Impact

Proposed Grid Connection

The sources of dust and other emissions generated during the operational phase will be from infrequent visits by Eirgrid maintenance to the 110kV on Site substation staff in light good vehicles (LGVs) approximately one or two visits per day, and private LGVs. Maintenance of the substation infrastructure may, on occasion, generate of small volumes of hydrocarbon waste. Any waste generated at the Site will be managed in accordance the Waste Management Act 1996 and under the relevant EU legislation. This will have a potential long-term, imperceptible impact on health during the operation phase.

Residual Impacts

Impacts from dust and other emissions to air from private and maintenance on Sensitive Properties during the operational phase of the Proposed Project considered to be a momentary and imperceptible. As such, this will be a long-term overall Moderate Positive effect on Air Quality.

Significance of Effects

The effect on air quality through the offsetting of Dust, NO2, PM10 and PM25 and CO2 Emissions from fossil fuels is considered have a moderate significant effect.

5.6.3.2.4 *Water Quality*

Pre-Mitigation Impact

Proposed Wind Farm

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 and hardstand areas. 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. There will be a long-term imperceptible impact on human health due to water quality.

Pre-Mitigation Impact

Proposed Grid Connection

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. 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. There will be a long-term imperceptible impact on human health due to water quality.

Mitigation and Monitoring Measures

The mitigation measures detailed in Chapter 9 Hydrology and Hydrogeology will ensure all surface water runoff from upgraded roads and new road surfaces (including hardstand and turbine base areas) will be captured and treated prior to discharge/release. Please see Chapter 9 for details. The full list of mitigation and monitoring measures for the Proposed Project are detailed in Chapter 18.

The mitigation measures will ensure all surface water runoff from upgraded roads and new road surfaces (including hardstand and turbine base areas) will be captured and treated prior to discharge/release. Settlement ponds, checks dams and buffered outfalls will prevent roads acting as preferential flowpaths by providing attenuation and water quality treatment.

It is proposed that bedrock from the on-site borrow pit (i.e. limestone) will be used to construct the sub-base layer of proposed upgraded and new access roads, hardstand areas and turbine base areas. Once installed the subbase layer will be overlain by a clean capping layer of high-grade stone material which will be sourced from the borrow pit or local quarries. Further information relating to the mitigation measures for control of hydrocarbons during maintenance works as described in Chapter 9: Section9.5.2.5

Residual Impacts

With the implementation of the Proposed Wind Farm drainage design and mitigation measures the residual effects are considered to be long term imperceptible impact on human health due to water quality.

Significance of Effects

Based on the assessment above the effects on water quality will be imperceptible.

5.6.3.2.5 *Traffic and Transport*

Pre-Mitigation Impact

Proposed Wind Farm

Major component failures are considered unlikely and therefore the presence of abnormal load vehicles and HGVs at the Site is considered extremely rare. Should a turbine component need replacing, the measures detailed in section 5.6.2.2.5 and Chapter 15 will be implemented.

All Site visits for maintenance and inspection purposes for the Proposed Wind Farm will be done so via LGVs with just one or two LGVs with day. Visits to the site by Eirgrid for maintenance and inspection purposes will be done so via LGVs) with just one or two visits per day.

Residual Impacts

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

Significance of Effects

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

5.6.3.2.6 *Major Accidents and Natural Disasters*

Proposed Wind Farm

Pre-Mitigation Impacts

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

Proposed Grid Connection

Pre-Mitigation Impacts

A risk register has been developed which contains all potentially relevant risks identified during the operational phase of the Proposed Grid Connection. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the operational phase have been identified and are presented in Chapter 16 Major Accidents and Natural Disasters. The risk register concludes that there is low potential for significant natural disasters to occur at the Proposed Grid Connection. As outlined in Section 16.4.1, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during operation is identified as 'Fire/Explosion' during operation.

Residual Impact

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

Mitigation and Monitoring Measures

- The Proposed Project will be designed and built in line with current best practice and, as such, mitigation against the risk of major accidents and/or disasters will be embedded through the design. In accordance with the provision of the European Commission '*Guidance on the preparation of Environmental Impact Assessment Reports'* 2017, a Risk Management Plan will be prepared and implemented on site to ensure an effective response to disasters or the risk of accidents. The plan will include sufficient preparedness and emergency planning measures.
- Please refer to chapter 18 Schedule of Mitigation and Monitoring Measures which details all proposed mitigation and monitoring measures for the construction, operation and decommissioning of the Proposed Project.
- The Proposed Project will also be subject to a fire safety risk assessment in accordance with Chapter 19 of the Safety, Health and Welfare at Work Acts 2005 to 2014, which will assist in the identification of any major risks of fire on site, and mitigation of the same during operation.

Residual Impact

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

Significance of Effects

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

5.6.3.2.7 Shadow Flicker

Proposed Wind Farm

Pre-Mitigation Impacts

Of the 140 No. properties modelled; it is predicted that of 86 Sensitive Properties experience shadow flicker that exceed the 2006 WEDGs, with 8 of these Sensitive Properties being involved landowners. However, this prediction does not consider wind direction or screening provided by intervening vegetation and topography. 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 property.

Mitigation and Monitoring 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. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

- 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.).
- Recording the house number, time and duration of Site visit and the observation point GPS coordinates.
- Recording the nature of the sensitive property, its orientation, windows, landscaping in the vicinity, any elements of the built environment in the vicinity, vegetation.
- 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.

It should be noted that 8 of the Sensitive Properties that theoretically may experience shadow flicker are involved landowners and therefore it is likely agreements with these landowners regarding shadow flicker limits with these properties will be arranged.

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.

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

1. *Recording the weather conditions at the time of the Site visit, including wind speeds and direction (i.e. blue sky, intermittent clouds, overcast, moderate breeze, light breeze, still etc.).*
2. *Recording the house number, time and duration of Site visit and the observation point GPS coordinates.*
3. *Recording the nature of the sensitive property, its orientation, windows, landscaping in the vicinity, any elements of the built environment in the vicinity, vegetation.*
4. *In the event of shadow flicker being noted as occurring the details of the duration (times) of the occurrence will be recorded*
5. *The data will then be sent to the wind farm operational team to confirm that the model and SCADA system are working.*

6. *Following 12 months of full operation of the Proposed Project a report can be prepared for the Local Authority describing the shadow flicker mitigation measures used at the wind farm and confirming the implementation and successful operation of the system.*

This method of shadow flicker mitigation has been technically well-proven at wind farms in Ireland and also in areas outside Ireland that experience significantly longer periods of direct sunlight.

In order to demonstrate how the SCADA control system can be applied to switch off particular turbines at the relevant times and dates. Table 5-12 below lists the 86 properties at which a shadow flicker mitigation strategy may be necessary to ensure the 2006 WEDGs 30-minute per day shadow flicker threshold is not exceeded. In this case, the relevant turbine(s) would be programmed to switch off for the time required to reduce daily shadow flicker to below the guideline limit of 30 minutes. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree alternative mitigation measures with the relevant property owner. The mitigation strategy outlined in Table 5-12elow is based on the theoretical precautionary scenario. The details presented in Table 5-12 list the days per year and the turbines that could be programmed to switch off at specific times, in order to reduce daily shadow flicker to a maximum of 28 minutes, which is below the guideline limit of 30 minutes.

Table 5-12 Shadow Flicker Mitigation Strategy for Daily Shadow Flicker Exceedance – Turbine Numbers and Dates

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Day No's)*	Days of Year When Mitigation May be Required (Dates)*
1	40	T01	78-80, 264-267	19-21 March, 21-24 Sept
2	37	T01	351-360	17-26 Dec
4	192	T01, T02	86-110, 235-260, 1-50, 296 - 365	27 Mar - 20 Apr, 23 Aug - 17 Sept, 1 Jan - 19 Feb, 23 Oct - 31 Dec
5	221	T06, T07, T09	124 - 221, 73 - 99, 246-272, 59-67, 279-287	4 May - 9 Aug, 14 Mar - 9 Apr, 3 Sept - 29/Sept, 28 Feb - 8 Mar, 6 Oct - 14 Oct
6	189	T07, T09	107-149, 195-239, 77-89, 256-268	17 Apr - 29 May, 14 July - 27 Aug, 18 Mar-30 Mar, 13 Sept - 25 Sept
7	205	T06, T07, T09	156-189, 90-120, 225-256, 68-78, 268-277	5 June - 8 July, 31 Mar - 30 Apr, 13 Aug - 13 Sept, 9 Mar - 19 Mar, 25 Sept - 4 Oct
8	60	T09	150-195	30 May - 14 July
9	189	T03, T04	81 - 108, 237 - 265, 9 - 46, 300 - 337	22 Mar - 18 Apr, 25 Aug - 22 Sept, 9 Jan - 15 Feb. 27 Oct - 3 Dec
10	247	T03, T04, T05, T06	129- 136, 209- 216, 91-102, 243 - 255, 58-64, 282-288, 1-10, 336-365	9 May - 16 May, 28 July- 4 Aug, 1 Apr - 12 Apr. 31 Aug - 12 Sept, 27 Feb - 5 Mar, 9 Oct - 15 Oct, 1-10 Jan , 2 - 31 Dec
11	208	T02, T03, T04	99-126, 218 - 245, 20-52, 293-326, 353-358	9 Apr - 6 May, 6 Aug - 2 Sept, 20 Jan - 21 Feb, 20 Oct- 22 Nov, 19-24 Dec
12	230	T04, T05, T06	99-106, 240-246, 69, 276-277, 1-29, 317-365	9-16 Apr, 28 Aug-3 Sept, 10 Mar, 3-4 Oct, 1 - 29 Jan, 13 Nov-31 Dec

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Day No's)*	Days of Year When Mitigation May be Required (Dates)*
14	207	T01, T02, T03	106-120, 225 - 239, 57-80, 265-289, 17-27, 319-329	16-30 Apr, 13-27 Aug, 26 Feb-21 Mar, 22 Sept-16 Oct, 17-27 Jan, 15-25 Nov
15	213	T04, T05, T06	94-103, 242-252,	4-13 Apr, 30 Aug-9 Sept
16	257	T04, T05, T08	143-201, 103-119, 225-241, 57-82, 263-288	23 May-20 July, 13-29 April, 13-29 Aug, 26 Feb-23 Mar, 20 Sept-15 Oct
18	251	T04, T05, T08	145-199, 105-121, 223-239, 61-85, 260-284	25 May- 18 July, 15 April - 1 May, 11-27 Aug, 2 - 26 Mar, 17 Sept - 11 Oct,
20	223	T04, T06	98-104, 241-247, 1-28, 318-365	8-14 April, 29 Aug - 4 Sept, 1-28 Jan, 14 Nov-31 Dec,
21	84	T01	24-56, 289-322	24 Jan-25 Feb, 16 Oct-18 Nov
22	242	T04, T05, T08	147-197, 108-123, 221-236, 66-89, 256-279	27 May - 16 July, 18 April - 3 May, 9 - 24 Aug, 7-30 Mar, 13 Sept - 6 Oct
23	235	T04, T05, T08	149-194, 110-124, 220-234, 70-92, 253-275	29 May - 13 July, 20 April-4 May, 8-22 Aug, 11 Mar - 2 April, 10 Sept-2 Oct
24	198	T01, T02, T03	108-120, 226-238, 60-82, 264-286, 20-30, 317-326	18-30 April, 14-26 Aug, 1-23 Mar, 21 Sept-13 Oct, 20-30 Jan, 13-22 Nov
25	79	T09	115-138, 206-229	25 April - 18 May, 25 July - 17 Aug
26	128	T01, T02	53-78, 267-293, 1-15, 331-365	22 Feb-19 Mar, 24 Sept - 20 Oct, 1-15 Jan, 27 Nov- 31 Dec
27	211	T04, T06	96-102, 244-250, 1-24, 322- 365	6-12 April, 1-7 Sept, 1-24 Jan, 18 Nov - 31 Dec
28	47	T09	165-178	14-27 June
30	67	T09	104-116, 228-240	14-26 April, 16-28 Aug
31	251	T01, T02, T03	134-210, 82-92, 253-263, 27-42, 304-318	14 May-29 July, 23 Mar - 2 April, 10 - 20 Sept, 27 Jan - 11 Feb, 31 Oct - 14 Nov
32	179	T01, T02, T03	109-120, 225-236, 64 - 84, 262-282, 21-1, 314-326	19 - 30 April, 13-24 Aug, 5 - 25 March, 19 Sept - 9 Oct, 21 Jan - 1 Feb, 10-22 Nov
33	206	T04, T06	93-100, 246-252, 1-20, 326-365	3-10 April, 3-9 Sept, 1-20 Jan, 22 Nov - 31 Dec
36	190	T04, T05, T08	89-114, 230-256, 32-60, 286-314, 3-4, 342-343, 347-364	30 Mar-24 April, 18 Aug -13 Sept, 1 Feb - 1 Mar, 13 Oct - 10 Nov, 3-4 Jan, 8-9 Dec, 13-30 Dec
37	54	T07, T09	163-180, 155-189	12 June - 29 June, 4 June - 8 July
38	168	T01, T02, T03	110-120, 225-235, 67-86, 259-279, 25-35, 311-321	20-30 April, 13-23 Aug, 8-27 March, 16 Sept-6 Oct, 25 Jan - 4 Feb, 7-17 Nov
40	107	T07, T09	138-144, 200-205, 126-218	18-24 May, 19-24 July, 6 May - 6 Aug
42	99	T07, T09	141-150, 193-202, 130-214	21-30 May, 12-21 July, 10 May - 2 Aug

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Day No's)*	Days of Year When Mitigation May be Required (Dates)*
43	217	T04, T05, T08	99-125, 219-245, 44-71, 274-301, 1-19, 326-365	9 April - 5 May, 7 Aug - 2 Sept, 13 Feb - 12 Mar, 1 -28 Oct, 1-19 Jan, 22 Nov - 31 Dec.
45	233	T04, T05, T08	144-150, 193-200, 107-117, 227-237, 69-87, 258-276,	24-30 May, 12-19 July, 17-27 April, 15-25 Aug, 10-28 Mar, 15 Sept - 3 Oct
46	91	T07, T09	144-158, 186-199, 134-210	24 May - 7 June, 5-18 July, 14 May- 29 July
47	181	T04, T05, T06	85-93, 252-260, 56-57, 288-290, 5, 341-342, 346-365	26 March - 3 April, 9 - 17 Sept, 25 - 26 Feb, 15-17 Oct, 5 Jan, 7-8 Dec, 12-31 Dec.
48	63	T09	105-114, 231-239	15-24 April, 19-27 Aug
50	280	T04, T05, T08	115-142, 202-229, 63-87, 257-282, 1-38, 307-365	25 April-22 May, 21 July - 17 Aug, 4 - 28 March, 14 Sept - 9 Oct, 1 Jan - 7 Feb, 3 Nov - 31 Dec
52	160	T01, T02, T03	107-114, 231 - 239, 64-81, 264-281, 25-32, 314-321	17-24 April, 19-27 August, 5 - 22 March, 21 Sept - 8 Oct, 25 Jan - 1 Feb, 10-17 Nov
56	158	T03, T04, T05	114-126, 219-231, 71-86, 260-275, 39-48, 298-307	24 April - 6 May, 7 - 19 August, 12-27 March, 17 Sept - 2 Oct, 8 - 17 Feb, 25 Oct - 3 Nov,
57	231	T01, T02, T03	130-133, 212-215, 93-110, 235-252, 48-55, 290-298	10-13 May, 31 July - 3 Aug, 3 - 20 April, 23 Aug - 9 Sept, 17-24 Feb, 17-25 Oct
58	42	T09	98-103, 241-246	8-13 April, 29 Aug - 3 Sept
59	247	T02, T03, T04	127-144, 200-217, 74 - 90, 254-271, 39-47, 299-307	7 - 24 May, 19 July - 5 Aug, 15-31 March, 11-28 Sept, 8-16 Feb, 26 Oct - 3 Nov,
61	142	T03, T04, T05	114-121, 224-231, 75-86, 260-271, 44-50, 296-302	24 April - 1 May, 12-19 Aug, 16-27 March, 17-28 Sept, 13-19 Feb, 23-29 Oct
62	98	T06, T07	63-78, 268-283, 44-50, 296-302	4-19 March, 25 Sept - 10 Oct, 13 - 19 Feb, 23-29 Oct
63	210	T02, T03, T04	114-128, 216- 230, 59-75, 270-286, 28-35, 311 - 318	24 April - 8 May, 4 - 18 August, 28 Feb - 16 March, 27 Sept - 13 Oct, 28 Jan - 4 Feb, 7 - 14 Nov
65	224	T02, T03	93-108, 237-253, 49-55, 290-297	03-18 April, 25 Aug - 10 Sept, 18-24 Feb, 17-24 Oct,
69	180	T01, T02	93-100, 245-252, 48-64, 281-298	3-10 April, 2-9 Sept, 17 Feb - 5 March, 8-25 Oct
71	112	T08	145-199	25 May- 18 July
72	163	T04, T05, T08	121-129, 215-223, 85-95, 249-260, 42-60, 285-303	1-9 May, 3-11 Aug, 26 March -5 April, 6-17 Sept, 11 Feb - 1 March, 12-30 Oct
73	140	T08	99-111, 233-245	9-21 April, 21 Aug - 2 Sept,
74	248	T02, T03, T04	103-118, 227-243, 57-63, 282-288, 16-23, 323-330	13-28 April, 15-31 Aug, 26 Feb - 4 Mar, 9-15 Oct, 16-23 Jan, 19-26 Nov,

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Day No's)*	Days of Year When Mitigation May be Required (Dates)*
75	237	T01, T02, T03	159-184, 96-105, 239-248, 44-57, 289-302	8 June - 3 July, 6-15 April, 27 Aug - 5 Sept, 13-26 Feb, 16-29 Oct,
76	92	T06, T07	64-76, 270-282, 45-49, 297-301	5-17 March, 27 Sept - 9 Oct, 14-18 Feb, 24-28 Oct
77	137	T06, T07	107-126, 219-238, 77-86, 259-268	17 April - 6 May, 7-26 Aug, 18-27 March, 16-25 Sept,
78	163	T01, T02	83-91, 255-263, 35-52, 294-311	24 March - 1 April, 12-20 Sept, 4 - 21 Feb, 21 Oct - 7 Nov,
79	140	T06, T07	109-129, 216-236, 79-88, 257-266	19 April - 9 May, 4-24 August, 20-29 March, 14-23 Sept.
80	243	T02, T03, T04, T05	142-156, 187-201, 94-107, 237-251, 56-62, 283-289, 22-27, 319-324	22 May - 5 June, 6-20 July, 4-17 April, 25 August - 8 Sept, 25 Feb - 3 Mar, 10-16 Oct, 22-27 Jan, 15-20 Nov
82	92	T08	82-92, 252-263,	23 March - 2 April, 9-20 Sept
83	149	T06, T07	114-136, 209-231, 83-93, 253-263,	24 April - 16 May, 28 July - 19 Aug, 24 March - 3 April, 10-20 Sept
84	151	T06, T07	116-138, 207-229, 84-94, 251 - 261	26 April - 18 May, 26 July - 17 Aug, 25 March - 4 April, 8 - 18 Sept
86	140	T02	63-75, 271-283	4-16 March, 28 Sept - 10 Oct,
87	224	T02, T03, T04	117-132, 213-229, 69-75, 270-277, 29-37, 309-317	27 April - 12 May, 1 - 17 August, 10-16 March, 27 Sept - 4 Oct, 29 Jan - 6 Feb, 5 - 13 Nov
89	96	T06, T07	99-113, 233-246, 73-79, 267-272	9-23 April, 21 Aug - 3 Sept, 14-20 March, 24-29 Sept
99	191	T03	90-95, 249-255	31 March - 5 April, 6-12 Sept
101	78	T06	58-64, 282-288	27 Feb - 5 March, 9 - 15 Oct
104	151	T06, T07	156-189, 112-123, 223-234	5 June - 8 July, 22 April - 3 May, 11-22 August,
106	200	T04	62-65, 280-284	3-6 March, 7-11 Oct,
107	125	T07	141-204	21 May - 23 July
110	112	T01,T02	52-60, 286-294, 1-8, 14, 332, 339-365	22 Feb-1 March, 13-21 Oct, 1-8 Jan, 14 Jan, 28 Nov, 5-31 Dec
111	104	T01	48-56, 290-298	17-25 Feb, 17-25 Oct,
112	75	T08	80-81, 264	21-22 Mar, 21 Sept
113	122	T03	89-91, 253-256	30 March - 1 April, 10-13 Sept,
117	92	T01	21-28, 318-325	21-28 Jan, 14-21 Nov
121	140	T07	119-126, 219-226	29 April - 6 May, 7-14 August
123	133	T07	121-129, 216-224	1-9 May, 4-12 August
124	127	T07	124-131, 214-221	4-11 May, 2-9 August
125	74	T01	36-43, 303-310	5-12 Feb, 30 Oct - 6 Nov
126	80	T01	17-28, 318-330	17-28 Jan, 14-26 Nov
128	118	T07	127-134, 211-218	7-14 May, 30 July - 6 Aug
129	100	T07	130-138, 207-215	10-18 May, 26 July - 3 Aug

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker Exceedance	Days of Year When Mitigation May be Required (Day No's)*	Days of Year When Mitigation May be Required (Dates)*
132	52	T01	32-39, 307-314	1-8 Feb, 3-10 Nov
133	72	T07	134-141, 204-211	14-21 May, 23-30 July
134	89	T01	43-46, 300-303	12-15 Feb, 27-30 Oct
140	74	T07	136-141, 204-210	16-21 May, 23-29 July

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

Overall, the details presented in Table 5-12 demonstrate that using the turbine control system, it will be possible to reduce the level of shadow flicker at any affected property to below the daily guideline limit of 30 minutes, by programming the relevant turbines to switch off at the required dates and times.

Table 5-13 lists the 13 properties at which a shadow flicker mitigation strategy may be necessary to ensure the 2006 WEDGs 30-hour annual shadow flicker threshold is not exceeded. In this case, the relevant turbine(s) would be programmed to switch off for the time required to ensure that the annual shadow flicker limit of 30 hours annually is not exceeded. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree suitable alternative mitigation measures with the relevant property owner. In reality the implementation of the Daily Shadow Flicker mitigation outlined in Table 5-12 will most likely reduce the Annual Shadow Flicker exceedances, however, regardless of this, Table 5-13 below illustrates the relevant turbines that may need to be controlled, based on the '*worst-case impact*' of shadow flicker impacts modelled.

Table 5-13 Shadow Flicker Mitigation Strategy for Annual Shadow Flicker Exceedance

Property No.	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Producing Shadow Flicker Exceedance	Post-mitigation Maximum Annual Shadow Flicker (hrs:mins:sec)
4	37:31:33	T01, T02	≤30:00:00
5	46:17:29	T06, T07, T09	≤30:00:00
6	32:55:29	T07, T09	≤30:00:00
7	34:41:13	T06, T07, T09	≤30:00:00
9	35:56:09	T03, T04	≤30:00:00
11	33:59:09	T02, T03, T04	≤30:00:00
16	34:50:06	T04, T05, T08	≤30:00:00
18	33:11:03	T04, T05, T08	≤30:00:00
22	30:57:13	T04, T05, T08	≤30:00:00
31	34:53:26	T01, T02, T03	≤30:00:00
36	30:08:00	T04, T05, T08	≤30:00:00
43	35:45:02	T04, T05, T08	≤30:00:00
50	49:48:09	T04, T05, T08	≤30:00:00

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

Residual Effect

Following the implementation of the above suite of mitigations measures, the 2006 WEDGs limit of 30 mins per day or 30 hours per year will not be exceeded and this will result in a long-term, imperceptible negative residual effect from shadow flicker on human health.

Significance of Effects

Based on the assessment above and the mitigation measures proposed the effects related to shadow flicker will be not significant.

5.6.4 Decommissioning Phase

The wind turbines proposed as part of the Proposed Wind Farm are expected to have a lifespan of approximately 30-35 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the Site may be decommissioned fully. The substation will remain in place as it will be under the ownership and control of ESBN/EirGrid.

The works required during the decommissioning phase are described in 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 and in combination Effects

The potential for impact between the Proposed Project (Proposed Wind Farm and Proposed Grid Connection combined), wind projects, and other relevant non-wind projects (existing, permitted or proposed) has been carried out with the purpose of identifying what influence the Proposed Project will have on population and human health as well as the interactions between these factors, when considered cumulatively and in combination with relevant existing, permitted or proposed projects and plans in the vicinity of the Site, as set out in Chapter 2 of this EIAR. Please see Section 2.8 of Chapter 2 for cumulative assessment methodology. Please refer to Appendix 2-1 for a comprehensive listing of the considered cumulative and in combination with relevant existing, permitted or proposed projects and plans in the vicinity of the Site.

As demonstrated above, there are no significant effects on Population and Human Heath arising from the construction, operation or decommissioning of the Proposed Wind Farm. The potential cumulative impact of the Proposed Project and combined with the potential impact of other projects and/or plans has been carried out with the purpose of identifying what influence the Proposed Project will have on the environment when considered collectively with approved and existing projects and projects pending a decision from the planning authority and land-uses in the defined cumulative assessment study areas as set out in Chapter 2 Section 2-8. There are no significant effects on Population from the construction, operation of the Proposed Grid Connection.

Therefore, there will be no significant effects arising from the construction, operation or decommissioning of the Proposed Project (Proposed Wind Farm and Proposed Grid Connection combined) with any existing, permitted or proposed project/plans listed in Chapter 2. There is no potential for cumulative impacts arising from the construction, operation or decommissioning of the Proposed Project with other existing, permitted or proposed wind farms in the surrounding landscape. Furthermore, there are no wind farms proposed, permitted, or in operation within a 5km radius of the Site. The closest wind farm to the Site is the operational Lisheen 1/2 Wind Farm located approx. 7.9km to the southeast and Bruckana and Ballinveny located over 9km to the southeast and west, respectively.