

<b>18. Shadow Flicker</b>	<b>2</b>
<b>18.1 Summary</b>	<b>2</b>
<b>18.2 Introduction and overview</b>	<b>2</b>
<b>18.3 Methodology</b>	<b>3</b>
<b>18.4 Baseline information</b>	<b>4</b>
<b>18.5 Predicted effects of the scheme</b>	<b>4</b>
<b>18.6 Mitigation and enhancement measures</b>	<b>4</b>
<b>18.7 Assessment of residual effects</b>	<b>4</b>
<b>18.8 References</b>	<b>4</b>

## **18. Shadow Flicker**

### **18.1 Summary**

- 18.1.1 This chapter addresses shadow flicker. Wind turbines, in common with all structures, cast shadows in sunny conditions. The shadows vary in position and length according to the direction of the sun and its height in the sky. Rotating turbine blades cast moving shadows. If the moving shadow is cast on to a building it can appear to flick on and off as the blades rotate. If this flicking shadow is viewed through a narrow opening such as a window or doorway an effect known as shadow flicker can occur.
- 18.1.2 Experience has shown that shadow flicker has the potential to cause annoyance to occupants of affected properties under certain circumstances. A study has therefore been undertaken to identify whether shadow flicker is likely to occur at residential properties in the vicinity of the proposed wind turbines at the Revised Consented Development.
- 18.1.3 An introduction to shadow flicker is set out within the Scottish Government’s web based renewables guidance on Onshore Wind Turbines<sup>1</sup>. However, there are no statutory or advisory limits in this or other UK legislation or policy to determine what levels of shadow flicker are acceptable. However, the guidance is consistent with the findings of a DECC report<sup>2</sup>, *Update of UK Shadow Flicker Evidence Base*, published in 2011.
- 18.1.4 For this chapter, potential receptors were screened in accordance with the web based renewables guidance note on Onshore Wind Turbines, i.e. only those within ten times the rotor diameter of turbines and within 130° either side of north relative to the turbines.
- 18.1.5 Since the nearest residential property is approximately 2 km away, shadow flicker was not predicted to occur at any of the nearby residential properties as a result of the Revised Consented Development.
- 18.1.6 Table 18.1 below provide an overview of effects on Shadow Flicker against the previous 2012 and 2016 ESs, including the 2017 SI.

**Table 18.1 Summary of Conclusions**

<b>2012 ES (24 Turbine Layout)</b>	<b>2016 ES (24 Turbine Layout)</b>	<b>2017 Supplementary Information (21 Turbine Layout - Consented Development)</b>	<b>2021 Section 36C Application (21 Turbine Layout with amended access tracks – Revised Consented Development)</b>
No effects were identified	No effects were identified	No effects were identified	No effects are identified

### **18.2 Introduction and overview**

<sup>1</sup> <https://www.gov.scot/publications/onshore-wind-turbines-planning-advice/> last accessed on 29/04/2021

<sup>2</sup> <http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/Energy%20mix/Renewable%20Energy/ORED/1416-update-uk-shadow-flicker-evidence-base.pdf> (last accessed 29/04/2016)

- 18.2.1 Shadow flicker can cause a nuisance to residential amenity where people are sitting within the rooms affected by the phenomenon. In order to quantify this effect, it is possible to calculate the number of hours per year that shadow flicker may occur at a dwelling. The approach and results from such an assessment for the Revised Consented Development are presented in this chapter.
- 18.2.2 Shadow flicker only occurs when certain conditions coincide at particular times of the day and year. It can only occur when the sun, wind turbine and the receptor (residential property) are aligned. The occurrence and duration of shadow flicker effect thus depends on:
- The direction of the property in relation to the wind turbines: in the UK only properties within 130 degrees either side of north, relative to the wind turbine, can be affected as the sun is always to the south in the UK;
  - The height of the wind turbine and diameter of the rotor;
  - The time of year and time of day (the elevation and position of the sun); and
  - Weather conditions – shadows are only cast when the sun is not occluded; shadow flicker can only occur when blades are turning – wind turbines typically operate when the wind speed is between 3.5 m/s and 25 m/s at hub height. The wind direction will determine the angle of the rotor and therefore the view of the rotor can vary from 'full-on' to 'side-on' – when the rotor is side on to the affected property shadow flicker effects do not generally occur.
- 18.2.3 The intensity of shadow flicker and consequent effect on residential amenity is also influenced by the distance between the wind turbines and the property: the further the observer is from the wind turbine the less pronounced the effect will be.
- 18.2.4 As a result of these factors, experience has shown that shadow flicker effects do not occur at a distance greater than ten rotor diameters from the wind turbine. The web based renewables guidance on Onshore Wind Turbines refers to shadow flicker in relation to wind turbines and states the following:

*'Where this could be a problem, developers should provide calculations to quantify the effect.'*

- 18.2.5 With respect to the distance over which this effect should be considered, the document 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.'*

## **18.3 Methodology**

### **Assessment scope and approach**

- 18.3.1 The purpose of the shadow flicker assessment was to identify whether shadow flicker is likely to occur at any neighbouring properties, and if so to predict approximate times of day and year, and duration of these effects. The distance between a wind turbine and a potential shadow flicker receptor affects the intensity of the shadows cast by the blades, and therefore the intensity of flickering. Shadows cast close to a turbine will be more intense, distinct and 'focused'.
- 18.3.2 The guidance on shadow flicker included in the web based renewables guidance on Onshore Wind Turbines, states that within 10 rotor diameters:

'shadow flicker should not be a problem'

14.1.1 In addition, The Update of the UK Shadow Flicker Evidence Base (DECC, 2011) reviewed 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.

18.3.3 At the Revised Consented Development the 'worst case' wind turbines are likely to have a rotor diameter of 133 m; therefore potential shadow flicker effects could occur, subject to the conditions set out above, out to 1330 m from the turbines.

## **18.4 Baseline information**

### **Sources of data**

18.4.1 Baseline conditions were established through desk-based examination of Ordnance Survey mapping at scales of 1:25,000 and 1:10,000.

18.4.2 In accordance with the web based renewables guidance on Onshore Wind Turbines, the scope of this assessment is restricted to properties within 10 rotor diameters of the turbines (1330 m) and 130° either side of north.

18.4.3 At the Revised Consented Development, there are no residential properties within ten rotor diameters (i.e. 1330 m, based upon the worst case 133 m rotor diameter turbines) of the proposed turbine locations.

18.4.4 An additional micro-siting distance of 50m around each turbine was also considered, but as this additional area did not include any further properties, no further consideration has been given to micro-siting of the turbines.

## **18.5 Predicted effects of the scheme**

18.5.1 As with the Consented Development, since there are no residential properties within 1330 m 130° either side of north, there are no predicted shadow flicker effects associated with the Revised Consented Development.

## **18.6 Mitigation and enhancement measures**

18.6.1 No mitigation measure will be required since no predicted shadow flicker effects have been identified.

## **18.7 Assessment of residual effects**

### **During construction**

18.7.1 Shadow flicker is only an issue during operation of the wind turbines therefore there can be no effect during construction of the proposed wind turbines.

### **During operation**

18.7.2 As no shadow flicker effects are predicted for any residential properties surrounding the Revised Consented Development there should be no residual effects during the operation of the proposed wind turbine.

### **Effects during decommissioning**

18.7.3 Shadow flicker is only an issue during operation of the wind turbines therefore there can be no effect during de-commissioning of the proposed wind turbines.

## **18.8 References**

P B Power, Update of UK Shadow Flicker Evidence Database, 16 March 2011.

Epilepsy Action, 2007. *Photo-sensitive Epilepsy*: Available from:  
<http://www.epilepsy.org.uk/info/photo.html>

Scottish Government Online Renewables Planning Guidance: Onshore Wind Turbines  
(Scottish Government, 2014).