

# SHADOW FLICKER ASSESSMENT

## Contents

|    |                                    |
|----|------------------------------------|
| 2  | Introduction                       |
| 3  | The Proposal                       |
| 4  | Method of Assessment               |
| 4  | Shadow Flicker Assessment          |
| 8  | Mitigation                         |
| 12 | Summary                            |
| 13 | References                         |
| 14 | Appendix A - Merged Shutdown Times |

## INTRODUCTION

1. This assessment, prepared by Engena Limited, presents the results of a shadow flicker assessment that has been undertaken to identify the potential effects of any shadows from the Co-operative Wind Turbine at Shafton Two Gates on the nearby dwellings.
2. A wind turbine can cast long shadows when the sun is low in the sky. When the sun is specifically positioned in the sky with respect to a turbine and the window of a neighbouring dwelling, this shadow may pass over the window; potentially causing a drop in light levels which comes and goes with each pass of a blade (whilst the sun is in the specific point in the sky). This potential effect is most commonly referred to as 'shadow flicker'.
3. For the potential for a shadow flicker effect to exist, a number of factors need to occur coincidentally:
  - clear skies and good visibility;
  - the sun needs to be low in the sky and in a specific position with respect to a turbine and the window of a property;
  - the wind must be blowing sufficiently to turn the wind turbines; and
  - the wind must be blowing in a direction such that the rotor is rotating in a plane perpendicular to an imaginary line drawn between the wind turbine, the sun and the property window.
4. As (depending on the time of year and latitude) the sun rises roughly in the east, passes through the south, and sets roughly in the west, the property needs to be approximately west, through north to approximately east of a wind turbine to experience shadow flicker. For UK latitudes, the zone projected on to the ground in which properties may be affected by shadow flicker is 130 degrees either side of north. In the UK a property to the south of a wind turbine will never be in its shadow.
5. Parsons Brinkerhoff undertook a study for the Department of Energy and Climate Change, titled 'Update of UK Shadow Flicker Evidence Base' (DECC 2011b). This states that (Page 8):

*'Flicker effects have been proven to occur only within ten rotor diameters of a turbine. Therefore if the turbine has 80m diameter blades [80m rotor diameter], the potential shadow flicker effect could be felt up to 800m from a turbine.'*
6. This zone of effect is reiterated in National Policy Statement for Renewable Energy Infrastructure (EN-3), (DECC, 2011a), at Paragraph 2.7.63 onwards.
7. There is a potential for shadow flicker to cause physiological disturbance if the frequency of the flicker is sufficiently high. The PPS22 companion guide states that (Paragraph 77, Technical Annex 8):

*'Around 0.5% of the population is epileptic and of these around 5% are photo-sensitive. Of photo-sensitive epileptics less than 5% are sensitive to lowest frequencies of 2.5-3 Hz [50-60rpm], the remainder are sensitive only to higher frequencies. The flicker*

*caused by wind turbines is equal to the blade passing frequency. A fast-moving three-bladed machine will give rise to the highest levels of flicker frequency. These levels are well below 2Hz [40rpm]. The new generation of wind turbines is known to operate at levels below 1Hz.'*

8. This is reinforced by a report produced as evidence by Professor Graham Harding of Birmingham University and honorary member of the Royal College of Physicians, for the Scout Moor planning appeal in November 2004. He states:

*'Photosensitive epilepsy is clearly related both to intensity of light and the rate of flashing. The most provocative flash rates are between 13 and 21 flashes per second (fps) [260-420rpm] (Harding & Harding 1999). In the case of the Scout Moor turbines the rate of shadow flicker from each turbine is less than 1 fps.'*

*To set this in context the television broadcast industry in the UK is restricted to a flash rate of 3 fps or less (Harding & Harding 1999). Similarly the Health and Safety Executive Guidelines restrict flashing by 'disco lights' or strobe lighting to 4 fps or less (Health and Safety Executive LAC 51/1).'*

9. A flicker frequency of 13 fps (or 13Hz) would correspond to a rotational speed of 260rpm; clearly, significantly beyond the rotational speed of the proposed turbine which has a peak rotational speed of 28rpm. As such, physiological disturbance from turbine shadows is not anticipated.

## THE PROPOSAL

10. The proposed co-operative turbine would be located on land at the former Shafton Two Gates coal works, between Grimethorpe and Cudworth. The application is proposed by the Energy Prospects Co-operative. This co-operative aims to develop and then facilitate community ownership and operation of a number of single turbines on land owned by Harworth Estates. The assessment is based upon a candidate turbine, the 500kW EWT DW 54 wind turbine which has a hub height of 50m and a rotor diameter of 54m and thus a maximum height to tip of 77m.

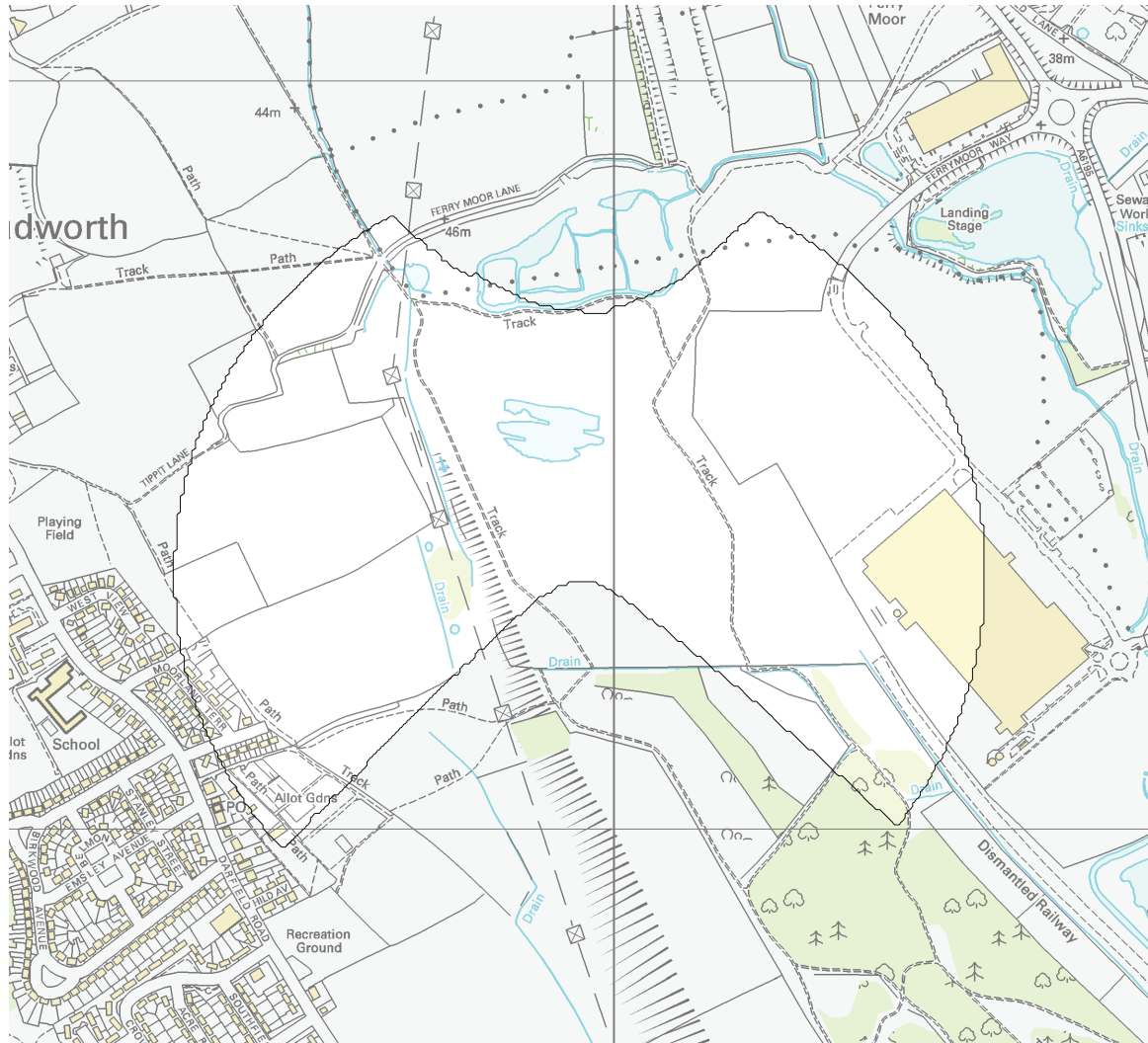
### METHOD OF ASSESSMENT

11. The assessment has been based on the result of the specialist wind farm software REsoft WindFarm computer model. It considers the location of the turbine, the surrounding terrain, property locations, property orientation, window placement and the path of the sun across the sky at various times of the year.
12. The recently published DECC study into the assessment of shadow flicker effects verified the use of the REsoft WindFarm model for shadow flicker assessment, and recognised its predictions as worse case.

### SHADOW FLICKER ASSESSMENT

13. The wind turbine proposed at Shafton Two Gates, will have a 54m rotor diameter. Based upon the distance within which NPS EN-3 (DECC, 2011a) states that shadow flicker effects are more likely to occur, ten rotor diameters equates to a 540m radius zone of potential effect surrounding the turbine. For UK latitudes, the zone projected on to the ground in which properties may be affected by shadow flicker is 130 degrees either side of north. In the UK a property to the south of a wind turbine will never be in its shadow.
14. The assessment area is shown in **Plate 1**. This has been calculated using REsoft Windfarm, and accounts for the parameters described above, as well as Ordnance Survey contours. The model was based upon Ordnance Survey Terrain 5 DTM data and calculates the potential shadow flicker effect for every 5m interval. Shadow Flicker is only predicted to occur within the unshaded area on the map.
15. **Plate 1** indicates the potential for shadow flicker effects at properties to the south west of the turbine, on Moorland Terrace. There are 13 properties comprising 26 dwellings within 540m of the proposed turbine.

Plate 1 - Shadow Flicker Assessment Area



Scale 1:10 000. © Crown copyright, All rights reserved. 2013, Licence number 01000316

16. **Table 1** displays the overall results of the shadow flicker assessment on the basis that there is no screening, be it vegetation or built form, between the turbine and the property, the sun shines every day and the rotor of the turbine is orientated perpendicular to the sun-turbine-window plane. The assessment also assumes that all properties have windows at ground and upstairs levels on the approximate north east and south elevations in the direction of the proposed turbine, with the exception of properties 8-11 inclusive which have no upstairs windows on the north and south elevations.

## SHADOW FLICKER ASSESSMENT

| HOUSE                       | NUMBER OF<br>DAYS PER YEAR<br>AN EVENT<br>OCCURS | MAX.<br>DURATION PER<br>DAY AN EVENT<br>OCCURS (MINS) | MEAN<br>DURATION PER<br>DAY AN EVENT<br>OCCURS (MINS) | TOTAL TIME<br>PER YEAR<br>(HRS) |
|-----------------------------|--------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|---------------------------------|
| H1: 34-36 Moorland Terrace  | 92                                               | 0.53                                                  | 0.37                                                  | 33.8                            |
| H2: 38-40 Moorland Terrace  | 79                                               | 0.51                                                  | 0.38                                                  | 29.7                            |
| H3: 42-44 Moorland Terrace  | 67                                               | 0.50                                                  | 0.38                                                  | 25.6                            |
| H4: 46-48 Moorland Terrace  | 64                                               | 0.49                                                  | 0.37                                                  | 23.7                            |
| H5: 50-52 Moorland Terrace  | 59                                               | 0.47                                                  | 0.37                                                  | 21.6                            |
| H6: 54-56 Moorland Terrace  | 55                                               | 0.46                                                  | 0.36                                                  | 19.6                            |
| H7: 30-32 Moorland Terrace  | 56                                               | 0.50                                                  | 0.39                                                  | 21.6                            |
| H8: 26-28 Moorland Terrace  | 48                                               | 0.48                                                  | 0.37                                                  | 17.7                            |
| H9: 22-24 Moorland Terrace  | 44                                               | 0.46                                                  | 0.36                                                  | 15.7                            |
| H10: 18-20 Moorland Terrace | 40                                               | 0.45                                                  | 0.36                                                  | 14.2                            |
| H11: 14-16 Moorland Terrace | 39                                               | 0.44                                                  | 0.34                                                  | 13.2                            |
| H12: 25-27 Moorland Terrace | 47                                               | 0.46                                                  | 0.36                                                  | 16.8                            |
| H13: 21-23 Moorland Terrace | 44                                               | 0.45                                                  | 0.35                                                  | 15.3                            |

*Table 1 - Shadow Flicker Events Summary*

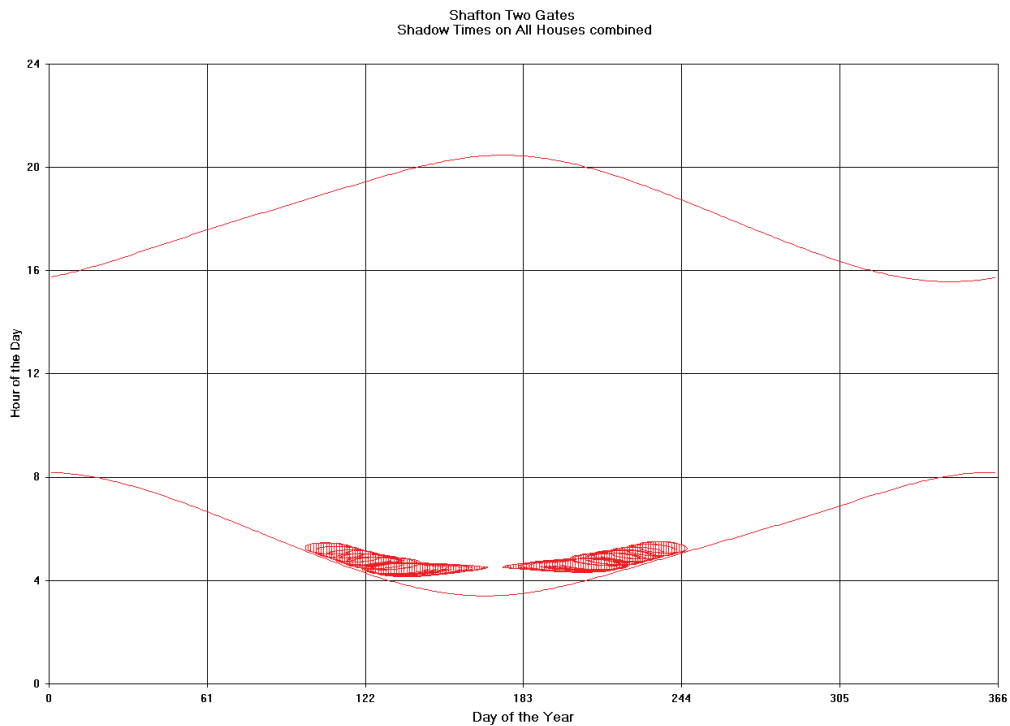
17. **Table 1** is represented graphically at **Plate 2** which demonstrates how the duration of the events vary over the year at each dwelling.
18. It can be noted that the maximum potential effects are restricted to two periods of the year in the early hours of the morning. This is predicted to be for a maximum

## Co-operative Wind Turbine at Shafton Two Gates

of 92 days per year, from 9<sup>th</sup> April to 3<sup>rd</sup> September. The earliest start time will be at approximately 04:09am and the latest end time will be at approximately 05:31am. The maximum duration of any shadow flicker event is predicted to be 32 minutes (0.53 hours) per day.

19. Whilst there is no possibility of physiological disturbance effects, as the rotor turns relatively slowly (6 to 25 rpm), shadow flicker can be deemed a nuisance if experienced within a property.

*Plate 2 - Shadow Flicker Events by Duration and Day of Occurrence*



### MITIGATION

20. The calculations employed to deduce the potential for shadow flicker events to occur are based on bare terrain to represent worst-case predictions. In the case of shadow flicker, it is very often the case that either the built environment or established vegetation can mitigate for the effect - blocking the shadow from ever falling on the potentially affected window.
21. **Plate 3** shows an aerial view of Moorland Terrace, and **Table 2** summarises the existing screening.

*Plate 3 - Aerial View, Moorland Terrace*



## Co-operative Wind Turbine at Shafton Two Gates

*Table 2 - Shadow Flicker Assessment Summary*

| PROPERTY                        | DISTANCE<br>(TO NEAREST<br>5m) AND<br>DIRECTION<br>ORIENTATION | OBSERVATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | TOTAL<br>TIME PER<br>YEAR<br>(HOURS) |
|---------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| H1: 34 - 36<br>Moorland Terrace | 465m WSW                                                       | Properties are semi-detached (therefore comprising 12 dwellings) and within a part of the terrace that is approximately north facing, therefore view to the turbine site is oblique and may be possible from approximately east facing windows on the east dwelling of the semi, although for properties further west on the street views may be obstructed by the adjacent property to the east.<br><br>There are some single trees at the front of the properties, for example properties 1, 3 and 6, and some short level hedges between dwellings. These features may have minimal screening effects from shadow flicker events because largely the frontage (north elevation) of the property is open.<br><br>Number 34, at the end of the terrace, is adjacent to an arable field to the east which separates the dwellings from the proposed turbine site. | 33.8                                 |
| H2: 38 - 40<br>Moorland Terrace | 480m WSW                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 29.7                                 |
| H3: 42 - 44<br>Moorland Terrace | 490m WSW                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 25.6                                 |
| H4: 46 - 48<br>Moorland Terrace | 505m WSW                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 23.7                                 |
| H5: 50 - 52<br>Moorland Terrace | 520m WSW                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 21.6                                 |
| H6: 54 - 56<br>Moorland Terrace | 535m WSW                                                       | A single semi-detached property (two dwellings) is approximately south facing and so the east elevation of no. 32 faces towards the proposed turbine site with no potential for screening from immediate vegetation. The south face of the building is oblique to the turbine location.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 19.6                                 |
| H7: 30 - 32<br>Moorland Terrace | 485m WSW                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 21.6                                 |

## SHADOW FLICKER ASSESSMENT

| PROPERTY                         | DISTANCE<br>(TO NEAREST<br>5m) AND<br>DIRECTION<br>ORIENTATION | OBSERVATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | TOTAL<br>TIME PER<br>YEAR<br>(HOURS) |
|----------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| H8: 26 - 28<br>Moorland Terrace  | 510m WSW                                                       | Property is a large semi-detached (comprising two dwellings) and one of four with approximate west facing frontages. The rear of the property (east face) is backed by the garden to no. 32 and has some boundary vegetation that may provide some screening of effects on downstairs windows. There are no upstairs windows on the approximate north or south facing elevations.                                                                                                                                                                                                                                   | 17.7                                 |
| H9: 22 - 24<br>Moorland Terrace  | 520m WSW                                                       | These three large semi-detached properties (comprising 6 dwellings) complete the row of approximately west facing properties on the east edge of the Terrace. They are similar to property H9, but have allotments to their rear (east) rather than a neighbouring garden.                                                                                                                                                                                                                                                                                                                                          | 15.7                                 |
| H10: 18 - 20<br>Moorland Terrace | 525m WSW                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 14.2                                 |
| H11: 14 - 16<br>Moorland Terrace | 535m WSW                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 13.2                                 |
| H12: 25 - 27<br>Moorland Terrace | 535                                                            | <p>A single semi-detached property (comprising two dwellings) is located on a corner of Moorland Terrace, facing approximately south-east. Windows on the north and east faces of the property may be subject to shadow flicker effects.</p> <p>There is some boundary vegetation and a tree to the south of no. 27, but this is unlikely to have any screening effect.</p> <p>Potentially property H7 (No.'s 30-32) may create some screening between this property (particularly no. 27) and the proposed turbine, although there is a gap between property H7 and H8 which projects through to property H12.</p> | 16.8                                 |

## Co-operative Wind Turbine at Shafton Two Gates

| PROPERTY                         | DISTANCE<br>(TO NEAREST<br>5m) AND<br>DIRECTION<br>ORIENTATION | OBSERVATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | TOTAL<br>TIME PER<br>YEAR<br>(HOURS) |
|----------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| H13: 21 - 23<br>Moorland Terrace | 540                                                            | <p>A single semi-detached property (comprising two dwellings) is located on the west side of the road opposite properties H8-11. The front of the property faces approximately east towards the proposed site but will be partially obscured by the intervening property H8. This screening effect would largely be upon no. 23. Windows on the south elevation of no. 23 are theoretically subject to shadow flicker effects but this would be screened by property H8.</p> <p>There is a short boundary fence and hedge at the front of the property but this is not likely to provide any screening.</p> | 15.3                                 |

22. Paragraph 36 of the Planning Practice Guidance for renewable and low carbon energy states:

*'Modern wind turbines can be controlled so as to avoid shadow flicker when it has the potential to occur. Individual turbines can be controlled to avoid shadow flicker at a specific property or group of properties on sunny days, for specific times of the day and on specific days of the year. Where the possibility of shadow flicker exists, mitigation can be secured through the use of conditions'.*

23. If effects are observed by the residents, to protect their amenity, control of the turbine would be used to turn the machine off during the brief periods identified when conditions are such that the effect may occur. Using a sensor to detect sunlight in combination with a reading of wind direction, the wind turbine control system can be programmed to switch off the turbine during the times of potential effect whenever the conditions for shadow flicker exist. Under such circumstances, during the days illustrated in **Plate 2** (and identified within **Appendix A**); and if the sun is detected to be shining during the period that there is potential for a flicker to be observed; and the wind is blowing; the turbine controller would be programmed to bring the rotor to a stop in advance of the commencement of the potential shadow event. Once the period of potential affect has passed, the turbine controller would pitch the blades back in to the wind and the turbine will resume turning.

### SUMMARY

24. In summary, the results of the assessment show the worst case effects for the dwellings within the study area. The maximum potential shadow flicker event that may occur at a property is for approximately 32 minutes (0.53 hours) per day. Potentially shadows may be cast for a maximum of 92 days per year.
25. Due to the limited number of hours that a shadow may potentially be cast from this turbine, and that in reality these events may not always coincide with correct weather conditions, it is practicable to mitigate for the potential shadow effect by control of the turbine.
26. No physiological effects are anticipated.
27. The raw output data from the shadow flicker model used in the analysis contained in this report are provided at Appendix A, at the end of this report. This can be used to programme the shut down times into the turbine controller.
28. It is therefore concluded under this assessment that following mitigation, no residential properties will be affected by shadow flicker.

### REFERENCES

Department for Communities and Local Government (DCLG), 2013, Planning practice guidance for renewable and low carbon energy, HMSO, UK.

Department of Energy and Climate Change (DECC), 2011a, National Policy Statement for Renewable Energy Infrastructure (EN-3), HMSO, UK.

Department of Energy and Climate Change (DECC), 2011b, Update of UK Shadow Flicker Evidence Base, DECC, UK.

# SHADOW FLICKER ASSESSMENT

## APPENDIX A - MERGED SHUTDOWN TIMES

Project : HE\_SHAFTON  
Run Name : 5MSHADOWFLICKERASSESSMENT.WFK

MERGED SHADOW TIMES FROM EACH TURBINE ON ALL HOUSES

| Turbine 1 |       | BeginHoursMinutes | EndHoursMinutes |
|-----------|-------|-------------------|-----------------|
| Day       | Month |                   |                 |
| 09        | 04    | 512               | 521             |
| 10        | 04    | 508               | 524             |
| 11        | 04    | 506               | 525             |
| 12        | 04    | 505               | 526             |
| 13        | 04    | 502               | 527             |
| 14        | 04    | 459               | 528             |
| 15        | 04    | 457               | 528             |
| 16        | 04    | 456               | 528             |
| 17        | 04    | 455               | 528             |
| 18        | 04    | 451               | 528             |
| 19        | 04    | 449               | 528             |
| 20        | 04    | 447               | 527             |
| 21        | 04    | 445               | 527             |
| 22        | 04    | 443               | 526             |
| 23        | 04    | 441               | 525             |
| 24        | 04    | 439               | 524             |
| 25        | 04    | 436               | 522             |
| 26        | 04    | 434               | 520             |
| 27        | 04    | 432               | 518             |
| 28        | 04    | 431               | 517             |
| 29        | 04    | 430               | 515             |
| 30        | 04    | 428               | 514             |
| 01        | 05    | 424               | 512             |
| 02        | 05    | 422               | 509             |
| 03        | 05    | 420               | 509             |
| 04        | 05    | 418               | 508             |
| 05        | 05    | 417               | 506             |
| 06        | 05    | 415               | 505             |
| 07        | 05    | 414               | 503             |
| 08        | 05    | 413               | 501             |
| 09        | 05    | 412               | 500             |
| 10        | 05    | 411               | 459             |
| 11        | 05    | 410               | 458             |
| 12        | 05    | 410               | 457             |
| 13        | 05    | 409               | 456             |
| 14        | 05    | 409               | 454             |
| 15        | 05    | 409               | 454             |
| 16        | 05    | 409               | 453             |
| 17        | 05    | 408               | 452             |
| 18        | 05    | 408               | 452             |
| 19        | 05    | 409               | 451             |
| 20        | 05    | 409               | 450             |
| 21        | 05    | 409               | 448             |
| 22        | 05    | 409               | 447             |
| 23        | 05    | 409               | 444             |
| 24        | 05    | 410               | 441             |

## Co-operative Wind Turbine at Shafton Two Gates

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|       |     |     |
|-------|-----|-----|
| 25 05 | 410 | 441 |
| 26 05 | 411 | 441 |
| 27 05 | 411 | 441 |
| 28 05 | 412 | 440 |
| 29 05 | 412 | 440 |
| 30 05 | 413 | 440 |
| 31 05 | 413 | 440 |
| 01 06 | 414 | 439 |
| 02 06 | 415 | 439 |
| 03 06 | 415 | 439 |
| 04 06 | 416 | 438 |
| 05 06 | 417 | 438 |
| 06 06 | 417 | 438 |
| 07 06 | 418 | 437 |
| 08 06 | 419 | 437 |
| 09 06 | 420 | 436 |
| 10 06 | 421 | 436 |
| 11 06 | 422 | 436 |
| 12 06 | 423 | 435 |
| 13 06 | 424 | 435 |
| 14 06 | 424 | 434 |
| 15 06 | 425 | 434 |
| 16 06 | 426 | 433 |
| 17 06 | 427 | 432 |
| 18 06 | 429 | 432 |
| 24 06 | 430 | 433 |
| 25 06 | 429 | 434 |
| 26 06 | 429 | 435 |
| 27 06 | 428 | 436 |
| 28 06 | 427 | 437 |
| 29 06 | 427 | 438 |
| 30 06 | 426 | 439 |
| 01 07 | 426 | 440 |
| 02 07 | 426 | 441 |
| 03 07 | 425 | 441 |
| 04 07 | 425 | 442 |
| 05 07 | 424 | 443 |
| 06 07 | 424 | 444 |
| 07 07 | 423 | 444 |
| 08 07 | 423 | 445 |
| 09 07 | 422 | 446 |
| 10 07 | 422 | 446 |
| 11 07 | 422 | 447 |
| 12 07 | 421 | 448 |
| 13 07 | 421 | 448 |
| 14 07 | 421 | 449 |
| 15 07 | 420 | 449 |
| 16 07 | 420 | 450 |
| 17 07 | 420 | 450 |
| 18 07 | 419 | 450 |
| 19 07 | 419 | 451 |
| 20 07 | 419 | 453 |
| 21 07 | 419 | 456 |

## SHADOW FLICKER ASSESSMENT

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|       |     |     |
|-------|-----|-----|
| 22 07 | 419 | 458 |
| 23 07 | 419 | 459 |
| 24 07 | 419 | 501 |
| 25 07 | 419 | 502 |
| 26 07 | 419 | 502 |
| 27 07 | 419 | 503 |
| 28 07 | 419 | 504 |
| 29 07 | 419 | 504 |
| 30 07 | 419 | 506 |
| 31 07 | 420 | 507 |
| 01 08 | 420 | 508 |
| 02 08 | 421 | 509 |
| 03 08 | 421 | 510 |
| 04 08 | 422 | 510 |
| 05 08 | 423 | 512 |
| 06 08 | 424 | 514 |
| 07 08 | 425 | 515 |
| 08 08 | 427 | 516 |
| 09 08 | 428 | 517 |
| 10 08 | 429 | 518 |
| 11 08 | 431 | 519 |
| 12 08 | 435 | 521 |
| 13 08 | 437 | 523 |
| 14 08 | 438 | 523 |
| 15 08 | 438 | 524 |
| 16 08 | 440 | 526 |
| 17 08 | 441 | 528 |
| 18 08 | 444 | 529 |
| 19 08 | 445 | 530 |
| 20 08 | 447 | 531 |
| 21 08 | 448 | 531 |
| 22 08 | 451 | 531 |
| 23 08 | 452 | 531 |
| 24 08 | 453 | 531 |
| 25 08 | 456 | 531 |
| 26 08 | 457 | 530 |
| 27 08 | 458 | 530 |
| 28 08 | 459 | 529 |
| 29 08 | 501 | 528 |
| 30 08 | 504 | 527 |
| 31 08 | 505 | 525 |
| 01 09 | 506 | 523 |
| 02 09 | 508 | 521 |
| 03 09 | 512 | 516 |