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# 14 Shadow Flicker

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## 14.1 Introduction

14.1.1. This chapter presents the preliminary assessment of the likely significant effects of the Proposed Development with respect to Shadow Flicker. It should be read in conjunction with the Proposed Development description provided in **Chapter 4: Development Description**.

14.1.2. This chapter describes:

- the legislation, policy and technical guidance that has informed the assessment (**Section 14.2**);
- consultation and engagement that has been undertaken and how comments from consultees relating to Shadow Flicker have been addressed (**Section 14.3**);
- the methods used for baseline data gathering (**Section 14.4**);
- overall baseline (**Section 14.5**);
- embedded measures relevant to Shadow Flicker (**Section 14.6**);
- the scope of the assessment for Shadow Flicker (**Section 14.7**);
- the methods used for the assessment (**Section 14.8**);
- the preliminary assessment of Shadow Flicker effects (**Section 14.9**);
- preliminary assessment of cumulative (inter-project) effects (**Section 14.10**); and
- a summary of the preliminary significance conclusions (**Section 14.11**).

### Limitations and assumptions

14.1.3. The information provided in this Draft ES is preliminary, the final assessment of likely significant Noise and Vibration effects will be reported in the Final ES. This Draft ES has been produced to fulfil the Applicants Pre-Application Consultation (PAC) responsibilities and enable consultees to develop an informed view of the likely significant effects of the Proposed Development based on latest current information.

14.1.4. There are no limitations relating to Shadow Flicker that affect the robustness of the assessment of the potential likely significant effects of the Proposed Development.

14.1.5. The properties considered in the Shadow Flicker assessment were not visited because a realistic worst-case scenario has been assessed. The realistic worst-case scenario assumes 4 windows are present on each property, oriented at 0, 90, 180 and 270 degrees. The model and results therefore assume that at least 1 window in each property will always be oriented in a direction that allows Shadow Flicker effects to occur. In reality, some properties may not have windows oriented in a direction that allows Shadow Flicker effects to occur.

## 14.2 Relevant legislation, planning policy and technical guidance

14.2.1. This section identifies the legislation, planning policy and technical guidance that has informed the assessment of effects with respect to Shadow Flicker. Further information on policies relevant to the Proposed Development is provided in **Chapter 5: Legislation and policy overview**.

### Planning Policy

14.2.2. A summary of the relevant national and local planning policy is given in **Table 14-1**.

**Table 14-1 Planning policy relevant to the Shadow Flicker assessment.**

Policy	Context
<b>National planning policy</b>	
<b>Future Wales: The National Plan 2040<sup>1</sup></b>	With respect to Shadow Flicker, this states: <i>“Policy 18 – Renewable and Low Carbon Energy Developments of National Significance ... 7. there are no unacceptable adverse impacts by way of shadow flicker, noise, reflected light, air quality or electromagnetic disturbance;”</i>
<b>Technical Advice Note (TAN) 8: Planning for Renewable Energy (2005) – Para 2.32 (revoked however used as a guide for this assessment)</b>	<i>“Under particular circumstances the sun may pass behind the rotors of a wind turbine and cast a shadow over neighbouring properties. The shadow flicks on and off as the blades rotate. This can be disturbing for the affected residents or even have the potential of being a health problem for people who are photo-sensitive epileptics.</i>  <i>The problem is only seasonal and lasts for a few hours per day but needs to be investigated where any potential exists. Developers should provide an analysis of the potential Shadow Flicker impacting upon nearby properties”.</i>
<b>Local planning policy Caerphilly County Borough Local Development Plan up to 2021<sup>2</sup>, p 35 paragraph 1.54.</b>	With respect to Shadow Flicker, there is no content, however the LDP states: <i>“The energy provision benefits of renewable energy schemes therefore need to be balanced against the potential impact of such development on the landscape and on sites of ecological interest.”</i>
<b>Torfaen County Local Development Plan up to 2021<sup>3</sup> (adopted December 2013) Policy BW1 General Policy - Development Proposals</b>	In respect to Shadow Flicker, the LDP does not explicitly state a position however the borough wide policy states: <i>“All development proposals will be considered favourably providing they comply with the following criteria where they are applicable:</i>

<sup>1</sup> Welsh Government (2021). Future Wales: The National Plan 2040. (online) Available at: <https://gov.wales/sites/default/files/publications/2021-02/future-wales-the-national-plan-2040.pdf> (Accessed September 2025).

<sup>2</sup> Caerphilly County Borough Local Development Plan up to 2021 (adopted 2010) (Online) Available at: <https://www.caerphilly.gov.uk/caerphillydocs/ldp/written-statement.aspx> (Accessed September 2025).

<sup>3</sup> Torfaen County Borough Council (2013) Torfaen County Borough Council Local Development Plan. (Online) Available at: <https://www.torfaen.gov.uk/en/Related-Documents/Forward-Planning/Adopted-Torfaen-LDP-Written-Statement.pdf> (Accessed September 2025).

Policy	Context
	<i>A - Amenity and Design – vi) The proposal does not have an unacceptable impact upon the amenities of the occupiers of adjoining or neighbouring properties;</i>

## Technical Guidance

14.2.3. A summary of the technical guidance for Shadow Flicker is given in **Table 14-2**.

**Table 14-2 Technical guidance relevant to the Shadow Flicker assessment.**

Technical guidance document	Context
<b>Best Practice Guidance to Planning Policy Statement 18 (PPS 18) Renewable Energy (Northern Ireland Department of the Environment, 2009)<sup>4</sup></b>	Whilst not strictly applicable in a Welsh context, the guidance in Northern Ireland provided in the draft Best Practice Guidance to Planning Policy Statement 18 (PPS 18) Renewable Energy (Northern Ireland Department of the Environment, 2009) is noteworthy. The draft guidance reaffirms the advice provided by DECC (2011) and the Welsh Government but further recommends that “ <i>shadow flicker at neighbouring offices and dwellings within 500m should not exceed 30 hours per year or 30 minutes per day.</i> ” The recommendation is based on a European Union sponsored study undertaken by Predac (2004), an organisation that promotes best practice in energy use and supply.
<b>Department of Energy and Climate Change, Update of UK Shadow Flicker Evidence Base, 2011<sup>5</sup></b>	Provides evidence and guidance to support Shadow Flicker assessments.

## 14.3 Consultation and Engagement

### Overview

14.3.1. The assessment has been informed by consultation responses and ongoing stakeholder engagement. An overview of the approach to consultation is provided in **Section 2.4 of Chapter 2: Approach to Environmental Impact Assessment**.

### Scoping Opinion

14.3.2. A Scoping Direction was issued by the Planning and Environmental Decisions Wales (PEDW, formerly Planning Inspectorate Wales), on behalf of the Welsh Ministers, on 04 December 2024 (reference DNS CAS-03701-H3V4Y3: Rhyswg Wind Farm). A summary of the relevant responses

<sup>4</sup> Northern Ireland Department of the Environment (2009). Best Practice Guidance to Planning Policy Statement 18 ‘Renewable Energy’. (online) Available at: [https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/Best%20Practice%20Guidance%20to%20PPS%2018%20-%20Renewable%20Energy\\_0.pdf](https://www.infrastructure-ni.gov.uk/sites/default/files/publications/infrastructure/Best%20Practice%20Guidance%20to%20PPS%2018%20-%20Renewable%20Energy_0.pdf) (Accessed September 2025).

<sup>5</sup> Department of Energy and Climate Change (2010). Update of Uevidence base (online). Available at: <https://assets.publishing.service.gov.uk/media/5a79770bed915d0422068aa3/1416-update-uk-shadow-flicker-evidence-base.pdf> (accessed September 2025).

received in the Scoping Opinion in relation to Shadow Flicker and confirmation of how these have been addressed within the assessment to date is presented in **Table 14-8**.

- 14.3.3. **Table 14-3** outlines the comments made in the Scoping Direction in relation to Shadow Flicker and how these have been addressed within this Draft ES.
- 14.3.4. The information provided in the Draft ES is preliminary and not all the Scoping Direction comments have been addressed at this stage. However, all comments will be addressed within the Final ES along with any additional comments raised during PAC.

**Table 14-3 Summary of EIA Scoping Direction Responses Shadow Flicker**

Consultee	Consideration	How addressed in this Draft ES
<b>PEDW</b>	<p>PEDW notes that in ‘Review of Light and Shadow Effects from Wind Turbines in Scotland’ (L.U.C. for climateXchange, 2017) it was found that “there is a lack of evidence to support the use of ten rotor diameters as a cut off, and this is entirely down to misinterpretation of the original reference to this distance.”</p> <p>The ES should provide a clear rationale as to the methodology adopted, and why it is considered appropriate given the scale of turbine proposed.</p>	<p>The methodology adopted for the Shadow Flicker assessment is recognised as industry best practice and discussed further in <b>Section 14.8</b>.</p>
<b>Caerphilly County Borough Council - Rights of Way Officer</b>	<p>It is welcomed that Shadow Flicker impacts on dwellings will be assessed and included in the ES. PEDW highlight that Shadow Flicker may impact other receptors such as PRoW users including equestrians. The scope of the shadow flicker assessment should be widened to include other sensitive receptors.</p>	<p>Shadow Flicker occurs within buildings where a turbine blade is passing between an opening, such as a window, and the sun. It does not affect bridleways or byways.</p> <p>With respect to people, PRoW receptors are scoped out. People’s use of PRoWs is highly transient, and because of this a significant effect would not occur.</p>

## Technical Engagement

- 14.3.5. This Shadow Flicker assessment is a desk-based exercise, and no technical consultation has been undertaken.

## 14.4 Data gathering methodology

### Study Area

- 14.4.1. The Shadow Flicker assessment comprises numerical modelling of the proposed turbines and receptors within the defined Study Area. It is noted that whilst there are a number of computer models

available, the DECC study (2011)<sup>6</sup> confirms that there are limited differences between outputs of the various packages. For Shadow Flicker assessments, one of the industry standard software packages, ReSoft Wind Farm software (version 5) is used.

- 14.4.2. The calculations from this assessment process assume a worst-case scenario based on the sun shining during all daylight hours over the course of a year, no obscuring features (such as trees, hedges, other buildings) being present, the face of the rotor always being aligned towards the dwelling, and that the rotor is always turning (i.e., the wind is always blowing between 4m/s and 25m/s, and no account is taken of shut down periods for maintenance). This methodology yields a theoretical maximum indication of potential Shadow Flicker incidence, together with the times of day, and dates during the year when potential incidence may occur.
- 14.4.3. The software performs calculations to determine the position of the sun throughout the year, and thus during what times of day it will theoretically cast a shadow across the windows of nearby houses within 10 rotor diameters (plus 50m micro-siting). Data input into the model where Shadow Flicker assessment is required is as follows:
- the locations of all properties within ten times the rotor diameter (including an allowance of 50m for micro-siting) and 130 degrees either side of north of any turbine;
  - the surrounding topography (Ordnance Survey Digital Terrain Model); and
  - the locations and dimensions of the turbines.

## Desk Study

- 14.4.4. A summary of the organisations that have supplied data, together with the nature of that data is outlined in **Table 14-4**.

**Table 14-4 Data sources used to inform the Shadow Flicker assessment**

Organisation	Data source	Data provided
Ordnance Survey	Ordnance Survey AddressBase Plus	Residential properties Location in relation to Proposed Development.
Ordnance Survey	OS Terrain 5 <sup>7</sup>	Terrain data
Google	Google Earth Pro 7.3.6.10201 <sup>8</sup>	Aerial imagery

## 14.5 Overall baseline

### Current baseline

- 14.5.1. As outlined in **Section 14.2** and **14.4** it is considered that Shadow Flicker does not have a significant effect at properties located at a distance greater than ten rotor diameters from the wind turbines. The

<sup>6</sup> Department of Energy and Climate Change, (2011). Update of UK Shadow Flicker Evidence Base (online). Available at: [Update of UK Shadow Flicker Evidence Base](#) (Accessed September 2025)

<sup>7</sup> Ordnance Survey (2025). *OS Terrain 50 (Free OS OpenData)*. (online) Available at: <https://osdatahub.os.uk/downloads/open/Terrain50> (Accessed August 2025).

<sup>8</sup> Google (2025). *Google Earth Pro, version 7.3.6.10201*. (online) Available at: <https://www.google.com/earth/about/versions/#download-pro> (Accessed September 2025).

turbines under consideration for development at this Site have rotor diameters of up to 136m, meaning a Study Area of 1,360m. We have also allowed 50m for micro-siting, giving a total Study Area of 1,410m.

- 14.5.2. Properties falling within this Study Area will be assessed with regards to the potential to experience Shadow Flicker. The Study Area is shown in **Figure 14.1**. None of the properties considered currently experience Shadow Flicker from other wind farm developments.

### Future baseline

- 14.5.3. On the basis of the information currently available, no changes to the baseline conditions are anticipated in the event that the Proposed Development does not proceed.

## 14.6 Embedded measures

- 14.6.1. There are no UK guidelines which quantify what exposure levels to Shadow Flicker would be acceptable. Therefore, where particular combinations of circumstances arise that have the potential for nuisance (particularly where rooms affected are in regular occupancy and the effect proves to be a frequent occurrence in reality), measures may be required to reduce the level of exposure to acceptable levels.
- 14.6.2. If Shadow Flicker effects occur in practice at a particular occupied building, it does not immediately follow that additional mitigation is required. Such effects would need to occur in a room that was occupied at the times of occurrence and for a duration that caused a nuisance. For example, if an effect was predicted to occur for a three-week period in the early hours of the morning in a room unlikely to be occupied at that time, with each occurrence lasting just a few minutes, then it is unlikely that mitigation measures would be needed.
- 14.6.3. However, until the turbine locations and technical parameters are precisely defined (following micro-siting and turbine selection through competitive tender activities), and the wind turbines are operating, neither the requirement for, nor the exact details of mitigation can be finalised.
- 14.6.4. The Applicant is committed to installing a Shadow Flicker impact control module prior to operation of turbines which have the potential to cause Shadow Flicker on nearby properties. Therefore if, following a complaint and appropriate investigation, Shadow Flicker is confirmed to result in a loss of residential amenity at any location, the technical mitigation measures built into these turbines would be activated. This covers all properties that could experience Shadow Flicker.
- 14.6.5. The Shadow Flicker control module consists of bespoke software, a clock, a timer, a switch, a wind direction sensor and a light sensor. The module can control a specific turbine (or turbines) which would be programmed to shut down on specific dates at specific times when the sun is bright enough, there is sufficient wind to rotate the blades and the wind direction is such that nuisance Shadow Flicker could occur. There is no specific UK guidance regarding what level of light is sufficient to cause a Shadow Flicker event. However, the actual light level that would trigger a turbine shut down can be manually configured onsite, following installation, to reflect local conditions.
- 14.6.6. A planning condition would provide for an appropriate form of mitigation to ensure that any complaints would be investigated within a reasonable timescale and that the rectification of any Shadow Flicker problem that is substantiated would be implemented promptly and effectively. As noted previously, the DECC guidance (2011)<sup>6</sup> states that “*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”.

- 14.6.7. A range of environmental measures have been embedded into the Proposed Development as outlined in **Section 4.9**. **Table 14-5** outlines how these embedded measures will influence the Shadow Flicker assessment.

**Table 14-5 Summary of the embedded environmental measures**

Receptor	Potential changes and effects	Embedded measures	Compliance mechanism
Operation Residential and/or occupied buildings within the Study Area	Experiencing Shadow Flicker effects	Implementation of a Shadow Flicker control module will reduce effects to an acceptable level	DNS planning condition

## 14.7 Scope of the assessment

- 14.7.1. The approach to Shadow Flicker assessment as set out in **Section 14.8** was outlined in the Scoping Report. It was stated that following determination of the final turbine layout for the Proposed Development, an assessment would be carried out if potential Shadow Flicker receptors were identified.

### Spatial Scope

- 14.7.2. The spatial scope of the assessment of Shadow Flicker covers the area of the Proposed Development contained within the EIA assessment area, together with the Zones of Influence (Zols) that have formed the basis of the Study Area described in **Section 14.8**.

### Temporal Scope

Shadow Flicker is an operational effect of the wind farm and is not present during construction or decommissioning. Therefore, the temporal scope of the assessment of Shadow Flicker is consistent with the period over which the development would be carried out and therefore covers the operational period of the wind farm.

### Potential Receptors

- 14.7.3. The Shadow Flicker receptors that have been identified as being potentially subject to effects are summarised in **Table 14-6**. Receptor sensitivity is provided in Table 14-7.

**Table 14-6 Shadow Flicker receptors**

Reference <sup>1</sup>	Receptor Name	Easting	Northing
1	RHYSWG FAWR FARM, RHYSWG FARM LANE	322662	194602

Reference <sup>1</sup>	Receptor Name	Easting	Northing
2	TYN Y FFYNON, CWMCARN FOREST DRIVE	324646	193999
3	BWTHYN MAMGU, RHYSWG FARM LANE	322624	194632
4	TRI CARREG, RHYSWG FARM LANE	322653	194555
5	27, RHYSWG ROAD	321695	194569
6	1 PENRHIWGWAIR COTTAGES, TWIN ROAD	322250	195399
7	75, COMMERCIAL ROAD	321759	194088
8	77, COMMERCIAL ROAD	321767	194060
9	PENRHIWGWAIR FARM, ABERCARN MOUNTAIN ROAD	322346	195467
10	CEFN RHYSWG FARM, RHYSWG FARM LANE	322389	194505
11	STABAL TO CARREG, RHYSWG FARM LANE	322676	194579
12	42, RHYSWG ROAD	321750	194387
13	BEECHWOOD HOUSE, THE GRAIG	322735	193846

Reference <sup>1</sup>	Receptor Name	Easting	Northing
14	GLAN-SHON FARM, GLAN-SHON FARM LANE	322467	195970
15	CEMETERY HOUSE, CEMETERY ROAD	322156	195602
16	26, CLYTHA SQUARE	322245	195262
17	HILLSIDE, THE GRAIG	322642	193957
18	48, LLANFACH ROAD	322102	195159
19	GRAIGWEN BUNGALOW, GWYDDON ROAD	322502	195263
20	1 GRAIG WEN HOUSES, GWYDDON ROAD	322442	195234
21	2 GRAIG WEN HOUSES, GWYDDON ROAD	322431	195235
22	FORESTERS HOUSE, GWYDDON ROAD	322466	195249
24	ROXBURGH BUNGALOW, ABERCARN MOUNTAIN ROAD	322406	195545
25	3 GRAIG WEN HOUSES, GWYDDON ROAD	322408	195219

Reference <sup>1</sup>	Receptor Name	Easting	Northing
26	68, GWYDDON ROAD	322097	195013
27	6 GRAIG WEN HOUSES, GWYDDON ROAD	322369	195197
28	5 GRAIG WEN HOUSES, GWYDDON ROAD	322379	195201
29	4 GRAIG WEN HOUSES, GWYDDON ROAD	322398	195218

<sup>1</sup> Note that receptor 13 was excluded from the assessment as it represents a property that is not occupied / is not a residential property.

**Table 14-7 Shadow Flicker receptors subject to potential effects**

Receptor	Reason for consideration
Residential receptors	Considered of high sensitivity with respect to Shadow Flicker

14.7.4. The residential receptors considered further in this assessment are detailed in Error! Reference source not found. and illustrated in **Figures 14.1** and **14.2**.

### Likely significant effects

14.7.5. Shadow Flicker is a potential operational effect of the Proposed Development (with no effects during construction or decommissioning).

#### Photo Sensitive Epilepsy

14.7.6. Research has been carried out to determine whether Shadow Flicker from wind turbines can cause seizures in photo-sensitive epilepsy sufferers<sup>9</sup>. Sufferers are usually sensitive to flickering light at frequencies from 3Hz–30Hz. For a typical 3-blade, 45m rotor diameter wind turbine the maximum rotational speed will be less than 20 revolutions per minute so the blade passing frequency is 60rpm, or 1Hz; this is well below the 3Hz–30Hz sensitivity range.

14.7.7. The proposed turbines will operate at varying speeds, up to 15 RPM. As the turbine rotors will have three blades, each blade will pass a particular point no more than 45 times a minute, which equates to a maximum frequency of 0.75 Hertz. This is much lower than the 3-30 Hertz frequency range generally thought to risk triggering photo-sensitive epilepsy. It is also noted in the DECC Report (2011) that *“on health effects and nuisance of the Shadow licker effect, it is considered that the*

<sup>9</sup> Harding G, Harding P, and Wilkins A, (2008): Wind turbine, flicker, and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them. (online) Available at: <https://onlinelibrary.wiley.com/doi/10.1111/j.1528-1167.2008.01563.x> (Accessed September 2025).

*frequency of the flickering caused by the wind turbine rotation is such that it should not cause a significant risk to health”.*

14.7.8. Therefore photo-sensitive epilepsy is not considered further in this assessment.

## 14.8 Assessment methodology

- 14.8.1. The generic project-wide approach to the assessment methodology is set out in **Chapter 2: Approach to Environmental Impact Assessment**, and specifically in Section **2.5 to 2.8**. However, whilst this has informed the approach that has been used in this Shadow Flicker assessment, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of this Shadow Flicker assessment.
- 14.8.2. The assessment approach recommended within both national and local planning guidance – recognised as industry best practice - is for the assessment of Shadow Flicker effects to be carried out at properties within 130 degrees either side of north and 10 rotor diameter distance from the nearest property. It is considered that this approach is appropriate and proportionate based on the national guidance defined significance thresholds as discussed in the next section, of greater than 30 minutes a day or greater than 30 hours per year at the affected receptors, fall well within the 10-rotor diameter distance. A Study area of 1,410m from each turbine has therefore been adopted for the Shadow Flicker assessment in order to include land within 10 times the maximum rotor diameter (based on a 136m rotor diameter in line with the worst-case access study scenario) plus a 50m micro-siting allowance.

### Significance evaluation methodology

- 14.8.3. Whilst the time and duration of Shadow Flicker events can be predicted accurately, the level of the effect is difficult to quantify as this would depend on the location of windows within a property, the use of the rooms affected, the level of shading surrounding the property and how susceptible the receptor is to light flicker.
- 14.8.4. As confirmed by the DECC study (2011)<sup>Error! Bookmark not defined.</sup>, there is no standard UK or Welsh guidance relating to a limit for Shadow Flicker. The DECC study also reviewed international legislation relating to the assessment of Shadow Flicker and concluded that the area within 130 degrees either side of north from the turbine, and out to 10 rotor diameters, is considered acceptable for Shadow Flicker assessment. The only guidance providing additional recommendations is the Northern Irish PPS 18 (2009) guidance which recommends that for properties within 500m of the turbines, Shadow Flicker should not exceed 30 hours per year or 30 minutes per day.
- 14.8.5. For the purpose of this assessment, once the effect of theoretical Shadow Flicker has been modelled, the approach to establishing the magnitude of change is based on professional judgement.
- 14.8.6. Significance is typically defined as a function of the sensitivity of a receptor with the magnitude of change. In this case the sensitivity of the receptor (an occupied building) is considered to be high and as such significance will be defined largely as a function of the magnitude of change. A methodology for the establishment of the magnitude of change has therefore been derived based on professional experience and is presented in **Table 14-8**. This is based on the distance of the property from the turbine location along with the number of predicted hours of Shadow Flicker effect.

**Table 14-8 Scoring Methodology for Magnitude of Change**

Magnitude of Change	Distance from Turbine	And / Or	Predicted Shadow Flicker Effect Duration
High	<500m		>30 minutes a day or >30 hours per year.
Medium	500 – 700m		>30 minutes a day or >30 hours per year.
Low	700m – 1,410m		<30 minutes a day or <30 hours per year.
No Change	>1,410m		No Shadow Flicker effect predicted.

14.8.7. The EIA Regulations require that a final judgement is made about whether or not each effect is likely to be significant. In this assessment, effects are considered to be significant or not significant according to the matrix in **Table 14-9**. Effects are rated as being either major or moderate (significant) where the magnitude of change is high or medium, or minor or negligible (not significant) where magnitude of change is low, or no change.

**Table 14-9 Matrix of EIA Significance**

Sensitivity	Magnitude of change			
	High	Medium	Low	No change
High	Major (Significant)	Moderate (Significant)	Minor (Not Significant)	Negligible (Not significant)

## Factors limiting the occurrence of Shadow Flicker

- 14.8.8. There are several additional factors that can influence the amount of Shadow Flicker actually experienced and these cannot be readily included in a computer-based assessment.
- 14.8.9. Climatic conditions dictate that the sun is not always shining. The closest Met Office location providing long term climate summaries is Tredegar, located some 8km from the Site.
- 14.8.10. Historic Met Office data (over the period 1991–2020) gives actual sunshine hours for the Tredegar Met Station to be 32% of total daylight hours<sup>10</sup>. Cloud cover during other times may obscure the sun and prevent Shadow Flicker occurrence. While some shadows may be cast under slightly overcast conditions, no shadow at all would be cast when heavy cloud cover prevails. During calm periods, or very high winds, the wind turbine blades would not rotate and Shadow Flicker would not occur. Turbines would also be periodically shut-down for maintenance or repair work.
- 14.8.11. Wind turbines automatically orientate themselves to face the prevailing wind direction. This means that the turbine rotors would not always face directly towards the occupied buildings. Under some wind conditions, the proposed turbines would face ‘side-on’ to properties, and in these conditions only a very small area of blade movement would be visible.

<sup>10</sup> Met Office (2025). UK Climate Averages: Blaenau Gwent. (online) Available at: <https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcivww0udy>  
Average sunshine hours of 1422 / Total number of daylight hours 4380 = 32% (Accessed September 2025)

## 14.9 Preliminary assessment of Shadow Flicker effects

### Predicted effects: operation

14.9.1. **Figure 14.2** shows a contour map representing the annual number of hours of potential Shadow Flicker effects on the occupied buildings included in the assessment.

14.9.2. **Table 14-10** below shows the number of days per year that each occupied building could be affected by Shadow Flicker. It also shows the maximum number of hours per day, the mean number of hours per day and the total number of hours per year that Shadow Flicker could occur. The likely number of hours per year when Shadow Flicker could occur has been calculated using Met Office records of the number of annual sunshine hours per year at Tredegar. Individual results for each receptor are provided in **Appendix 14A**.

**Table 14-10 Shadow Flicker Model Results**

ID <sup>2</sup>	Days / Year	Turbine(s) causing Shadow Flicker	Distance to nearest turbine (m)	Mean no. of minutes / day	Theoretical max hours / year	Likely hours / year <sup>1</sup>	Magnitude of change	Significance
1	158	1, 2, 3	345	77.4	204	65.3	High	<b>Major (Significant)</b>
2	0	-	962	0	0	0.0	No change	Negligible (Not significant)
3	179	1, 2, 3	378	69	206	65.9	High	<b>Major (Significant)</b>
4	126	1, 2, 3	367	67.8	141.8	45.4	High	<b>Major (Significant)</b>
5	0	-	1,309	0.0	0	0.0	No change	Negligible (Not significant)
6	48	1	1,042	25.2	20.1	6.4	Low	Minor (Not Significant)
7	0	-	1,372	0	0	0.0	No change	Negligible (Not significant)
8	0	-	1,377	0	0	0.0	No change	Negligible (Not significant)
9	58	1	1,027	25.8	25	8.0	Low	Minor (Not Significant)
10	121	1	634	41.4	83.2	26.6	Medium	<b>Moderate (Significant)</b>
11	139	1, 2, 3	337	73.8	170.9	54.7	High	<b>Major (Significant)</b>
12	0	-	1,282	0	0	0.0	No change	Negligible (Not significant)
13	0	-	870	0	0	0.0	No change	Negligible (Not significant)
14	0	-	1,400	0	0	0.0	No change	Negligible (Not significant)

ID <sup>2</sup>	Days / Year	Turbine(s) causing Shadow Flicker	Distance to nearest turbine (m)	Mean no. of minutes / day	Theoretical max hours / year	Likely hours / year <sup>1</sup>	Magnitude of change	Significance
15	34	1	1,253	20.4	11.7	3.7	Low	Minor (Not Significant)
16	45	1	956	27.6	20.5	6.6	Low	Minor (Not Significant)
17	0	-	802	0	0	0.0	No change	Negligible (Not significant)
18	41	1	1,020	25.2	17.1	5.5	Low	Minor (Not Significant)
19	90	1, 2	770	27.6	41.3	13.2	Medium	<b>Moderate (Significant)</b>
20	85	1, 2	789	27	38	12.2	Medium	<b>Moderate (Significant)</b>
21	84	1, 2	798	27	37.6	12.0	Medium	<b>Moderate (Significant)</b>
22	87	1, 2	783	27	39.3	12.6	Medium	<b>Moderate (Significant)</b>
24	89	1	1,053	26.4	39.3	12.6	Medium	<b>Moderate (Significant)</b>
25	82	1, 2	803	26.4	36.3	11.6	Medium	<b>Moderate (Significant)</b>
26	32	1	964	26.4	14.2	4.5	Low	Minor (Not Significant)
27	80	1, 2	818	25.8	34.5	11.0	Medium	<b>Moderate (Significant)</b>
28	81	1, 2	813	25.8	34.9	11.2	Medium	<b>Moderate (Significant)</b>
29	82	1, 2	810	26.4	35.9	11.5	Medium	<b>Moderate (Significant)</b>

<sup>1</sup> Based on average sunshine hours at the site, 32% of daylight hours.

<sup>2</sup> Note that receptor 23 was excluded from the assessment as it represents a property that is not occupied / is not a residential property.

- 14.9.3. The approach taken to the modelling assessment is theoretical and based on the worst-case scenario in that it assumes each property is occupied, that there are windows or doors facing the wind turbines, that there are no intervening obstructions, that the sun shines throughout daylight hours, that the wind blows constantly within the operating parameters of the wind turbines and that the rotor is always orientated towards the receptor.
- 14.9.4. The results show that all three proposed turbines the potential to cause Shadow Flicker effects.
- 14.9.5. Examination of the detailed results of the model found in **Appendix 14A** shows that receptors 2, 5, 7, 8, 12, 13, 14 and 17 would not experience any Shadow Flicker as a result of the Proposed Development. The remaining 20 receptors could experience between 11.7 and 206 hours of Shadow Flicker per year, based on the worst-case model.
- 14.9.6. If average annual sunshine hours are applied to the model, then all currently occupied buildings are likely to experience Shadow Flicker for no more than 65.9 hours per annum.
- 14.9.7. Receptor assessed as having potentially moderate to major significance impacts from Shadow Flicker could require mitigation measures to be applied. As stated in **Section 14.6**, the Applicant is committed to installing a Shadow Flicker control module where required. This module can control a specific turbine (or turbines) which would be programmed to shut down on specific dates at specific

times when the sun is bright enough, there is sufficient wind to rotate the blades, and the wind direction is such that nuisance Shadow Flicker could occur. The effects are therefore concluded as not significant once this mitigation is taken into consideration.

## Predicted effects and their significance

14.9.8. A summary of the results of the assessment of Shadow Flicker is provided in **Table 14-11**.

**Table 14-11 Summary of significance of adverse effects**

Receptor and summary of predicted effects	Sensitivity of receptor <sup>1</sup>	Magnitude of change <sup>2</sup>	Significance <sup>3</sup>	Summary rationale
Shadow Flicker effects on residential property: four occupied buildings	High	High	Major (Significant, and following mitigation not significant)	Although, according to Table 14-10 any Shadow Flicker effects would be investigated and fully mitigated through a Shadow Flicker control module in turbines. No significant effects would therefore arise.
Shadow Flicker effects on residential property: ten occupied buildings	High	Medium	Moderate (Significant, and following mitigation not significant)	Although, according to Table 14-10, any Shadow Flicker effects would be investigated and fully mitigated through a Shadow Flicker control module in turbines. No significant effects would therefore arise.
Shadow Flicker effects on residential property: six occupied buildings	High	Low	Minor (Not significant)	Modelling has shown that significant effects are considered unlikely. Any Shadow Flicker effects would be fully mitigated through a Shadow Flicker control module in turbines.
Shadow Flicker effects on residential property: eight occupied buildings	High	No change	Negligible (Not significant)	

1. The sensitivity of a receptor is defined using the criteria set out in **Section 14.8** above and is defined as high;
2. The magnitude of change on a receptor resulting from activities relating to the development is defined using the criteria set out in **Section 14.8** above and is defined as no change, low, medium and high;
3. The significance of the environmental effects is based on the combination of the sensitivity/importance/value of a receptor and the magnitude of change and is expressed as major (significant), moderate (significant) or minor/negligible (not significant), subject to the evaluation methodology outlined in **Section 14.8**.

## 14.10 Preliminary assessment of cumulative (inter-project) effects

- 14.10.1. A preliminary cumulative effects assessment (CEA) has been undertaken for the Proposed Development which considers the combined impacts with other developments on the same single receptor or resource (inter-project effects). The detailed method followed in identifying and assessing potential cumulative effects is set out in **Section 2.9** of **Chapter 2**.
- 14.10.2. Due to their location and distance from the Proposed Development, and as Shadow Flicker effects would be mitigated via control modules on turbines as appropriate, and no significant effects are concluded as a result of the Proposed Development, no cumulative effects are expected in combination with other wind farm developments.

## 14.11 Preliminary Significance conclusions

- 14.11.1. A summary of the results of the Shadow Flicker assessment is provided in **Table 14-10**.
- 14.11.2. The assessment has identified the potential for significant Shadow Flicker effects at 14 occupied buildings, and non-significant effects at 14 occupied buildings. Mitigation has been identified in the form of a control system which automatically shuts down the wind turbine causing the effect to restrict effects to less than 30 minutes per day and / or 30 hours per year at any property.
- 14.11.3. With this measure in place no significant effects from Shadow Flicker would arise as a result of the Proposed Development.
- 14.11.4. A programme of monitoring would ensure the effectiveness of the proposed mitigation and allow for it to be adapted, e.g., to cater for turbine micro siting issues.