

13. Shadow Flicker

13.1 Introduction

- 13.1.1 Consideration has been given at scoping stage to the potential for shadow flicker effects associated with the Proposed Development. This consideration has been undertaken in accordance with the Environmental Impact Assessment requirements applicable to Significant Infrastructure Projects under the Infrastructure (Wales) Act 2024, as set out in the Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017 (as amended) (Senedd Cymru, 2024) (Welsh Ministers, 2017).
- 13.1.2 Shadow flicker is a phenomenon that may occur when rotating wind turbine blades cast moving shadows over neighbouring receptors under specific combinations of sun position, turbine geometry and receptor location. This chapter of the Scoping Report sets out the legislative context, baseline considerations and scoping rationale for shadow flicker and establishes whether a standalone assessment is required within the Environmental Statement.

13.2 Legislation, Policy and Guidance

- 13.2.1 Planning policy in Wales relevant to shadow flicker effects associated with the Proposed Development is set out in Future Wales: The National Plan 2040 (Welsh Government, 2021) and Planning Policy Wales (PPW) Edition 12 (Welsh Government, 2024). These documents require that proposals for renewable energy development demonstrate that there would be no unacceptable adverse effects on local communities, including impacts on residential amenity. In particular, Future Wales requires that proposals ensure that effects such as shadow flicker do not result in unacceptable impacts on sensitive receptors, whilst PPW requires that development safeguards the health, well-being and quality of life of existing and future occupants.
- 13.2.2 In this context, the Applicant is required to identify and assess the potential for shadow flicker effects as part of the broader Environmental Impact Assessment (EIA) undertaken in support of an application for Infrastructure Consent under the Infrastructure (Wales) Act 2024 (Senedd Cymru, 2024). The EIA Regulations (Wales) require consideration of likely significant effects on population and human health, and therefore provide the statutory basis for the assessment of shadow flicker effects. Within Wales there is no prescribed methodology or defined threshold for assessing shadow flicker effects. Accordingly, the assessment of shadow flicker is informed by established UK good practice and relevant guidance documents. These include the Update of UK Shadow Flicker Evidence Base (Department of Energy and Climate Change (DECC), 2011) and other professional guidance which collectively set out commonly accepted methods for identifying whether shadow flicker could occur. These approaches consider factors such as the distance between turbines and receptors, the relative orientation of receptors to turbine locations, turbine

dimensions, and the path of the sun. Such guidance is widely applied within Welsh EIA practice to determine whether shadow flicker has the potential to give rise to likely significant effects and whether further detailed assessment is required. In the absence of Wales-specific thresholds, reference may also be made to guidance from other UK jurisdictions as a comparator. For example, the Best Practice Guidance to Planning Policy Statement (PPS) 18 Renewable Energy (Northern Ireland Department of the Environment, 2009) suggests that shadow flicker at neighbouring dwellings within 500 m should not exceed 30 hours per year or 30 minutes per day. While this guidance does not form part of the Welsh planning policy framework, it provides a useful benchmark for understanding the scale of effects that may be considered acceptable in a UK context.

- 13.2.3 Shadow flicker effects can only arise under a defined and limited set of conditions, relating to the proximity, orientation and use of nearby receptors in relation to turbine locations. Where these conditions are not met, established UK good practice confirms that shadow flicker does not have the potential to give rise to likely significant environmental effects and does not require further consideration within the EIA. Having regard to the separation distances between the proposed turbines and nearby residential receptors, the relative orientation of those receptors, and the intervening topography and screening, the conditions necessary for shadow flicker to occur are not present. It is therefore concluded that shadow flicker effects can be appropriately scoped out of the EIA, and no further assessment is required within the Environmental Statement.

13.3 Study Area

- 13.3.1 The study area for shadow flicker consideration is defined by the distance and geometric conditions within which shadow flicker could theoretically occur. At scoping stage, this is typically limited to residential receptors located within a distance of ten times the rotor diameter of a turbine and where the relative orientation of the turbine, receptor and sun path means shadow flicker is possible. This includes consideration of turbine height and rotor diameter, the bearing between turbines and receptors, the seasonal and daily path of the sun, and local topography that may obstruct or prevent shadow flicker from occurring.
- 13.3.2 For the purposes of this Scoping Report, the consideration of shadow flicker has focused on nearby residential properties in the vicinity of the Proposed Development that could plausibly be affected, having regard to distance, relative orientation to turbine locations, sun path, local topography and land. This approach reflects commonly applied shadow flicker screening criteria used to identify receptors with a realistic potential to experience effects.

13.4 Methodology

- 13.4.1 A qualitative, scoping-level review has been undertaken to determine whether the Proposed Development has the potential to give rise to significant shadow flicker effects.

- 13.4.2 The review has considered the location of turbines relative to nearby residential receptors, the surrounding topography and landform, and the presence of intervening screening such as woodland or built features, together with the geometric and directional conditions under which shadow flicker could occur. In applying commonly used UK shadow flicker occurrence thresholds as stated by the Northern Ireland Department of the Environment Planning Policy 18 ‘Renewable Energy’ guidance (30 hours per year or 30 minutes per day) (Northern Ireland Department of the Environment, 2009), allowance has also been made for turbine micro-siting to ensure that the screening of receptors remains robust at scoping stage.
- 13.4.3 In addition to the identification of receptors with a theoretical potential to experience shadow flicker under a worst-case scenario, it is necessary to consider the realistic occurrence of sunshine, as shadow flicker can only arise when direct sunlight is present. Accordingly, a sunshine correction factor is applied within the assessment using representative meteorological data obtained from the Met Office (Met Office, 2026) for the local area. UK-wide evidence indicates that direct sunshine typically occurs for approximately 30% of total daylight hours on average. This factor is therefore applied to refine the worst-case (astronomical maximum) shadow flicker predictions to derive a more realistic estimate of likely exposure at receptors. The application of this approach is consistent with established UK good practice, which distinguishes between theoretical maximum and meteorologically adjusted shadow flicker effects, thereby ensuring that the assessment reflects realistic environmental conditions.
- 13.4.4 Where initial screening identifies that a limited number of receptors may have the potential to experience shadow flicker effects, but that any such effects are likely to be limited in extent and duration, a standalone quantitative assessment within the Environmental Statement is not considered necessary at this stage. In this instance, receptors have been identified using the current maximum layout as having the potential to be subject to shadow flicker effects. Should further assessment of these receptors be required, this can be appropriately undertaken within the Other Environmental Effects chapter, where potential effects on receptors can be considered holistically alongside other environmental impacts.

13.5 Baseline Context

- 13.5.1 The Proposed Development is located in a rural area characterised by a dispersed pattern of residential receptors and undulating upland topography. The relationship between turbine locations and nearby residential properties is such that opportunities for shadow flicker to occur are limited.
- 13.5.2 Existing landform and vegetation provide a degree of natural screening between turbines and surrounding receptors, further reducing the potential for shadow flicker effects.

13.6 Consideration of Potential Shadow Flicker Effects

Construction

13.6.1 Shadow flicker effects do not arise during construction.

Operation

13.6.2 Shadow flicker effects, where they occur, are limited to specific times of day and year and are dependent on precise geometric conditions. Based on the preliminary screening undertaken, the Proposed Development is not expected to give rise to significant shadow flicker effects at nearby residential receptors as set out further in section 13.7.

Decommissioning

13.6.3 Shadow flicker effects do not arise during decommissioning.

13.7 Scoping Assessment

13.7.1 On the basis of the scoping-level review, the Proposed Development is not expected to give rise to significant shadow flicker effects, although a small number of receptors have been identified with a theoretical potential for limited effects.

13.7.2 The spatial relationship between turbines and nearby residential receptors, combined with local topography and screening, indicates that any potential shadow flicker effects would be limited in extent and duration.

13.7.3 In the unlikely event that minor shadow flicker effects were identified at a later stage, these would be capable of being addressed through turbine design parameters or operational controls rather than through EIA mitigation.

13.7.4 The shadow flicker screening has been undertaken on a precautionary basis using a maximum layout and identified residential receptors. Residential receptors have been screened where located within 10 rotor diameters of any turbine plus micro-siting tolerance, consistent with standard UK shadow flicker practice. Research by Clarke demonstrated that shadow flicker only occurs inside buildings when flicker appears through a narrow opening, particularly if the window is the sole source of light. As a general principle, the residential property must also be within ten rotor diameters of the wind turbine, and in Britain properties must lie within 130 degrees either side of north, relative to the wind turbines (Clark, 2001). For the Proposed Development, this equates to a screening distance of 1,680 m (10×163 m maximum rotor diameter + 50m micro-siting). The screening also takes account of the geometric and directional conditions necessary for shadow flicker to occur (turbine–sun–receptor alignment and sun path) and the potential for local topography and intervening screening (e.g. woodland and built features) to obstruct shadow flicker.

13.7.5 An allowance for turbine micro-siting has been factored into the screening exercise of 50m. The use of the maximum layout provides a conservative basis at scoping stage, and the

screening distance has been applied such that small positional changes to turbine locations would not materially alter the identification of receptors requiring further consideration.

- 13.7.6 For receptors screened in, the potential for significant shadow flicker effects is typically judged by reference to commonly applied UK occurrence thresholds of 30 hours per year and/or 30 minutes per day under a worst-case scenario. These thresholds provide a recognised basis for identifying where shadow flicker could give rise to a likely significant effect at a residential receptor, although they do not form part of Welsh planning policy.
- 13.7.7 Shadow flicker effects are only capable of occurring where a receptor lies within a defined geographical relationship to a turbine, governed primarily by the position of the sun. Established UK good practice identifies that shadow flicker may only occur where receptors are located within approximately 130 degrees either side of north relative to a turbine. This reflects the fact that shadow flicker can only arise when the sun is positioned behind the turbine from the perspective of the receptor, which in the UK occurs when the sun is shining from the southern half of the sky. Receptors located outside this zone will not experience shadow flicker, as the turbine cannot physically cast a moving shadow towards them. Accordingly, where receptors fall outside the 130-degree sector, it can be reasonably concluded, in accordance with established guidance, that they are not susceptible to shadow flicker effects and can be excluded from further assessment (Department of Energy and Climate Change (DECC), 2011) (Northern Ireland Department of the Environment, 2009).
- 13.7.8 The initial screening indicates that there are residential receptors located within 1,680 m of one or more turbines in the maximum layout and therefore have a theoretical potential to experience shadow flicker, subject to the geometric conditions described above and the presence of screening. The remaining residential receptors lie beyond the 10 rotor diameter and micrositing screening distance and are not considered likely to experience shadow flicker effects.
- 13.7.9 On this basis, and given the limited number of receptors screened in and the role of topography/screening in reducing potential effects, shadow flicker effects are proposed to be scoped out of the Environmental Statement as a standalone topic. Should consultees request, a proportionate confirmation assessment of the screened-in receptors can be undertaken within the Other Environmental Effects chapter to demonstrate whether the occurrence thresholds could be exceeded.

Table 13.1 - Matters to be scoped out of the assessment

Matters to be scoped out of the assessment	
Matter	Rationale
Construction phase effects	Shadow flicker does not occur during construction
Operational shadow flicker	Preliminary screening indicates potential effects to receptors
Decommissioning	Shadow flicker does not occur during decommissioning

phase effects	
Cumulative shadow flicker	No evidence of cumulative effects requiring assessment, including in combination with other operational or consented wind farms.

13.8 Summary of Scoping position

- 13.8.1 The Proposed Development is not expected to result in significant shadow flicker effects. Shadow flicker is therefore proposed to be scoped out of the Environmental Statement as a standalone topic.
- 13.8.2 The potential for shadow flicker effects has been considered at scoping stage with reference to the spatial relationship between the maximum turbine layout and nearby residential receptors. Three residential properties are located within the shadow flicker screening distance of 10 rotor diameters (1,630 m) from one or more turbines. The closest of these is Nant y Maen Farm, which lies within the Order Limits, with one additional property located on the eastern boundary of the site and one to the south.
- 13.8.3 The screening has taken account of distance, relative orientation between turbines and receptors, local topography and landform, and the presence of intervening screening such as woodland or built features, together with an allowance for turbine micro-siting. On the basis of this screening, and applying commonly used UK shadow flicker occurrence thresholds, the potential for shadow flicker effects to give rise to a likely significant effect is considered limited. Shadow flicker is therefore proposed to be scoped out of the Environmental Statement.
- 13.8.4 Notwithstanding this position, should the Welsh Ministers consider that further confirmation is required, a proportionate shadow flicker assessment for the three screened-in residential properties can be undertaken at Environmental Statement stage to demonstrate whether the commonly applied occurrence thresholds could be exceeded.

13.9 References

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