

## 10. SHADOW FLICKER

### 10.1 INTRODUCTION

This chapter assesses the potential for shadow flicker from the operation of the proposed wind turbines, as part of the Proposed Project, to impact on sensitive receptors in the area surrounding the proposed wind farm site.

The objectives of this chapter are to describe what shadow flicker is, outline the relevant best practice guidance and assessment methodology, describe the likely significant effects and mitigation measures, if required, describe the residual effects, if any, and assess the likely significant cumulative effects with other plans and projects.

The proposed project is described in Chapter 2 - Description of the Proposed Project. For the purpose of this assessment, the proposed wind turbines are the only infrastructure that have the potential to cause shadow flicker, so other elements of the Proposed Project (such as the Proposed GCR, met mast, substation and TDR works) are scoped out of the assessment.

The proposed turbine locations are shown in Figure 10-1.

This chapter comprehensively assesses all permutations of the proposed turbine dimension range outlined in Chapter 2 - Description of the Proposed Project.

#### 10.1.1 Statement of Authority

This assessment has been carried out by TOBIN. The shadow flicker modelling and assessment was carried out by Samuele Pezzetta, GIS Manager in TOBIN. Samuele holds a Master's Degree in Environmental Science and Geographical Information Systems (UPEM, Marne-la-Vallee, France, 2018). Samuele has over 8 years of professional experience in building and environmental consulting including the preparation of shadow flicker impact assessments. Samuele has worked on a number of wind farms with various roles, which included carrying out shadow flicker modelling and EIAR chapter preparation. Samuele completed training with EMD International, a global consultancy providing software for wind energy projects including *WindPRO*, which has been used to model the shadow flicker in this assessment.

This chapter has been reviewed by Orla Fitzpatrick, Technical Director in TOBIN. Orla has over 20 years' experience working in the delivery of EIA projects in environmental consultancy. She holds a BSc in Geophysics and MSc in Environmental Consultancy and is a Chartered Environmentalist. She has considerable experience as technical approver of environmental deliverables for major infrastructure projects.

#### 10.1.2 Background

Wind turbines can cast long shadows when the sun is low in the sky. The effect known as shadow flicker occurs where the blades of a wind turbine cast a shadow over a window in a nearby house and the rotation of the blades causes the shadow to flick on and off (WEDG's, 2006)

Rotating wind turbine blades can cause brightness levels to vary periodically at locations where they obstruct the sun's rays. This intermittent shadow flicker can be a cause of annoyance at residences near wind turbines, if it occurs for a significant period of time. Shadow flicker is largely dictated by the relative position of the turbine(s) and the window, in combination with weather conditions (i.e. presence of direct sunlight, wind speed and wind direction) and the time of day and year (i.e. affecting the position of the sun). Shadow flicker will only occur if the turbine



rotors are located between an observer within a dwelling and the sun. The frequency of the flicker effect is related to the frequency of the rotating turbine blades. It can also be dependent on the number of individual turbine rotors that are casting shadows on a window.

The occurrence of shadow flicker effects is determined by a number of criteria as follows:

**The presence of screening:** Screening can occur from a variety of sources, including vegetation, terrain, and buildings. If sufficient screening is present between the property and the wind turbine/sun, then shadow flicker would not occur at that property.

**The orientation of the property:** The windows of the property must be facing the proposed turbines in order to be able to receive shadow flicker.

**The distance of the property from turbines:** The potential effect of shadow flicker diminishes as distance from the turbine increases. An industry standard best practice approach is to use a distance of ten (10) rotor diameters as a maximum limit within which significant shadow flicker effects can occur (see Section 10.2.1).

**The presence of direct sunlight:** Cloud cover can remove the presence of direct sunlight so that it is diffused and does not cast a shadow. If direct sunlight is present, the turbine blades must be located in the direct path between the sun and the window of the property.

**The time of year and day:** The path of the sun varies over the seasons resulting in a changing potential for a shadow to be cast throughout the year. Similarly, the sun's position in the sky over the course of a day is changing such that the shadow cast by a turbine is constantly changing.

**Wind speed:** In order for shadow flicker to occur, the turbine must be rotating. This requires a wind speed high enough to cause the turbine to turn on.

**Wind direction:** The width of a shadow at any given property is dependent on the direction of the wind. This will be different on any given day at every property. The worst-case shadow occurs when the turbine faces directly towards or away from a property, while minimum flicker occurs when it faces perpendicular to the property.

**The presence of people:** If the property is empty and not occupied at the time of a shadow flicker event, then it would not cause a nuisance.

This chapter will assess the potential occurrences of shadow flicker on all potentially sensitive properties in proximity to the proposed wind farm site.

### 10.1.3 Sensitive Receptors

Properties where occupants are more susceptible to the adverse effects of shadow flicker, i.e. those which contain rooms that are occupied during daylight hours, particularly those with windows facing the turbines, are considered sensitive receptors to shadow flicker. These include, but are not limited to, residential dwellings, hospitals, schools, day care facilities, care homes and offices. In this case, only residential dwellings and potential for future residential dwellings (residential planning applications) have been identified have been identified as sensitive receptors within the study area (as defined in Section 10.1.3.2).



## 10.2 METHODOLOGY

### 10.2.1 Relevant Guidance

There are various sources of guidance with regard to the assessment and management of shadow flicker effects caused by wind turbines. Irish guidance relevant to the Proposed Project is summarised below. Additional guidance from the UK is also presented to provide technical context.

#### **Department of Environment, Heritage & Local Government – Wind Energy Development Guidelines (2006)**

The 2006 Guidelines state that:

*“Careful site selection, design and planning, and good use of relevant software, can help avoid the possibility of shadow flicker in the first instance. It is recommended that shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year or 30 minutes per day”.*

The Guidelines also state that:

*“At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low. Where shadow flicker could be a problem, developers should provide calculations to quantify the effect and where appropriate take measures to prevent or ameliorate the potential effect, such as by turning off a particular turbine at certain times”.*

The shadow flicker modelling approach in this assessment is consistent with this recommendation.

#### **Draft Revised Wind Energy Development Guidelines (2019)**

The Revised Draft WEDGs were published in December 2019 and are subject to a consultation process. It is noted that the Draft WEDGs do not specify a maximum distance for assessing shadow flicker. There is no fixed cut off distance at which effects can occur, as this is influenced by many parameters including the exact latitude of the site and the terrain around the development location.

The Draft WEDGs note that:

*“Generally only properties within 130 degrees either side of north, relative to the turbines, can be affected at these latitudes in the UK and Ireland – turbines do not cast long shadows on their southern side.”*

The Draft WEDGs also outline that the time period in which a neighbouring property may be affected by shadow flicker is completely predictable from the relative locations of the wind turbine(s) and the property. To support this, *“A Shadow Flicker Study detailing the outcome of computational modelling for the potential for shadow flicker from the development should accompany all planning applications for wind energy development.”*

The Draft 2019 WEDGs further advise that if shadow flicker prediction modelling indicates that there is potential for shadow flicker to occur at any particular dwelling or other potentially affected property, that a design review should be carried out to consider if one or more of the turbines can be relocated to eliminate the occurrence of shadow flicker. If this cannot be accommodated, then measures which provide for automated turbine shutdown to eliminate shadow flicker would be required.



The Draft 2019 WEDGs also state that:

*“The planning authority or An Bord Pleanála should impose condition(s) 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”.*

This approach provides for the prevention of shadow flicker by automatic shutdown of the turbines. This means that turbines will need to be programmed to shut down when shadow flicker effects occur, i.e. no amount of shadow flicker per day or per year would be acceptable. The nature of the automatic shutdown process in modern turbine technology requires a very short period of shadow flicker to occur as the blades are moved into the idle position and the blade movement comes to a halt.

Section 10.5.2 outlines the measures that will be implemented to ameliorate potential shadow flicker effects.

It is noted that at the time of the preparation of this assessment (February 2026), the Draft 2019 WEDGs have not yet been adopted and the 2006 Guidelines referred to above remain in place.

Although the Draft WEDGs have not been adopted and might be subject to change, the assessment complies with the Draft WEDGs to the extent that they reflect current best practice.

#### **Parsons Brinckerhoff – Update of UK Shadow Flicker Evidence Base (2011)**

Parsons Brinckerhoff were commissioned by the Department of Energy and Climate Change in the UK to carry out a study to advance the understanding of the shadow flicker effect. The report *“presents an update of the evidence base which has been produced by carrying out a thorough review of international guidance on shadow flicker, an academic literature review and by investigating current assessment methodologies employed by developers and case study evidence”.*

The report sets out that *“Consultation (by means of a questionnaire) was carried out with stakeholders in the UK onshore wind farm industry including developers, consultants and Local Planning Authorities (LPAs). This exercise was used to gauge their opinion and operational experience with shadow flicker, current guidance and the mitigation strategies that can and have been implemented.”*

The report summarised that *“The current recommendation in Companion Guide to PPS22 (Planning Policy Statement 22) (2004) to assess shadow flicker impacts within 130 degrees either side of north is considered acceptable, as is the 10 rotor diameter distance from the nearest property”*, though it is mentioned that this approach may not be suitable at all latitudes.

The Companion Guide to PPS22 was a planning policy statement produced by the UK Government in 2004 and, in addition to the above, states that *“Shadow flicker only occurs inside buildings where the flicker appears through a narrow window opening”.*

In terms of shadow flicker modelling, the report states that *“The three key computer models used by the industry [at that time] are WindPro, WindFarm and Windfarmer. It has been shown that the outputs of these packages do not have significant differences between them. All computer model assessment methods use a “worst case scenario” approach and don’t consider “realistic” factors such as wind speed and cloud cover which can reduce the duration of the shadow flicker impact”.* It is noted that the WindPRO modelling software has been used in the assessment of shadow flicker for the Proposed Project.



The report goes on to say, *“On health effects and nuisance of the shadow flicker effect, it is considered that the frequency of the flickering caused by the wind turbine rotation is such that it should not cause a significant risk to health”*. Further discussion on shadow flicker and human health risks is contained in Chapter 5 - Population and Human Health.

In summarising measures to minimise shadow flicker effects, *“Mitigation measures which have been employed to operational wind farms such as turbine shut down strategies, have proved very successful, to the extent that shadow flicker cannot be considered to be a major issue in the UK”*.

#### **UK Department for Business Enterprise and Regulatory Reform – Onshore Wind Energy Planning Conditions Guidance Note – A Report for the Renewables Advisory Board and BERR (2007)**

This Guidance Note was prepared in the UK for the Renewables Advisory Board and Department for Business, Enterprise and Regulatory Reform (BERR) in 2007 and states that shadow flicker *“occurs only within buildings where the shadow appears through a narrow window opening”* and that *“Only dwellings within 130 degrees either side of north relative to a turbine can be affected and the shadow can be experienced only within 10 rotor diameters of the wind farm”*.

The Guidance Note advises in terms of planning control that *“a local planning authority may consider it appropriate to impose a planning condition to provide that wind turbines should operate in accordance with a shadow flicker mitigation scheme..... Unless a survey carried out on behalf of the developer in accordance with a methodology approved in advance by the local planning authority confirms that shadow flicker effects would not be experienced within habitable rooms within any dwelling”*.

#### **Irish Wind Energy Association (IWEA) – Best Practice Guidelines for the Irish Wind Energy Industry (2012)**

The IWEA Best Practice Guidelines note that, *“At certain times of the year, the moving shadows of the turbine blades could periodically reduce light to a room causing the light to appear to flicker. This would not generally have any effect on health or safety but could on limited occasions present a brief nuisance effect for some neighbours.”*

The Guidelines identify that modifications to predicted worst-case shadow flicker effects to account for sunshine probability and wind direction are reasonable and refers to mitigation measures such as wind turbine operation controls and screening where shadow flicker is anticipated to lead to potential problems.

The Guidelines also include guidance on cumulative shadow flicker assessments, stating:

*It is important to determine if there are other existing and/or permitted but not constructed wind farms in the vicinity of the proposed development which could contribute towards a cumulative shadow flicker impact on any receptors. Any such wind farm developments within 2 km of the proposed development should be considered in a separate cumulative shadow flicker assessment.*

#### **EPA EIAR Guidelines 2022**

This assessment was undertaken in accordance with the EPA EIAR Guidelines 2022 as outlined in Chapter 1.



## 10.2.2 Study Area

As outlined in Section 10.2.1 – Relevant Guidance, it is best practice to apply a distance of ten rotor diameters as a maximum limit within which significant shadow flicker effects can occur. The validity of this limit is discussed within Section 10.2.1 with some stating that effects can only occur within this distance and others stating that the risk beyond this distance is low.

The Parsons Brinckerhoff Report referenced in Section 10.2.1 acknowledges that the latitude of the site will determine the distance from a wind turbine where shadow flicker can occur.

The Onshore Wind Energy Planning Conditions Guidance Note (2007), prepared in the UK for the Renewables Advisory Board and Department for Business, Enterprise and Regulatory Reform (BERR), stated that “*shadow flicker has been proven to occur only within ten rotor diameters of a turbine position*”. The Scottish Government *Onshore Wind Turbines: Planning Advice* (2014) states that “*where separation is provided between wind turbines and nearby dwellings (as a general rule 10 rotor diameters), “shadow flicker” should not be a problem*”.

The Northern Ireland (NI) Department of the Environment *Best Practice Guidance to Planning Policy Statement 18 ‘Renewable Energy’* (2009) states that “*At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low*”.

The IWEA Guidelines (2012) referred to in Section 10.2.1 state that “*The assessment of potentially sensitive locations or receptors within a distance of ten rotor diameters from proposed turbine locations will normally be suitable for EIA purposes*” and refers to the 2006 WEDGs recommended threshold limits of 30 hours per year or 30 minutes per day for receptors within 500 m.

Ireland’s 2006 WEDGs use the same wording as the NI Guidance above (“*At distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low*”) and, in addition, state that “*It is recommended that shadow flicker at neighbouring offices and dwellings within 500 m should not exceed 30 hours per year or 30 minutes per day*”.

Given the recommendations of the above guidance, it is considered that an assessment of potential shadow flicker at properties within ten rotor diameters of the turbine locations is appropriate to provide a robust assessment of shadow flicker from the Proposed Project.

The proposed rotor diameter range is 149 – 163m, so on the basis of the largest 163 m rotor diameter, all sensitive receptors within 1.63 km of the proposed turbine locations have been included in the shadow flicker assessment. For the purposes of this assessment, the 2006 WEDGs recommended maximum thresholds of 30 hours per year or 30 minutes per day have been applied to all sensitive receptor locations within 1.63 km of a proposed turbine location in order to identify any shadow effect requiring mitigation. The Applicant has committed to having zero shadow flicker at any occupied dwelling house within 1.63 km (ten rotor diameters) of the proposed turbine locations. In fact, for dwellings where shadow flicker is likely to exceed the threshold limit values, there are a range of control/mitigation measures that will be implemented. These measures are discussed further in Section 10.5.2.

## 10.2.3 Shadow Flicker Modelling

The analysis has been undertaken using *WindPRO: Shadow – Version 3.6.377* (by EMD International) which is one of the leading industry software packages for carrying out a shadow flicker simulation. It is a specialist modelling software package that incorporates:

- Wind turbine configuration;



- Terrain mapping;
- Sun path throughout the year at the development latitude; and
- Defined receptors.

The wind turbine dimensions inputted to the model are consistent with the maximum turbine size envelope discussed in Chapter 2 - Description of the Proposed Project. The maximum turbine tip height used is 185 m which represents the worst case shadow flicker conditions as the height of the turbine would result in the longest potential shadow length. Further details are available in Section 10.2.4.

The ground level on which the wind turbines and surrounding properties are situated has been incorporated into the model using Digital Terrain Modelling. This terrain mapping ensures that the realistic elevation variations between the turbines and properties is accounted for. This includes a Zone of Visual Influence (ZVI) calculation that checks whether the terrain provides screening for a given property from each turbine and from the sun.

The model allows for user defined receptor locations (i.e. size, position, and orientation of windows at a receptor/property location). The location of properties in the model has been defined using address data from the Geodirectory database, which provides addresses and associated Eircodes (refer to Appendix 4-1). This data has been used to define the sensitive receptor properties within a distance of 2km of the proposed wind farm site and specifically in relation to this shadow flicker assessment, within 1.63 km of all proposed turbines. A ground truthing exercise was carried out to ensure accuracy of the identified sensitive receptors. Further details are provided in Section 4.3.2.3, Chapter 4 - Population and Human Health.

The model was set up to incorporate windows within a property (typically with a size of 1m x 1m and an elevation of 1 m above ground level) directed towards the centre of the proposed wind farm site. This feature can be used to provide specific detailed analysis on the locations of windows and allow for modelling multiple windows on properties facing different groups of turbines. However, to ensure consideration of a worst case scenario, these features are overridden in the model by the 'greenhouse mode' which assumes that shadows can be seen from 360 degrees at a property/receptor as opposed to only through windows facing the wind turbines.

The model default assumes that the turbine rotor is turning at all times. However, in practice, calm conditions, low wind speeds and maintenance shutdown will reduce the duration of operation of the turbines throughout the year and accordingly the potential shadow flicker effect. The model default also assumes that the wind direction is such that the turbine rotor is always perpendicular to the direction to the property so that it casts the maximum shadow possible for each wind turbine. Again, in practice, the wind direction will change periodically over the course of the year, and the wind turbines are programmed to rotate around, or 'yaw', in order to face the wind direction.

The modelling software has built in long term solar statistics that accurately replicate the sun's path throughout the year at the development latitude. The model considers a minimum sun elevation of 3 degrees over the horizon which is a typical value at this latitude to accommodate terrain obstruction at the horizon for low solar elevation angles.

There are several features of the software that can produce highly conservative or 'worst-case' results in terms of modelling the potential shadow flicker effect. For example, there are a range



of factors that could diminish shadow flicker effects namely cloud cover, varying wind direction and low wind speed. In relation to cloud cover, the default annual shadow flicker calculated by the model for each property assumes 100% sunshine during daytime hours. However, Met Éireann data for the closest representative location (Clones, Co. Monaghan) shows that the sun shines on average for 30% of the daylight hours per year<sup>1</sup> thus, the total hours per year of shadow flicker is likely to be significantly less than the theoretical worst-case durations produced by the model. The modelled results, therefore, overestimate the likely effects based on sunshine probability.

Similarly, the worst case model inputs assume that the wind direction is such that all turbines are orientated to cast the maximum shadow over the identified receptors. However, Met Éireann meteorological data indicates that the prevailing wind direction across the country is between south and west<sup>2</sup>. On-site wind measurements have confirmed this to be the case locally. Therefore, the direction that the blades of the turbine face (the turbine blades automatically orientate to face into the wind) will vary and, as such, will not always be perpendicular to the position of the receptors. The modelled results, therefore, overestimate the likely effects based on wind direction.

The worst-case modelled shadow flicker outputs assume unobstructed (from vegetation or other obstacles) visibility between a receptor and the turbine rotors, bright weather conditions and rotor alignment with maximum potential to cast a shadow. These are worst-case conditions used to predict the maximum possible shadow flicker effect. In practice, over the course of any year, the actual weather conditions and any screening will reduce the worst-case modelled effects.

## 10.2.4 Turbine Range Assessment

In order to ensure the full extent of the moving shadow which would be created by the proposed turbine range considered in the assessment, the following representative scenario was modelled:

- Hub height of 103.5 m, tip height of 185 m and rotor diameter of 163 m. The turbine model used for the assessment is the Nordex N163 with 185 m tip height (i.e. largest rotor diameter at the tallest tip height).

As illustrated in Drawing 10955-2032 - Turbine Details, the rotor area of the modelled turbine contains the rotor areas of all other potential combinations of smaller rotor diameters and various hub heights and there is no possibility of a greater shadow flicker effect from any other combination within the turbine parameters proposed. Furthermore, even if the effects from a different combination are lower, they are not lower to such a degree that they would change the conclusion on likely significant effects in this chapter, based on the relatively narrow range of the turbine dimensions

In this regard, the potential for shadow flicker to occur as a result of all configurations within the turbine range, will be less than that modelled. This is because the overall area of the shadow for all other scenarios is smaller and within the modelled shadow that has been assessed (refer to Drawing 10955-2032). As such, the potential shadow flicker effect from within these dimensional boundaries will be less than that presented above.

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<sup>2</sup> [Clones 1978-2010 averages](#)



## 10.2.5 Cumulative Assessment

It is noted that regardless of the wind energy guidelines which are in place, the Applicant has committed to having zero shadow flicker at any occupied dwelling house within 1.63 km (ten rotor diameters) of the proposed turbine locations. The shadow flicker assessment considers the fourteen (14) proposed wind turbines and quantifies the potential shadow flicker effects that may arise from the turbines either on their own or in combination with each other. The guidance mentioned in Section 10.2.1 above was used for this assessment.

As mentioned in Section 10.2.1, the IWEA (2012) Guidelines also includes guidance on cumulative shadow flicker assessments. The currently operational Faughary Wind Farm (Leitrim County Council Planning Ref. P.04/550 and P.11/207) is located 450m to the north-west of the proposed wind farm. Given the proximity to the Proposed Development, cumulative shadow flicker effects from Faughary Wind Farm have been assessed below in Section 10.7.

Potential shadow flicker from Faughary Wind Farm has been modelled using the following turbine model dimensions as per the currently operational turbines at Faughary Wind Farm:

- Hub height of 78 m, tip height of 119 m and rotor diameter of 82 m: ENERCON E-82 2000 82.0.

## 10.2.6 Assessment of Significance of Effects

As mentioned in Section 10.2.1, for the purposes of this assessment, the 2006 WEDGs recommended maximum thresholds of 30 hours per year or 30 minutes per day to be applied to all sensitive receptor locations within 1.63 km of a proposed turbine location in order to identify any shadow effect requiring mitigation. Any shadow flicker effect that exceed the 2006 WEDGs recommended limits of 30 mins per day or 30 hours per year at any sensitive receptor is considered significant.

## 10.2.7 Statement of Limitations and Difficulties Encountered

No limitations or difficulties were encountered when undertaking this assessment or compiling the chapter.



## 10.3 EXISTING ENVIRONMENT

### 10.3.1 Identification of Sensitive Receptors

The shadow flicker receptors identified for the purpose of this assessment are shown on Figure 10-1. The figure also displays the locations of the proposed turbines as well as the shadow flicker study area which extends to 1.63 km from the proposed turbine locations (i.e. allowing for 10 x rotor diameters of the full range being considered). The proposed layout has achieved a high level of separation between dwellings and turbines by providing a minimum separation distance of 720 m (i.e. allowing for 4 times tip height of the full proposed range of tip heights).

The shadow flicker receptors have been identified from a combination of publicly available mapping<sup>3</sup>, aerial imagery, street-level imagery and Geodirectory address data<sup>4</sup>. Following this, a thorough ground truthing survey was undertaken by the TOBIN Project Team to verify the list of properties. The ground-truthing survey consisted in driving within 3km of the proposed turbines and confirming the presence of properties listed in the Geodirectory address data and/or add other non-listed buildings. In addition, a search of planning applications within 1.63 km of the proposed turbine locations was carried out to identify proposed developments and consented, but as yet not built, developments (most recently carried out in February 2026). A total of 84 no. sensitive receptors were identified and are presented in Table 10-1 and Figure 10.1 below. Each receptor identified has been assigned an ID number in the shadow flicker modelling software for reference (see *SH "ID"* – "*ReceptorID*" labels on Figure 10-1 below where *SH "ID"* refers to the shadow flicker modelling assigned labels and "*ReceptorID*" to sensitive receptors' IDs listed on Chapter 5 - Population and Human Health).

During the verification process, any properties/buildings identified that would not be considered sensitive receptors (i.e. farm sheds, garages, etc.) were omitted. Only existing dwellings and planning consented dwellings were found in our shadow flicker study area (10 times rotor diameter) and therefore included as shadow flicker receptors. Planning consented dwellings and offices, which were not built, and where the expiry period for development had elapsed were excluded. There were no offices found in the study area.

<sup>3</sup> <https://www.myplan.ie/national-planning-application-map-viewer/> (Accessed September 2025)

<sup>4</sup> Geodirectory address data captured from <https://mygeoaddress-online.ie/#/> in September 2024



## 10.4 ASSESSMENT OF EFFECTS

### 10.4.1 Future Baseline

The shadow flicker effects examined in this chapter are entirely dependent on the installation and operation of proposed turbines at the proposed wind farm site.

The existing receiving environment at the proposed site, located northeast of Manorhamilton, County Leitrim, is characterised by a predominantly upland rural landscape comprising extensive areas of commercial coniferous forestry, interspersed with areas of blanket bog, peatland habitats, and pockets of rough grazing land. The surrounding area is sparsely populated, with settlement largely confined to dispersed one-off rural dwellings and farmsteads typically located along the local road network and in lower-lying areas adjacent to the site. Land use within the study area is strongly influenced by established forestry operations, including periodic harvesting and replanting cycles, together with agricultural activity and associated rural infrastructure. Most of the site is located within an area identified as suitable for wind energy development under the Leitrim County Development Plan Wind Energy Strategy 2023-2029<sup>5</sup>, which identifies areas with capacity to accommodate wind energy development, subject to environmental sensitivities and planning considerations.

In accordance with Section 3 of the EPA Guidelines (2022)<sup>6</sup>, consideration has been given to the likely evolution of the current state of the environment in the absence of the Proposed Project (the 'Future Baseline' scenario), based on available scientific knowledge and reasonable assumptions regarding land use trends and planning policy. In the absence of the Proposed Project, it is anticipated that the receiving environment would remain broadly consistent with the current land use and landscape character, while being subject to incremental change arising from ongoing agricultural land management, cyclical forestry operations, rural housing development subject to statutory planning control, and the potential implementation of other permitted or planned renewable energy or infrastructure projects within the wider area.

### 10.4.2 Construction Phase

There are no likely significant effects relating to shadow flicker during the majority of the construction phase of the Proposed Project as shadow flicker can only occur when the proposed turbine blades are installed and rotating. At the very end of the construction phase there may be a short time where there is a potential for shadow flicker to occur. This would be in the stage of testing and commissioning of the proposed turbines. As set out in Chapter 2 - Description of the Proposed Project, the commissioning phase of the Proposed Project is anticipated to have a two-month duration. During this stage there would be a potential for a slight momentary effect on any receptor. During commissioning, the turbine blades and shadow flicker management software will be installed and tested. Minimal shadow flicker may be experienced while the software is being refined but there will be no exceedance of the maximum daily limit of 30 minutes per day during this period. The likely significant effect from shadow flicker in the worst case scenario at the identified receptors (within 10 rotor diameters) during commissioning will be minimal and temporary, with a momentary to brief duration of effect t on a daily basis. During

<sup>5</sup> Leitrim County Development Plan Wind Energy Strategy 2023-2029: <https://www.leitrim.ie/council/services/planning-building/forward-planning-development/leitrim-county-development-plan>

<sup>6</sup> EPA Guidelines (2022). Available at [https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR\\_Guidelines\\_2022\\_Web.pdf](https://www.epa.ie/publications/monitoring--assessment/assessment/EIAR_Guidelines_2022_Web.pdf)



commissioning, shadow flicker will not exceed the 2006 WEDGs recommended limits of 30 mins per day or 30 hours per year at any sensitive receptor. Therefore, effects from shadow flicker will not be significant during this phase.

Shadow flicker mitigation measures are outlined in Section 10.5.

### 10.4.3 Operational Phase

The shadow flicker model provides a detailed report and illustration of the potential shadow effects on the identified receptors. The full report is provided in Appendix 10-1.

#### Hours per day

Table 10-1 details the predicted maximum daily shadow flicker representing the maximum number of hours in any one day when shadow flicker may be experienced by a potential receptor in the worst case conditions. The number of days where the predicted daily shadow flicker exceeds the 30 minutes per day threshold is also detailed. Based on the worst case conditions (and without any mitigation), it is predicted that fifty-nine (59) of the eight-four (84) receptors included in the modelling assessment (i.e. within 10 rotor diameters) will experience some level of shadow flicker, with twenty-nine (29) of these in excess of the 2006 WEDGs threshold of 30 minutes per day at certain times of the year. A total of twenty-five (25) receptors will not experience any shadow flicker.

The model inputs used to predict the daily shadow flicker levels have assumed worst case conditions, including direct sunshine for the full duration of daylight hours throughout the year, that the proposed turbine blades are always turning, that the proposed turbine blades are always facing the receptors, the property has windows facing the turbines, the property is always occupied and that there is no screening (vegetation or other obstacles). In reality, the actual occurrence and incidence of shadow flicker over the course of a day is likely to be significantly less than that the maximum predicted in Table 10-1 (Expected Scenario).

#### Hours per year

Table 10-1 also details the total shadow flicker hours per year for comparison against the 2006 WEDG threshold of 30 hours per year. The '*Worst Case Annual Shadow Flicker*' column in Table 10-1 represents the worst case scenario which assumes 100% sunshine on every day during daylight hours as well as worst case wind conditions resulting in maximum shadow cast in the direction of a receptor for the entire year.

As noted in Section 10.2.3, the Met Éireann data for this region shows that the sun shines on average for only 30% of the daylight hours per year. Accordingly, a sunshine reduction factor can be applied to account for the more realistic sunshine probability at the site. Additionally, as it is not possible for all turbines to face directly towards sensitive receptors at all times, and as wind direction is subject to change, a wind direction reduction factor can also be applied to the worst case annual shadow flicker results. The *WindPRO* modelling software<sup>7</sup> has built-in options to specify statistical weather data to produce more realistic (referred to as 'Expected' in the modelling software) predictions of annual shadow flicker effects. These predicted results are presented in the column titled '*Expected (Realistic)*' in Table 10-1.

The technical assessment shows that the guideline threshold limit of 30 hrs per year is predicted to be exceeded at twenty-eight (28) receptors in the worst case scenario and is expected to be

<sup>7</sup> WindPRO V3.3.294 - EMD International - <https://www.emd-international.com/windpro/>



exceeded at zero (0) receptors when the statistical sunshine probability is taken into account. Therefore, the realistic 'Expected Values' for shadow flicker at the identified receptors are significantly reduced from the worst-case scenario. Results of the worst case scenario can also be seen on Figure 10-1.

For the operational phase of the proposed wind farm, the potential effect from shadow flicker in the worst case scenario and before mitigation measures are applied, at the receptors as set out in Table 10-1 is likely to be significant and periodic over the long-term and will have a momentary to brief effect with respect to the duration of the effect on a daily basis at certain times of the year at any receptor that does receive shadow flicker (with no effect at receptors that do not receive it). Therefore, significant shadow flicker effects will occur at sensitive receptors where the 2006 WEDGs recommended limits of 30 mins per day or 30 hours per year are exceeded before mitigation measures are applied (see Table 10-1).

This list of properties/receptors in Table 10-1 includes all properties which are located within 1.63 km (ten rotor diameters) of the proposed turbine locations. A list of all properties/receptors within 2km (which includes the properties below) is provided in Appendix 4-1 and Table 4-3, Chapter 4 - Population and Human Health.

Exceedances are shown in red. Number of days exceeding 30 minutes/day in bold.

**Table 10-1: Predicted Daily and Annual Shadow Flicker Effects – Proposed Wind Turbines**

Property / Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
1	Sensitive Receptor (Dwelling)	00:00	<b>0</b>	0:00	00:00
2	Sensitive Receptor (Dwelling)	01:10	<b>82</b>	73:11	07:49
3	Sensitive Receptor (Dwelling)	01:07	<b>66</b>	66:55	08:50
4	Sensitive Receptor (Dwelling)	00:29	<b>0</b>	25:27	03:14
5	Sensitive Receptor (Dwelling)	00:37	<b>32</b>	64:48	08:49
6	Sensitive Receptor (Dwelling)	00:28	<b>0</b>	22:42	03:09
7	Sensitive Receptor (Dwelling)	00:00	<b>0</b>	0:00	00:00



Property / Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
8	Sensitive Receptor (Dwelling)	00:28	0	25:35	04:30
9	Sensitive Receptor (Dwelling)	00:30	3	27:20	04:38
10	Sensitive Receptor (Dwelling)	00:34	30	45:19	05:15
11	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
12	Sensitive Receptor (Dwelling)	01:00	79	75:34	08:22
13	Sensitive Receptor (Dwelling)	00:29	0	19:26	02:29
14	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
15	Sensitive Receptor (Dwelling)	00:26	0	17:54	02:38
16	Sensitive Receptor (Dwelling)	00:30	11	49:59	08:15
17	Sensitive Receptor (Dwelling)	01:00	82	79:59	08:53
18	Sensitive Receptor (Dwelling)	00:27	0	15:21	02:43
19	Sensitive Receptor (Dwelling)	01:01	82	80:23	08:55
20	Sensitive Receptor (Dwelling)	01:08	66	68:59	09:05
21	Sensitive Receptor (Dwelling)	00:27	0	19:21	02:47
22	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00



Property / Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
23	Sensitive Receptor (Dwelling)	00:38	29	33:46	05:08
24	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
25	Sensitive Receptor (Dwelling)	01:00	56	59:21	06:16
26	Sensitive Receptor (Dwelling)	00:27	0	23:37	03:53
27	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
28	Sensitive Receptor (Dwelling)	00:28	0	28:53	05:19
29	Sensitive Receptor (Dwelling)	00:39	34	38:01	06:04
30	Sensitive Receptor (Dwelling)	00:28	0	16:04	01:58
31	Sensitive Receptor (Dwelling)	00:30	6	22:45	03:29
32	Sensitive Receptor (Dwelling)	00:29	0	23:30	02:55
33	Sensitive Receptor (Dwelling)	00:26	0	18:59	03:11
34	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
35	Sensitive Receptor (Dwelling)	00:28	0	39:00	06:48
36	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
37	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00



Property / Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
38	Sensitive Receptor (Dwelling)	01:04	54	49:30	06:32
39	Sensitive Receptor (Dwelling)	00:35	40	30:23	05:15
40	Sensitive Receptor (Dwelling)	00:37	30	34:05	05:45
41	Sensitive Receptor (Dwelling)	00:25	0	16:55	02:30
42	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
43	Sensitive Receptor (Dwelling)	00:24	0	9:05	01:25
44	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
45	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
46	Sensitive Receptor (Dwelling)	00:29	0	16:15	02:02
47	Sensitive Receptor (Dwelling)	00:26	0	28:45	04:34
48	Sensitive Receptor (Dwelling)	00:29	0	24:58	03:14
49	Sensitive Receptor (Dwelling)	00:31	17	43:40	07:13
50	Sensitive Receptor (Dwelling)	00:26	0	15:01	02:47
51	Sensitive Receptor (Dwelling)	00:34	28	52:15	08:12
52	Sensitive Receptor (Dwelling)	00:25	0	26:57	04:05



Property / Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
53	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
54	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
55	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
56	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
57	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
58	Sensitive Receptor (Dwelling)	00:28	0	16:00	01:59
59	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
60	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
61	Sensitive Receptor (Dwelling)	00:25	0	11:44	02:03
62	Sensitive Receptor (Dwelling)	00:33	26	27:22	05:05
63	Sensitive Receptor (Dwelling)	01:03	88	85:18	09:42
64	Sensitive Receptor (Dwelling)	00:54	44	39:59	04:00
65	Sensitive Receptor (Dwelling)	00:25	0	15:09	01:45
66	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
67	Sensitive Receptor (Dwelling)	00:59	79	73:34	08:10

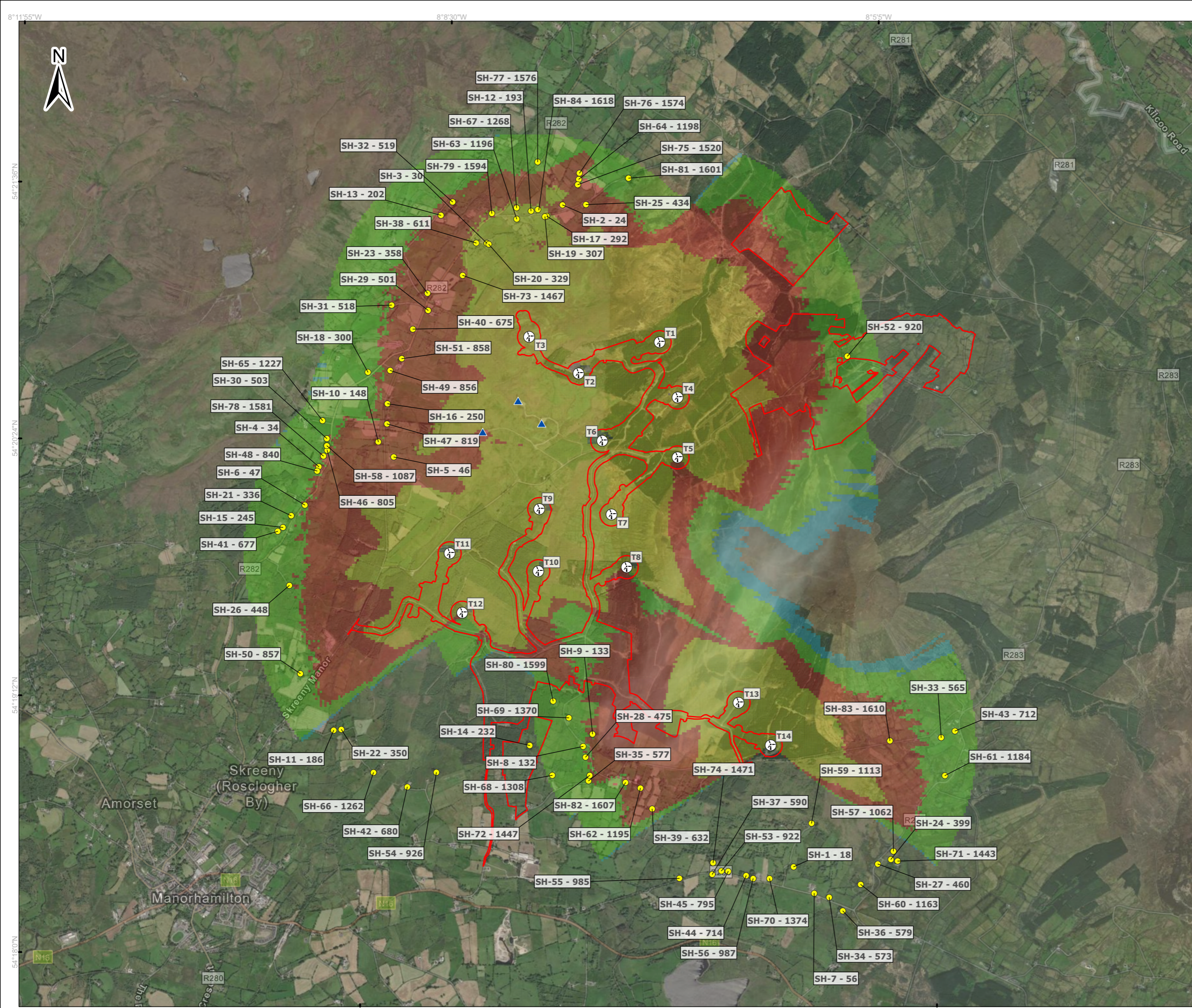


Property / Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
68	Sensitive Receptor (Dwelling)	00:23	0	13:07	2:29
69	Sensitive Receptor (Dwelling)	00:25	0	18:43	3:09
70	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
71	Sensitive Receptor (Dwelling)	00:00	0	0:00	0:00
72	Sensitive Receptor (Dwelling)	00:28	0	42:11	07:27
73	Sensitive Receptor (Dwelling)	00:52	52	49:27	07:03
74	Sensitive Receptor (Dwelling)	00:00	0	0:00	00:00
75	Sensitive Receptor (Dwelling)	00:55	50	45:24	04:37
76	Sensitive Receptor (Dwelling)	00:50	40	34:05	03:21
77	Sensitive Receptor (Dwelling)	00:26	0	16:02	01:35
78	Sensitive Receptor (Dwelling)	00:28	0	15:16	01:58
79	Sensitive Receptor (Dwelling)	00:59	78	65:36	07:26
80	Sensitive Receptor (Dwelling)	00:24	0	9:05	01:31
81	Sensitive Receptor (Dwelling)	00:25	0	24:41	02:38
82	Sensitive Receptor (Dwelling)	00:30	3	18:34	03:16



Property / Receptor ID for Shadow Flicker Model	Description	Worst Case Scenario			Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	No. of Days exceeding 30 mins/day Threshold	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
83	Sensitive Receptor (Dwelling)	00:37	26	36:47	06:16
84	Sensitive Receptor (Dwelling)	01:00	78	73:37	08:07





**Legend**

- Application Boundary
- Turbine Locations
- Cumulative: Faughary Wind Farm Turbines
- Sensitive Receptors

**Shadow Flicker (Maximum Minutes per Day)**

- 0.1 -< 10.0
- 10.0 -< 30.0
- 30.0 -< 60.0
- 60.0 <= 90.0

0 0.5 1  
Kilometers

**Spatial Reference**  
Datum: IRENET95  
EPSG: 2157

**Copyrights:**  
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community,

A	18/02/2026	First issue	S.P	S.R
Rev	Date	Description	By	Chkd.

Client:  
**FuturaEnergy Ireland**

Project:  
Lissinagroagh Wind Farm

Title:  
Figure 10-1:  
Shadow flicker assessment area

Scale @ A3: 1:30,000

Prepared by: S. Pezzetta  
Checked by: S. Ryan  
Date: February 2026

**TOBIN**

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Map Ref: 10955-017-SHADW.FLCKR-SENS.R-TOB-A  
Draft: A

## 10.4.4 Decommissioning Phase

There are no potential effects relating to shadow flicker during the decommissioning phase of the Proposed Project as shadow flicker can only occur when the turbine blades are installed and rotating. Turbines would not be rotating during this phase. Effects from shadow flicker are therefore considered not significant.

## 10.5 MITIGATION MEASURES

The shadow flicker modelling predicts worst case 'bare earth' conditions without vegetation (including forestry), buildings or other obstacles. In reality, existing screening in the form of buildings, vegetation and local topographic variations will have a significant effect on the level of shadow flicker that will actually be experienced by the identified receptors. When these additional screening features are taken into account, the actual effect in terms of incidence and duration may be significantly reduced or even eliminated.

Shadow flicker almost exclusively occurs in the operational phase of a wind farm. While there is a potential for minimal momentary effects to occur during turbine commissioning at the end of the construction phase (while the mitigation strategy is being refined), no likely significant effects are expected. This is due to the short timeframe that the commissioning stage takes (approximately 2 months), the fact that turbines are often left stationary (i.e. not rotating) during it, unless it is required for them to be rotating and the fact that the turbine control software will be operated and tested during this period. All of the mitigation described below would apply during the final stage of the construction phase also.

### 10.5.1 Turbine Shutdown

It is noted that, the Applicant has committed to having --zero shadow flicker at any occupied dwelling house within 1.63 km (ten rotor diameters) of the proposed turbine locations. There may be a very brief time where a shadow moves over a property in the time it takes for the proposed turbine rotor to come to a safe stop, between 1 and 2 minutes. This will depend on the reaction time of the shadow flicker control modules and the particular proposed turbine type, however this is considered a negligible effect as it would likely take at most 1-2 minutes to stop.

A shadow flicker control system will be installed on each of the wind turbines that have the potential to cause shadow flicker for sensitive receptors, namely the turbines to the west (T2, T3, T9, T11) and south (T13, T14) Further details of the specific turbines casting shadow are provided in Appendix 10-1).

The control system will detect and calculate, in real-time:

- Whether shadow flicker has the potential to affect nearby properties, based on pre-programmed co-ordinates for the properties and turbines outlined in this assessment;
- Wind speed (can affect how fast the proposed turbine will turn and how quickly the flicker will occur);
- The intensity of the sunlight.

When the sunlight is strong enough to cast a shadow, and the shadow falls on a property or properties, then the proposed turbine will automatically shut down; and will restart when the potential for shadow flicker ceases at the affected properties.



The Turbine Shutdown Scheme will be the primary mitigation measure for the potential shadow flicker effect and will be implemented based on the predicted shadow flicker at each shadow flicker receptor. The Turbine Shutdown Scheme will be employed to ensure that shadow flicker does not occur at the affected properties). A process will be established by the proposed wind farm operator whereby local residents can highlight any concerns or complaints about the operation of the scheme (as outlined in Section 5.2.4 of the CEMP provided in Appendix 2-4)). All concerns raised will be investigated by the proposed wind farm operator and the turbine shutdown software adjusted accordingly, to ensure that the turbines shut down at the appropriate time. Should adjustments be required to the software, the flicker occurrence will be monitored. This will determine any further adjustments that might be required to shut down times for any given turbine.

### 10.5.2 Screening Measures

If there is sufficient existing screening at a shadow flicker receptor, the Turbine Shutdown Scheme may not be necessary for that receptor. The Applicant will engage with any affected residents to investigate options for new or additional screening measures (such as planting vegetation to act as a screen or installation of suitable window blinds in the affected rooms of the residence) where appropriate and agreeable to the affected residents. If screening is not acceptable and/or will not be effective the Turbine Shutdown scheme as set out in Section 10.5.1 will be implemented to ensure 'zero shadow flicker'.

Where agreed screening measures are implemented, the effectiveness of the measures will be monitored and if the measures are not functioning to the satisfaction of the property owner/occupant, they will be included in the Turbine Shutdown Scheme as set out in Section 10.5.1.

## 10.6 RESIDUAL EFFECTS

The Applicant is committed to minimising any adverse effects from the Proposed Project on the local community. The implementation of mitigation measures to screen shadow flicker effects from sensitive receptors and/or implement wind turbine control measures in accordance with a defined Turbine Shutdown scheme will ensure that any residual shadow flicker effects from the proposed project will be reduced at any shadow flicker receptors to achieve - zero shadow flicker as committed by the Applicant. This will be the case irrespective of which turbine dimensions are selected within the turbine range. As noted previously, the immediate shutdown of a turbine(s) is subject to the technical capabilities of turbine technology where controlled and safe slow-down of blade rotation is required, lasting between 1 and 2 minutes at most. This would have an imperceptible long-term negative effect.

## 10.7 CUMULATIVE EFFECTS

As mentioned in Section 10.2.1, the IWEA (2012) Guidelines also includes guidance on cumulative shadow flicker assessment. The operational Faughary Wind Farm (Leitrim County Council P.04/550 and P.11/207) is located approximately 550m to the north-west of the proposed wind farm. Given the proximity to the Proposed Wind Farm, cumulative shadow flicker effects from Faughary Wind Farm have been assessed below.



The existing environment (in terms of sensitive receptors) and the methodology are identical to the those presented for the Proposed Project (Sections 10.2 and 10.3). Potential shadow flicker from Faughary Wind Farm has been modelled using the following turbine model dimensions for the operational turbines at Faughary Wind Farm:

- Hub height of 78 m, tip height of 119 m and rotor diameter of 82 m: ENERCON E-82 2000 82.0.

In relation to the likely significant effects, expected variations on the results are presented below during operational phase (refer to Section 10.4 for construction and decommissioning phases).

The shadow flicker modelling results provided in Appendix 10-1 provides a detailed report and illustration of the potential shadow effects on the identified potential receptors.

### Hours per day

Table 10-2 details the predicted cumulative maximum daily shadow flicker representing the maximum number of hours in any one day when shadow flicker may be experienced by a potential receptor in the worst-case conditions. The number of days where the predicted daily shadow flicker exceeds the 30 minutes per day threshold is also detailed. Based on the worst case conditions (and without any mitigation), it is predicted that one (1) additional receptor (i.e. 60 total) of the 84 included in the modelling assessment (i.e. within 10 rotor diameters of the proposed turbines) will experience some level of daily shadow flicker compared with the above assessment of the proposed wind farm alone. Thirty-one (31) of these receptors are in excess of the 2006 WEDGs threshold of 30 minutes per day. A total of twenty four (24) sensitive receptors will not experience any shadow flicker.

The model inputs used to predict the daily shadow flicker levels have assumed worst-case conditions, including direct sunshine for the full duration of daylight hours throughout the year, that the proposed turbine blades are always turning, that the proposed turbine blades are always facing the receptors, the property has windows facing the turbines, the property is always occupied and that there is no screening (vegetation or other obstacles). In reality, the actual occurrence and incidence of shadow flicker over the course of a day is likely to be significantly less than that the maximum predicted in Table 10-2.

### Hours per year

Table 10-2 also details the cumulative total shadow flicker hours per year for comparison against the 2006 WEDG threshold of 30 hours per year. The 'Worst Case Annual Shadow Flicker' column in Table 10-2 represents the worst-case scenario which assumes 100% sunshine on every day during daylight hours as well as worst-case wind conditions resulting in maximum shadow cast in the direction of a receptor for the entire year.

As noted in Section 10.2.3, the Met Éireann data for this region shows that the sun shines on average for only 30% of the daylight hours per year. Accordingly, a sunshine reduction factor can be applied to account for the more realistic sunshine probability at the site. Additionally, as it is not possible for all turbines to face directly towards sensitive receptors at all times, and as wind direction is subject to change, a wind direction reduction factor can also be applied to the



worst case annual shadow flicker results. The *WindPRO* modelling software<sup>8</sup> has built-in options to specify statistical weather data to produce more realistic (referred to as 'Expected' in the modelling software) predictions of annual shadow flicker effects. These predicted results are presented in the column titled 'Expected (Realistic)' in Table 10-2.

The technical assessment shows that the guideline threshold limit of 30 hrs per year is predicted to be exceeded at two (2) additional receptors (i.e. 30 total) compared with the above assessment of the proposed wind farm alone in the worst case scenario and is expected to be exceeded at zero (0) receptors when the statistical sunshine probability and wind direction factor is taken into account.

The list of properties/receptors in Table 10-2 includes all properties which are located within 1.63 km (ten rotor diameters) of the proposed turbine locations. A list of all properties/receptors within 2km (which includes the properties below) is provided in Appendix 4-1 and Table 4-3, Chapter 4 - Population and Human Health.

Exceedances are shown in red.

**Table 10-2: Predicted Daily and Annual Shadow Flicker Effects - Cumulative Assessment**

Property / Receptor ID for Shadow Flicker model	Description	Worst Case Scenario		Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
1	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
2	Sensitive Receptor (Dwelling)	01:10	73:11	07:49
3	Sensitive Receptor (Dwelling)	01:07	66:55	08:50
4	Sensitive Receptor (Dwelling)	00:29	29:04	03:53
5	Sensitive Receptor (Dwelling)	00:47	97:07	14:38
6	Sensitive Receptor (Dwelling)	00:28	22:42	03:09
7	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
8	Sensitive Receptor (Dwelling)	00:28	25:35	04:30
9	Sensitive Receptor (Dwelling)	00:30	27:20	04:38

<sup>8</sup> WindPRO V3.3.294 - EMD International - <https://www.emd-international.com/windpro/>



Property / Receptor ID for Shadow Flicker model	Description	Worst Case Scenario		Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
10	Sensitive Receptor (Dwelling)	00:34	45:19	08:25
11	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
12	Sensitive Receptor (Dwelling)	01:00	75:34	08:22
13	Sensitive Receptor (Dwelling)	00:29	19:26	02:29
14	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
15	Sensitive Receptor (Dwelling)	00:26	17:54	02:38
16	Sensitive Receptor (Dwelling)	00:36	68:07	10:50
17	Sensitive Receptor (Dwelling)	01:00	79:59	08:53
18	Sensitive Receptor (Dwelling)	00:27	23:36	03:58
19	Sensitive Receptor (Dwelling)	01:01	80:23	08:55
20	Sensitive Receptor (Dwelling)	01:08	68:59	09:05
21	Sensitive Receptor (Dwelling)	00:27	19:21	02:47
22	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
23	Sensitive Receptor (Dwelling)	00:38	50:38	07:03
24	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
25	Sensitive Receptor (Dwelling)	01:00	59:21	06:16
26	Sensitive Receptor (Dwelling)	00:27	23:37	03:53



Property / Receptor ID for Shadow Flicker model	Description	Worst Case Scenario		Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
27	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
28	Sensitive Receptor (Dwelling)	00:28	28:53	05:19
29	Sensitive Receptor (Dwelling)	00:39	61:47	08:53
30	Sensitive Receptor (Dwelling)	00:28	19:33	02:35
31	Sensitive Receptor (Dwelling)	00:30	32:46	04:49
32	Sensitive Receptor (Dwelling)	00:29	23:30	02:55
33	Sensitive Receptor (Dwelling)	00:26	18:59	03:11
34	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
35	Sensitive Receptor (Dwelling)	00:28	39:00	06:48
36	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
37	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
38	Sensitive Receptor (Dwelling)	01:04	52:45	06:50
39	Sensitive Receptor (Dwelling)	00:35	30:23	05:15
40	Sensitive Receptor (Dwelling)	00:37	50:44	08:02
41	Sensitive Receptor (Dwelling)	00:25	16:55	02:30
42	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
43	Sensitive Receptor (Dwelling)	00:24	9:05	01:25



Property / Receptor ID for Shadow Flicker model	Description	Worst Case Scenario		Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
44	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
45	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
46	Sensitive Receptor (Dwelling)	00:29	20:00	02:41
47	Sensitive Receptor (Dwelling)	00:40	46:45	07:46
48	Sensitive Receptor (Dwelling)	00:29	28:36	03:54
49	Sensitive Receptor (Dwelling)	00:31	57:57	09:18
50	Sensitive Receptor (Dwelling)	00:26	15:01	02:47
51	Sensitive Receptor (Dwelling)	00:34	68:19	10:32
52	Sensitive Receptor (Dwelling)	00:25	26:57	04:05
53	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
54	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
55	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
56	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
57	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
58	Sensitive Receptor (Dwelling)	00:28	19:41	02:38
59	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
60	Sensitive Receptor (Dwelling)	00:00	0:00	00:00



Property / Receptor ID for Shadow Flicker model	Description	Worst Case Scenario		Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
61	Sensitive Receptor (Dwelling)	00:25	11:44	02:03
62	Sensitive Receptor (Dwelling)	00:33	27:22	05:05
63	Sensitive Receptor (Dwelling)	01:03	85:18	09:42
64	Sensitive Receptor (Dwelling)	00:54	39:59	04:00
65	Sensitive Receptor (Dwelling)	00:25	18:12	02:16
66	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
67	Sensitive Receptor (Dwelling)	00:59	73:34	08:10
68	Sensitive Receptor (Dwelling)	00:23	13:07	02:29
69	Sensitive Receptor (Dwelling)	00:25	18:43	03:09
70	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
71	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
72	Sensitive Receptor (Dwelling)	00:28	42:11	07:27
73	Sensitive Receptor (Dwelling)	00:52	73:20	09:35
74	Sensitive Receptor (Dwelling)	00:00	0:00	00:00
75	Sensitive Receptor (Dwelling)	00:55	45:24	04:37
76	Sensitive Receptor (Dwelling)	00:50	34:05	03:21
77	Sensitive Receptor (Dwelling)	00:26	16:02	01:35



Property / Receptor ID for Shadow Flicker model	Description	Worst Case Scenario		Expected (Realistic)
		Maximum Daily Shadow Flicker (hrs:mins/day)	Annual Shadow Flicker (hrs:mins/year)	Annual Shadow Flicker (hrs:mins/year)
78	Sensitive Receptor (Dwelling)	00:28	18:52	02:36
79	Sensitive Receptor (Dwelling)	00:59	65:36	07:26
80	Sensitive Receptor (Dwelling)	00:24	9:05	01:31
81	Sensitive Receptor (Dwelling)	00:25	24:41	02:38
82	Sensitive Receptor (Dwelling)	00:30	18:34	03:16
83	Sensitive Receptor (Dwelling)	00:37	36:47	06:16
84	Sensitive Receptor (Dwelling)	01:00	73:37	08:07

Based on the modelling and results presented above when taking into account the three (3) existing turbines associated with Faughary Wind Farm, no additional likely significant effects relating to shadow flicker have been identified.

Given the commitment to zero shadow flicker by the Applicant (see Section 10.5), there will therefore be no likely significant cumulative effects as a result of the Proposed Project.

Conclusions on likely significant effects and mitigation measures to be adopted will remain as described in Section 10.4.

## 10.8 TRANSBOUNDARY EFFECTS

The Proposed Project is located 2.6km from Northern Ireland with T1, the closest turbine, located 4.2km South-West of the border. Due to the proximity of the Proposed Project to Northern Ireland, transboundary effects have been considered.

As mentioned in Section 10.2.2, the Shadow Flicker study area is defined as 1.63 km (ten rotor diameters) from the proposed turbine locations. All receptors (84 no.) within this study area have also been defined in Section 10.3.1. Given the distance from the study area, and the identified sensitive receptors within in, to Northern Ireland, transboundary effects are considered to be not significant.

## 10.9 CONCLUSION

The incorporation of set-back distances from the proposed turbines to buildings, which have been considered and implemented in the design of the proposed wind farm site layout, means



that there are no sensitive receptors located within 740 m of a proposed turbine location. The assessment above has considered the full range of proposed turbine dimensions. The closest receptor is located 763 m from a proposed turbine. The potential for shadow flicker to occur is entirely predictable and the modelling software used in this assessment and installed in the proposed wind turbines can accurately predict when shadow flicker has potential to occur at specific properties. Turbine shutdown mitigation measures as set out in Section 10.5, will ensure that there are no significant residual effects of shadow flicker from the proposed wind farm and the identified cumulative development (Faughary Wind Farm), on the identified receptors within ten rotor diameters irrespective of which turbine is selected within the turbine range.



## 10.10 REFERENCES

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