17 Shadow Flicker

17. Shadow Flicker

17.1. Summary

Table 17.1 – Summary of Conclusions – Proposed Varied Development and Consented Development

2018 Section 36 Application, supported by Additional Environmental Information I (2019) and Additional Environmental Information II (2021) - the Consented Development	2026 Section 36C Application - the Proposed Varied Development
The 2018 Environmental Impact Assessment (EIA) and Additional Environmental Information I conclude that no shadow flicker effects will occur during construction or decommissioning.	The assessment of the Proposed Varied Development also concludes that no shadow flicker effects will occur during construction or decommissioning.
The 2018 EIA and Additional Environmental Information identified two shadow flicker receptors within the assessment study area: Craigengillan and Craigengillan Cottage. The 2018 EIA and Additional Environmental Information I conclude that with mitigation, all shadow flicker effects are assessed as not significant.	This assessment identifies an additional four receptors above the two considered in the Consented Development's shadow flicker assessment: Moorbrock, Gamekeeper's Cottage, Smittons and Furmiston. This is due to a larger shadow flicker study area for the Proposed Varied Development as the proposed rotor diameter is larger. This assessment also concludes that with mitigation, all shadow flicker effects are assessed as not significant.
The 2018 EIA and Additional Environmental Information I found that no receptors were found within the shadow flicker study area of nearby wind farm developments. Therefore, cumulative effects were not considered further.	This assessment also established that no receptors were found within the shadow flicker study area of nearby wind farm developments. Therefore, cumulative effects have not been considered further.
Additional Environmental Information II does not consider shadow flicker other than scoping it out of when considering turbine delivery and effects associated with the Lorg Grid Connection.	The Lorg Grid Connection is scoped out of the shadow flicker cumulative assessment for the Proposed Varied Development as it remains that there is no potential for shadow flickers effects associated with this development.

17.2. Introduction

17.2.1. This Chapter reports the likely significant effects of the Proposed Varied Development in terms of shadow flicker in the context of the site and surrounding area.

17.2.2. This Chapter (and its associated figures and appendices) is not intended to be read as a standalone assessment, and reference should be made to the description of the Proposed Varied Development in **Chapter 4: Description of Proposed Varied Development**.

17.2.3. The Scottish Government Onshore Wind Turbines: Planning Advice (2014)[1] states Shadow flicker occurs when, *"Under certain combinations of geographical position, time of day and time of year, the sun may pass behind the rotor and cast a shadow over neighbouring properties. When the blades rotate, the shadow flicks on and off; the effect is known as "shadow flicker". It occurs only within buildings where the flicker appears through a narrow window opening".*

17.2.4. Any receptors which may potentially be affected have been identified and the potential occurrence of shadow flicker has been calculated.

17.2.5. The magnitude of shadow flicker effects varies both spatially and temporally, and depends on a number of environmental conditions coinciding at a particular point in time, which include:

- time of day and year;
- wind direction;
- height of wind turbine and blade length;
- position of the sun in the sky;
- weather conditions;
- proportion of daylight hours in which the turbines operate;
- type and frequency of use of the affected space; and
- distance and direction of the wind turbine from the receptor.

17.2.6. The flickering effect caused by shadow flicker also has the potential to induce epileptic seizures in people with photosensitive epilepsy. The Epilepsy Society advises that around 1 in 100 people have epilepsy and up to 5 % of these have photosensitive epilepsy (Epilepsy Society, 2024). The common rate or frequency at which photosensitive epilepsy might be triggered is between 3 and 30 hertz (Hz, flashes per second). Large commercial turbines rotate at low speeds resulting in less than 3 flashes per second and are therefore unlikely to cause epileptic seizures (Harding et al., 2008: Smedley et al., 2010). Therefore,

[1] This guidance has been formally withdrawn, however remains a useful reference.

there are not considered to be any health effects associated with the Proposed Varied Development and this assessment will address the effects of shadow flicker related only to local amenity.

17.2.7. Turbines can also cause flashes of reflected light, which can be visible for some distance. It is possible to ameliorate the flashing, but it is not possible to eliminate it. Careful choice of blade colour and surface finish can help reduce the effect and all modern turbine manufacturers use light grey semi-matt finishes to reduce this effect.

17.2.8. A wind development of more than one turbine can also result in more than one turbine affecting a specific receptor at any time, potentially increasing the overall shadow flicker intensity or frequency. This potential effect has been taken into account within this assessment.

17.2.9. This Chapter is supported by the following figures and technical appendices:

- **Figure 17.1**: Shadow Flicker Study Area;
- **Figure 17.2**: Shadow Flicker Results (Realistic Scenario);
- **Figure 17.3**: Cumulative Shadow Flicker Study Area;
- **Appendix 17.1**: Shadow Flicker Meteorological Data; and
- **Appendix 17.2**: Potential Shadow Periods.

17.3. Legislation, Policy and Guidelines

Legislation

17.3.1. There is no applicable legislation setting out any relevant rules or requirements for the assessment or control of shadow flicker.

Policy

17.3.2. This assessment has taken into consideration the policies contained in the National Planning Framework 4 (NPF4) (Scottish Government, 2023) and Dumfries and Galloway Council Local Development Plan 2 (2019). **Chapter 5: Planning and Energy Policy Context** of the EIA Report sets out the planning policy framework that is relevant to the EIA.

17.3.3. Particularly, Policy 11 part (e)i. of NPF4 (2023) states that any potential impacts on communities from shadow flicker must be addressed by the development. This is further noted within Dumfries and Galloway Local Development Plan 2 policy IN1: Renewable Energy and Policy IN2: Wind Energy.

Guidance

17.3.4. The update of UK Shadow Flicker Evidence Base (DECC, 2011) reviews international legislation relating to the assessment of shadow flicker for wind turbine development and concludes 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 Department of Energy and Climate Change (DECC) study also concluded that there have not been extensive issues with shadow flicker in the UK and, in circumstances where the potential for significant shadow flicker issues effects have been identified, these have been resolved using standard mitigation.

17.3.5. This assessment also takes into consideration the Scottish Government Onshore Renewables Planning Advice: Onshore Wind Turbines (Scottish Government, 2014)[2] which states *"where separation is provided between wind turbines and nearby dwellings (as a general rule, 10 rotor diameters), 'shadow flicker' should not be a problem*".

17.4. Assessment Methodology and Significance Criteria

Study Area

17.4.1. The Study Area is shown in **Figure 17.1,** and the shadow flicker assessment has been carried out for the proposed 11 turbines at the locations identified in **Chapter 4**. The final turbine model has not been selected, and this will be based on the most advanced technology available at the time. The assessment is based on the candidate turbine which is a Nordex N163. Dimensions of the candidate turbine model used for the purposes of the shadow flicker assessment can be found in **Table 17.2.**

Table 17.2 – Details of the Turbine Model Used for the Shadow Flicker Assessment

Tip Height	220 metres (m)
Hub Height	138.5 m
Rotor Diameter	163 m

17.4.2. The Study Area within which receptors could potentially be affected by shadow flicker has been set at a distance of 10 rotor diameters from each turbine and 130 degrees either side of north (relative to each turbine), as noted within the DECC report (DECC, 2011). In this assessment, the Study Area extends to 1.63 kilometres (km) from each turbine. **Figure 17.1** shows the extent of this area and those receptors that could potentially be affected by shadow flicker.

[2] This guidance has been formally withdrawn, however remains a useful reference; no subsequent guidance has been published by the Scottish Government to indicate any change to the relevant study area to be considered for shadow flicker assessment.

Desk Study

17.4.3. The desk study assessment identified six residential receptors within the Study Area (shown in **Figure 17.1**). **Table 17.3** summarises the locations of the receptors and the distance from each property to the nearest turbine.

Table 17.3 – Receptor Locations

ID	Property	X-Coordinate	Y-Coordinate	Approximate Distance to Nearest Turbine (m)	Closest Turbine
A	Moorbrock	262939	596654	973	1
B	Gamekeeper's Cottage	263020	596495	889	2
C	Craigengillan Cottage	263635	594934	887	4
D	Craigengillan	263696	594824	970	4
E	Smittons	263317	591700	1,248	9
F	Furmiston	260305	592291	1,258	10

17.5. Assessment of Potential Effect Significance

17.5.1. There are no UK statutory provisions setting out acceptable levels of shadow flicker. The DECC 2011 report identifies best practice guidelines across Europe, and this assessment will adopt the generally accepted quantitative guidance which adopts two maximum limits to define significant effects:

- A worst-case scenario limit of 30 hours per year; and
- A realistic scenario taking account of meteorological parameters limited to 8 hours per year.

17.5.2. Within this assessment the sensitivity of the receptors is assumed to be high in all cases as all receptors are residential dwellings.

17.6. Assessment Modelling

17.6.1. In assessing the effect of shadow flicker, the commercial software model windPRO 4.2 was used to calculate the expected number of hours shadow flicker that could occur at each receptor. The model takes into account the movement of the sun relative to the time of day and time of year and predicts the time and duration of expected shadow flicker at a window of an affected receptor. The input parameters used in the model are as follows:

- the turbine locations;
- the turbine dimensions;
- the location of the receptors to be assessed; and
- the size of windows on each receptor and the direction that the windows face.

17.6.2. The windPRO model is based upon a Zone of Theoretical Visibility (ZTV) analysis, which in this case was based upon a Digital Terrain Model (DTM) of 5 m resolution.

Theoretical Scenario

17.6.3. Calculations were undertaken for predicted shadow hours at each of the receptors for two scenarios: a theoretical (worst-case) and a realistic scenario. For the worst-case scenario the following assumptions were made:

- all receptors have a 1 m x 1 m window facing directly towards the turbine;
- the turbine blades were assumed to be rotating for 365 days per year;
- there is a clear sky 365 days per year;
- the turbine blades were assumed to always be positioned towards each receptor;
- more than 20 % of the sun is covered by the blade; (in practice, at a distance, the blades do not cover the sun but only partly mask it, substantially weakening the shadow);
- the receptor is occupied at all times; and
- no screening is present.

17.6.4. The effect of shadow flicker was not calculated where the sun lies less than 3 degrees above the horizon due to atmospheric diffusion, low radiation (intensity of the sun's rays is reduced) and high probability of natural screening. It is generally accepted that below 3 degrees shadow flicker is unlikely to occur to any significant extent (Nordhein-Westfalen, 2002).

17.6.5. These assumptions result in a highly conservative assessment for the following reasons:

- the receptor may not directly face the turbines;
- the turbine blades will not turn for 365 days of the year, and will turn to face into the direction of the wind, in order to maximise the energy generating potential from the wind, and therefore will not always face the receptor;
- it is unlikely that there will be clear skies 365 days a year;

- the receptor may not be occupied at the time that the shadow flicker impact is experienced; and
- screening, such as vegetation including the surrounding forestry, or curtains covering the window is not accounted for within the DTM and model and will prevent any shadows from being cast onto the window and therefore prevent any flickering effect.

17.6.6. In addition, the distance between the turbine and a window has an impact on the intensity of any shadow flicker that is experienced. The Study Area has been set at 10 rotor diameters as the effects of shadow flicker are shown to be greatly reduced outside this distance.

17.6.7. The assessment carried out is limited to the effects of shadows within buildings. Moving shadows will also be apparent out of doors; however, these do not result in flicker in the same manner or to the same extent, as the light entering windows. Therefore, shadow flicker effects outdoors have been scoped out of further assessment.

17.6.8. The modelling results for the theoretical scenario are typically considered to be a theoretical worst-case estimation of the impacts experienced, which would not arise in practice given the assumptions listed above.

Realistic Scenario

17.6.9. For much of the year weather conditions will be such that shadows will not be cast or will be weak and would therefore not give rise to shadow flicker effects. windPRO calculations most likely overestimate the duration of effects as outlined in the theoretical scenario. To create a more realistic scenario for the potential impact of shadow flicker on receptors, it was necessary to identify the expected meteorological conditions at the site. Other factors such as the potential for screening by vegetation or structures will also reduce or prevent flicker incidence in practice, though the model assumes that no screening is present as a conservative approach.

17.6.10. In order to estimate the impact of cloud cover, information available from the Met Office (2026) was used to consider the likelihood of sunshine at different times of the year and therefore allow calculations of the 'expected' values for shadow flicker occurrence. As part of the windPRO calculation it is possible to upload data from the nearest climatic station to the Proposed Varied Development. In the case of the Proposed Varied Development this is Glenlee weather station located approximately 13 km south of the site.

17.6.11. The realistic scenario represents a long-term average as it is based on long-term historic metrological data. The variation between individual years can be significant and may lead to future observations differing from the predicted results.

17.6.12. A 16-degree sector wind rose was calculated for 7,446 hours of wind (assuming the Proposed Varied Development is operational for 85 % of the year) based on RenSMART data. The data was from Glasgow Prestwick Airport weather station, located

approximately 40 km north-west, over the period 2000-2010, as no meteorological mast data was available from a nearby weather station or at the site for a long-term period.

17.6.13. The windPRO model also employs a slightly simplistic assumption that sunshine probability and turbine operational probability are independent parameters. The realistic scenario model is therefore expected to yield slighting higher results as there is a degree of correlation between bright and sunny weather conditions and low wind speeds.

17.6.14. There are a number of assumptions which remain in the realistic scenario model which leads to the model predicting higher levels of shadow flicker than are likely to be experienced. These assumptions are;

- all receptors have a 1 m x 1 m window facing directly towards the turbine;
- the receptor is occupied at all times; and
- no screening is present.

17.7. Limitations to Assessment

17.7.1. All assumptions made by the windPRO 4.2 model are noted above.

17.7.2. Given the absence of UK guidance on shadow flicker, the assessment has adopted the generally accepted industry practised limit of 30 hours per year (worst case scenario) and 8 hours per year (realistic scenario) for permanent dwellings within 10 rotor diameters of the proposed turbines.

17.7.3. The realistic scenario results represent an average as they are based on historic metrological (10 years, from 2000 to 2010 for wind and 29 years, from 1991 to 2020 for sunshine). The variation between individual years can be significant and may lead to future observations differing from the predicted results.

17.7.4. As noted above, the historic meteorological data was also taken from Glenlee and Prestwick Airport weather station and is not site-specific. Glenlee weather station is situated approximately 13 km south and Glasgow Prestwick Airport is situated approximately 40 km north-west. There may be slight variations in the historical data used.

17.8. Baseline Conditions

17.8.1. Six receptors have been identified within the Study Area with the potential to experience shadow flicker (refer to **Figure 17.1** and **Table 17.3**).

17.8.2. For the purpose of the assessment, it is assumed that the properties face the Proposed Varied Development, and no local screening (vegetation and blinds/curtains) is considered.

17.8.3. Within this assessment the sensitivity of receptors is assumed to be high in all cases.

17.9. Potential Effects

Construction

17.9.1. No shadow flicker will occur during construction of the Proposed Varied Development.

17.9.2. Given that any occurrence of shadow flicker during the short commissioning period would replicate itself during operation of the Proposed Varied Development, albeit more frequently, it is considered appropriate to consider the commissioning activities as part of the operational stage of the Proposed Varied Development.

Operation

Theoretical Modelling of Shadow Flicker Occurrence

17.9.3. The modelling results presented below represent the theoretical worst-case scenario discussed in the previous section. The results of the modelling are shown in **Table 17.4**. The theoretical duration of shadow flicker calculated is indicated to be significant at five receptors (greater than 30 hours per year). It should be noted that this is the theoretical modelling and in reality the duration of shadow flicker at each location is likely to be considerably less than that indicated below for the reasons outlined in the Assessment Modelling section above.

Table 17.4 - Worst-Case Scenario Shadow Flicker Occurrence at Each Receptor

ID	Property	Shadow Flicker hours per year	Significance
A	Moorbrock	72.09	**Significant**
B	Gamekeeper's Cottage	87:56	**Significant**
C	Craigengillan Cottage	44.40	**Significant**
D	Craigengillan	50.11	**Significant**
E	Smittons	16.22	Not Significant
F	Furmiston	45.41	**Significant**

Realistic Modelling of Shadow Flicker Occurrence

17.9.4. The modelling results presented in **Table 17.5**, **Appendix 17.2** and **Figure 17.2** represent the realistic scenario. The inclusion of indicative wind data and average sunshine hours into the shadow flicker calculations has greatly reduced the potential of shadow flicker occurrence at all of the receptors, with three predicted to experience flicker for more than 8 hours per year.

Table 17.5 - Realistic-Case Scenario Shadow Flicker Occurrence at Each Receptor

ID	Property	Shadow Flicker hours per year	Significance
A	Moorbrock	6.56	Not Significant
B	Gamekeeper's Cottage	8:41	**Significant**
C	Craigengillan Cottage	7.23	Not Significant
D	Craigengillan	8.10	**Significant**
E	Smittons	2.43	Not Significant
F	Furmiston	8.01	**Significant**

17.9.5. The model still does not take into consideration any local screening from vegetation, blinds or curtains, or true window orientation relative to the turbines, which in reality will further reduce the potential time receptors are likely to experience shadow flicker over the course of the year. This model also still assumes that all receptors windows face towards the Proposed Varied Development and that receptors are occupied at all times of the day that shadow flicker is predicted.

17.9.6. The realistic scenario model does indicate potential for shadow flicker to occur for at least short periods at all receptors. The realistic duration of shadow flicker calculated is indicated to be at **significant** levels at Receptors B, D and F, with a duration greater than 8 hours per year.

17.9.7. It is important to stress the theoretical and conservative nature of the model, and the absence of any consideration of screening in the model. For these reasons it is unlikely the number of hours predicted in the 'realistic' scenario would actually occur at the sensitive receptors. In reality, the expected total shadow hours will be less than modelled. Notwithstanding these points, the Applicant is committed to providing a Shadow Flicker Mitigation Protocol to be engaged should any concerns in relation to shadow flicker effects be raised and shadow flicker subsequently be found to be causing nuisance in certain atmospheric conditions.

17.9.8. The realistic duration of shadow flicker calculated is indicated to be at non-significant levels at the remaining three receptors, with a duration less than 8 hours per year.

17.9.9. Graphs A to F within **Appendix 17.2** summarise the occurrence of shadow flicker at the receptors and illustrate the times of year and times of day when shadow flicker could theoretically occur and by which turbine.

Decommissioning

17.9.10. Given that any occurrence of shadow flicker during the short decommissioning period would replicate that which would occur during operation of the Proposed Varied

Development, it is considered appropriate to consider the decommissioning activities as part of the operational stage of the Proposed Varied Development.

17.9.11. No shadow flicker impact can occur post-decommissioning of the Proposed Varied Development.

17.10. Cumulative Assessment

17.10.1. In order to assess the potential for cumulative impact from other proposed consented or built wind farms in the surrounding area, any turbines within 5 km of the proposed turbine locations were noted. Shadow flicker impacts are considered to extend to 10 rotor diameters from turbine locations, therefore a 10 rotor diameter study area has been placed around all turbines in the vicinity of the Proposed Varied Development. **Figure 17.3** shows the cumulative shadow flicker study area[3].

17.10.2. No receptors were identified within the overlap between the shadow flicker study areas (refer to **Figure 17.3**), and as such the potential for cumulative shadow flicker effects is negligible and as such no modelling of cumulative shadow flicker effects has been undertaken.

17.10.3. There is no potential for shadow flickers effects associated with the Lorg Grid Connection and therefore there is no potential for cumulative effects.

17.11. Mitigation

Construction

17.11.1. No mitigation measures are required during the construction phase of the Proposed Varied Development.

Operation

17.11.2. Although the realistic scenario takes into consideration expected operational time for the turbines and average sunshine hours for the region, the results are likely to still be conservative due to local vegetation, dwelling orientation and internal screening from blinds, curtains or furniture that are not included in the model. Additionally, while shadow flicker may potentially occur at these locations it is possible that flicker will not be 'experienced' at all locations due to the time of day during which it may potentially occur.

[3] A Section 42 application was submitted for Cornharrow Wind Farm in October 2025 (Reference: 25/1889/S42) to increase tip height from 200 m to 220 m, move the construction compound, battery storage compound and the substation outwith their 50 m micrositing allowance, and to make an amendment to the site entrance. However, the location and rotor diameter of the turbines remains unchanged and as such, the shadow flicker study area for this development would remain the same should the Section 42 application be approved.

17.11.3. Nevertheless, in the event of consent in order to ensure that potential shadow flicker effects do not exceed acceptable limits at any property, the Applicant proposes that prior to the erection of the first turbine a written scheme (known as the 'Wind Farm Shadow Flicker Protocol') will be submitted to and approved in writing by Dumfries and Galloway Council (DGC). This will set out mitigation measures to alleviate shadow flicker attributable to the Proposed Varied Development as well as a protocol for addressing a complaint received from a receptor within the Study Area. Operation of the turbines would be required to take place in accordance with the approved Wind Farm Shadow Flicker Protocol and any mitigation measures that have been agreed through the protocol would require to be implemented as appropriate.

17.11.4. Mitigation measures could include the provision of local screening to reduce or block shadow flicker effecting a receptor. Should screening provision not be possible, the most effective mitigation measure to mitigate shadow flicker is by selective automatic turbine shutdown during the times of year when shadow flicker is predicted if the weather conditions are correct. The relevant technology which will allow for the automatic shutdown of the turbine will be fitted to the Proposed Varied Development turbines and details included within the Wind Farm Shadow Flicker Protocol. It is proposed that this is secured through a mitigation scheme requirement condition attached to the permission.

Decommissioning

17.11.5. No mitigation measures are required during the decommissioning phase of the Proposed Varied Development.

17.12. Existing Planning Conditions

17.12.1. Annex 2 of the Shepherds' Rig Wind Farm (the Consented Development) Decision Letter outlines the Conditions attached to the Deemed Planning Permission. A planning condition was attached to the consent of the Consented Development in order to ensure mitigation against any potential effects associated with shadow flicker. Condition 37 states:

(1) "Prior to the erection of the first wind turbine, a scheme for the avoidance of shadow flicker effects caused by the operation of the Development shall be submitted to and approved in writing by the Planning Authority.

(2) The scheme shall be implemented in accordance with the approved details."

17.12.2. It is considered that the same or a similar condition would be suitable for the Proposed Varied Development.

17.13. Residual Effects

17.13.1. On the basis that potential shadow flicker effects can be mitigated through matters secured through the agreement of the Wind Farm Shadow Flicker Protocol, no significant residual effects are predicted during the operational, construction or decommissioning phases of the Proposed Varied Development.

17.14. Summary

17.14.1. This assessment considers whether the effect known as 'shadow flicker' is likely to be caused by the Proposed Varied Development and assesses the potential for impacts on sensitive receptors. Shadow flicker is the effect of the sun passing behind the moving rotors of the turbines casting a flickering shadow through the windows and doors of neighbouring properties. This occurs in certain combinations of geographical position, time of day, time of year and specific weather conditions.

17.14.2. The Study Area within which properties could potentially be affected by shadow flicker covers a distance of 10 rotor diameters from each turbine and lies 130 degrees either side of north (relative to each turbine). In the case of the Proposed Development, this area extends to 1.63 km from each turbine.

17.14.3. A shadow flicker assessment was undertaken at six identified receptors within the Study Area. Calculations have shown that effects from shadow flicker have the potential to be significant at three of the five receptors.

17.14.4. It is important, however, to note that these results do not take into account existing screening features (structures and vegetation), dwelling orientation and local mitigation measures such as blinds or curtains which will reduce potential effects further. Receptors may also be in rooms that are not generally used at the affected times, therefore, the amount of time when shadow flicker is actually 'experienced' will likely be significantly less than what has been predicted.

17.14.5. The Applicant proposes that prior to the erection of the first turbine a Wind Farm Shadow Flicker Protocol will be submitted to and approved in writing by DGC. This will set out mitigation measures to alleviate shadow flicker attributable to the Proposed Varied Development as well as a protocol for addressing a complaint received from a receptor within the Study Area. Operation of the turbines would be required to take place in accordance with the approved Shadow Flicker Protocol and any mitigation measures that have been agreed through the protocol would require to be implemented as appropriate.

17.14.6. The residual effect of shadow flicker is, therefore, expected to be not significant for all receptors during the operational phase of the Proposed Varied Development.

17.14.7. The assessment of significance of effects for the Proposed Varied Development remains unchanged from that outlined within the 2018 EIA Report and 2019 AEI Report for the Consented Development. **Table 17.6** provides a summary of conclusions between the Proposed Varied Development and the Consented Development regarding shadow flicker.

Table 17.6 – Summary of Effects

Description of Effect	Significance of Potential Effect		Mitigation and/or Enhancement Measure	Significance of Residual Effect		Change to Consented Development Conclusion
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse	
Construction						
No shadow flicker effects during construction.						
Operation						
Shadow flicker nuisance to Receptors B (Gamekeeper's Cottage), D (Craigengillan) and F (Furmiston).	Significant	Adverse	Wind Farm Shadow Flicker Protocol.	Not Significant	Adverse	No change identified. Although more receptors have been identified in this assessment due to a larger study area, the 2018 EIA Report EIA and Additional Environmental Information I also conclude that, with mitigation, the significance of residual effects on all receptors is not significant.
Decommissioning						
No shadow flicker effects during decommissioning.						

References

DECC- Department of Energy and Climate Change (16 Mar 2011). Update of UK Shadow Flicker Evidence Base. Prepared by Parsons Brinckerhoff.

Dumfries and Galloway Council (2019). Local Development Plan 2. Available at: https://www.dumfriesandgalloway.gov.uk/sites/default/files/2024-07/Adopted_LDP2_OCTOBER_2019_web_version.pdf

Epilepsy Society (2024). Photosensitive epilepsy. Available at: https://epilepsysociety.org.uk/about-epilepsy/epileptic-seizures/seizure-triggers/photosensitive-epilepsy

Harding G, Harding P & Wilkins A (2008). Wind turbines, Flicker and photosensitive epilepsy: Characterising the flashing that may precipitate seizures and optimising guidelines to prevent them. Epilepsia. Vol. 19 (6): 1095-1098.

Met Office – Glenlee (1991 – 2020). Available at: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcuezdjq3 (Accessed 10/03/26)

NOABL Met Office – Prestwick Airport distribution of wind power by direction over the period 2000 to 2010. Available at: https://www.rensmart.com/Maps#NOABL (Accessed 10/03/26)

Nordrhein-Westfalen (2002). Notes on the identification and Evaluation of the Optical Emissions of Wind Turbines. States Committee for Pollution Control. Germany

Scottish Government. (2014). Onshore wind turbines: planning advice. Available at: https://www.gov.scot/publications/onshore-wind-turbines-planning-advice/

Scottish Government (2023). National Planning Framework 4. Available at https://www.transformingplanning.scot/nationalplanning-framework/adopted-npf4/

Smedley ARD, Webb AR & Wilkins AJ (2010). Potential of wind turbines to cause epileptic seizures under various meteorological conditions. Epilepsia. Vol. 51(7): 1146-1151.

Abbreviations

Abbreviations	Definition
DECC	Department of Energy and Climate Change
DGC	Dumfries and Galloway Council
DTM	Digital Terrain Model
EIA	Environmental Impact Assessment
m	Metres
NPF4	National Planning Framework 4
ZTV	Zone of Theoretical Visibility