13. Shadow Flicker

13.1 Introduction

13.1.1 This chapter presents an assessment of the potential shadow flicker effects on local residential properties as a result of the operation of the proposed Blackstone Edge Wind Farm.

13.1.2 The chapter has been prepared by Jenny Gascoigne with site assessments undertaken by Mark Reynolds and Clare Horner, Entec UK Ltd.

13.2 Context

Site context

13.2.1 The site is located in a rural area of South Yorkshire; the nearest settlement is Crow Edge which lies approximately 1.7km to the south west of the site. The nearest properties to the Blackstone Edge site are New Maythorn (approximately 640m from the site), Lower Maythorn (approximately 800m from the site) and Spicer House (approximately 700m from the site).

Policy context

13.2.2 In 2004, the Office of the Deputy Prime Minister published Planning for Renewable Energy, A Companion Guide to PPS22 to provide practical guidance on the implementation of Planning Policy Statement 22: Renewable Energy.

13.2.3 The Companion Guide refers to shadow flicker in relation to wind turbines and states the following:

"Although problems caused by shadow flicker are rare, for sites where existing development may be subject to this problem, applicants for planning permission for wind turbine installations should provide an analysis to quantify the effect."

13.2.4 With respect to the distance over which this effect should be considered, the companion guide states:

"Flicker effects have been proven to occur only within ten rotor diameters of a turbine."

13.3 Methodology

13.3.1 Shadow flicker may occur under certain combinations of geographical position and time of day, when the sun passes behind the rotors of a wind turbine and casts a shadow over neighbouring properties. As the blades rotate, the shadow flicks on and off, an effect known as shadow flicker. The effect only occurs inside buildings, where the flicker appears through a window opening.

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13.3.2 The purpose of this assessment was to identify whether shadow flicker was likely to occur at any neighbouring properties, and if so to predict approximate times of day and year, and duration of these effects.

13.3.3 The assessment includes all properties within ten rotor diameters (820m) of the wind turbines and within approximately 130 degrees of either side of north from the turbine positions (see Figure 13.1).

13.3.4 The assessment has been undertaken on a predominantly desk-based basis, with assumptions made about the location and sizes of windows for individual properties. These have been confirmed, as far as was reasonably practical, during a site visit, although it was not possible to gain access to the properties or see whether windows were present on all facing walls.

13.3.5 The shadow flicker effects have been calculated using ReSoft WindFarm software. This software calculates times throughout a year when a turbine rotor viewed from the window of a house is in line with the sun and therefore the potential for shadow flicker exists, by modelling the location of the wind turbines and residential properties relative to the sun's position. The following factors are taken into account in the calculation:

- Turbine locations, rotor diameter and hub height;
- Topography;
- Locations of residential properties;
- Position, size and orientation of windows on buildings;
- Latitude and Longitude of the proposed site (used in calculating the position of sun);

13.3.6 The software calculates the dates and times when the shadow of a wind turbine's rotor will fall onto a window. The following worst-case assumptions are made throughout the calculation:

- Weather conditions are such that shadows are always cast (i.e. bright/clear/sunny at all times of day and throughout the year); and
- Turbine is facing directly towards receptor at all times, therefore the cast shadow is its maximum possible size.

Baseline studies

13.3.7 Baseline conditions were established through desk-based examination of Ordnance Survey mapping at scales of 1:50,000 and 1:25,000 and a site visit.

Scope of study

Approach to scoping

13.3.8 The scope of this assessment is restricted to properties within 10 rotor diameters of the turbines (820m) in accordance with PPS22 companion guide.

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Effects requiring further consideration

13.3.9 Shadow flicker can be 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 Blackstone Edge Wind Farm are presented in this Chapter.

Effects not requiring further consideration

13.3.10 The flickering effect caused by shadow flicker has been associated with the potential to induce epileptic seizures, through a condition known as photosensitive epilepsy. Around one in two hundred people in the UK have epilepsy although only 3-5% of these suffer from **photosensitive epilepsy** (National Society for Epilepsy, 2002).

13.3.11 The frequency at which photosensitive epilepsy might be triggered varies from person to person. Generally, it is between 5 and 30 flashes per second (Hertz). While some people are sensitive at higher frequencies, it is uncommon to have photosensitivity below 5 Hertz (National Society for Epilepsy, 2002).

13.3.12 The turbines on the proposed wind farm will operate at around 6 to 20 revolutions per minute (RPM). Given the turbines will have three blades, the frequency at which a blade will pass a particular point will be in the order of between 18 and 60 times a minute which equates to between 0.3 and 1.0 Hertz. This is much less than the 5 - 30 Hertz frequency range generally thought to induce photosensitive epilepsy. Therefore the issue of photosensitivity epilepsy is not considered further in this assessment.

Assessment and evaluation methodologies

13.3.13 Whilst the time and duration of shadow flicker events can be predicted accurately, the level of the effect is difficult to quantify as this will 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. There is no UK guidance on a limit for Shadow Flicker.

13.3.14 Evaluation of effects will be based on the frequency, timing and duration of events, and whether these are considered likely to impact on the amenity of the occupants.

13.4 Description of baseline conditions

13.4.1 Four properties have been identified within the assessment area, these are identified in Table 13.1.

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Table 13.1 Shadow Flicker Sensitive Receptors

Name	Easting	Northing	Distance/ Direction to Nearest Turbine	Description/Use
Lower Maythorn	418740	405595	816m to the west of turbine 2	Residential property and agricultural buildings. Property sits at a lower elevation to the proposed site and orientated on an east to west axis.
New Maythorn	418913	405463	616m to the west of turbine 2	New residential property (single storey) with direct views towards the proposed turbines.
Brown's Edge Farm	420430	405748	787m to the north-east of turbine 3	Residential property. Orientated on a north-east to south-west axis. No windows in the gable end walls.
Spicer House	420472	405580	715m to the north-east of turbine 3	Residential property and agricultural buildings. Orientated on a north-west to south-east axis. Windows face the road to the front and are assumed to face the proposed site to the rear.

13.4.2 Based on the findings of the site assessment, Brown's Edge Farm and Lower Maythorn do not have any windows which would be orientated towards the wind turbines.

13.4.3 Spicer House is orientated on a north-west to south-east axis. It was not possible to gain access to the rear of the property (overlooking the proposed site). For the purpose of this assessment it is assumed that Spicer House has windows which are orientated directly towards the proposed turbines.

13.4.4 Four windows at the New Maythorn property face the proposed windfarm; these are all located at ground level. A formal survey was not undertaken, but typical dimensions have been assumed.

Table 13.2 Windows Used in Shadow Flicker Calculation

Name	Facing Walls	Windows	Direction of View	Width (m)	Depth (m)	Height (m)
New Maythorn	South-east	4 windows observed during site visit	135	1	1	1
Spicer House	South-west	Windows are assumed given the orientation of	250	2	2	2

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Table 13.2 (continued) Windows Used in Shadow Flicker Calculation

Name	Facing Walls	Windows	Direction of View	Width (m)	Depth (m)	Height (m)
		the property, one upstairs and one down of equal size.				

13.4.5 Shadow flicker effects would occur only during the operation of the proposed wind farm.

13.4.6 Results of the shadow flicker calculation have been produced as a summary of events at Spicer House and New Maythorn.

13.4.7 Table 13.3 indicates the days in the year and times of day when potential interference from shadow flicker is likely to occur. Given the locations and orientations of properties in the area, shadow flicker events are only anticipated at Spicer House and New Maythorn.

Table 13.3 Predicted Shadow Flicker events

House	Days per year	Max minutes per day	Mean minutes per day	Period during which effects may occur	Time at which effects occur	Turbine ID causing effect
Spicer House	21	29	23	Feb	16:00 – 16:30	3
Spicer House	21	29	23	Oct - Nov	15:30 - 16:00	3
New Maythorn	18	30	25	Jan – March	07:20 – 07:50	1
New Maythorn	20	32	25	April – May	05:40 – 06:15	2
New Maythorn	20	32	25	Aug – Sept	05:40 – 06:15	2
New Maythorn	18	30	25	October	07:00 – 07:25	1

13.4.8 Shadow flicker events at Spicer House could occur on a maximum of 42 days of the year during late afternoons in February and from late September to early November. A maximum of 16.5hrs of shadow flicker would be experienced over the course of a year.

13.4.9 Shadow flicker events at New Maythorn could occur on a maximum of 83 days of the year during early mornings from late January to early March, mid April to mid May, mid August to mid September and October. No affects are anticipated after 08:00. A maximum of 33hrs of shadow flicker would be experienced over the course of a year.

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13.4.10 The actual occurrence of shadow flicker will be reduced by a number of factors including cloud cover, shading of the affected windows by buildings and vegetation, periods when the turbines are not turning and orientation of the hub and rotors. The calculated values represent a theoretical worst-case scenario and it is unlikely the situation would occur this way in practice.

Information Gaps

13.4.11 In the absence of more detailed information, two large (2m x 2m) windows have been assumed at Spicer House orientated towards the proposed Wind Farm.

13.5 Mitigation, offsetting and enhancement measures incorporated into the proposed development

13.5.1 As the occurrence of shadow flicker will be reduced in practice by a number of factors, including cloud cover, times when turbines are not turning, orientation of the hub and rotors, no mitigation in any initial form is proposed, as the calculated values represent a theoretical worst-case scenario and it is unlikely the situation would occur this way in practice, if at all. The situation will be kept under review by the Applicant during operation of the wind farm in case particular instances of shadow flicker arise.

13.5.2 Should shadow flicker present a problem following commissioning of the turbines, a more detailed assessment can be carried out to predict the exact time of day and conditions during which the phenomenon could occur. This information would then be used to inform the detailed design of mitigation measures. There are various effective mitigation options available to rectify problems. These include, for example, fitting shutters or curtains to windows and planting or constructing garden screening. Because the calculations for indicating theoretical shadow flicker incidence provide very accurate predictions of the potential times of day and dates during the year when it may occur this information can also be used to control a problematic turbine at specific times where the sun is deemed bright enough to cast nuisance shadows. A solar sensor may be fitted on the turbine to monitor the light intensity to facilitate this function. A planning condition may provide a final form of mitigation to ensure that the rectification of any shadow flicker problem will be implemented promptly and effectively.

13.6 Assessment of potential effects

13.6.1 Worst-case scenario predictions indicate that shadow flicker may occur at New Maythorn and Spicer House. The maximum duration of any shadow flicker events in a particular room with a window directly facing the proposed site is 32 minutes in any day.

13.6.2 The situation will be kept under constant review by the Applicant, and should any instances of shadow flicker causing an effect on amenity be reported controls would be implemented to fully mitigate the effects. Thus, there are no residual effects predicted.

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13.7 Summary of significance evaluation

13.7.1 Under worse case and unrealistic conditions, shadow flicker events at New Maythorn could occur on a maximum of 83 days per year for up to 32 minutes in any day; and at Spicer House on a maximum of 42 days per year for up to 29 minutes in any day.

13.7.2 Given the short duration of each event, and the limited frequency of events throughout the year, the effects are judged to be not significant. Should any instances of shadow flicker causing an effect on amenity be reported, controls would be implemented to fully mitigate the effects.

13.7.3 A summary of the significance evaluation for the shadow flicker assessment is provided in Table 13.4.

Table 13.4 Summary of significance of residual effects

Receptor and summary of predicted residual effects	Type of effect[1]	Significance[2]
New Maythorn	-ve	NS
Spicer House	-ve	NS

Key/footnotes:

1. Type of effect	-ve = negative	**2.**	S	Significant
	+ ve = positive		or	
	N = Neutral		NS	Not-significant
	? = unknown			

13.8 References

Planning Policy Statement 22: Companion Guide.

National Society for Epilepsy (2002) *Information on Epilepsy: Photosensitive Epilepsy [online].* http://www.epilepsynse.org.uk (last accessed 15/12/06).

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