15 Shadow Flicker

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15 Shadow Flicker

15.1 Executive Summary

15.1.1 The shadow flicker assessment follows the same methodology outlined and undertaken for the Consented Development. The study area, of 10 rotor diameters and 130 degrees either side of north from each proposed turbine location, was revised to account for the increase in rotor diameter of the Revised Development. The increase in study area resulted in an additional of 3 residential receptors being included within the assessment.

15.1.2 The conclusions to the shadow flicker assessment below are the same for the Revised Development as those reached for the Consented Development. It is anticipated that there will be no significant residual shadow flicker effects on nearby residential properties as a result of the operation of the Revised Development.

15.2 Introduction

15.2.1 This chapter describes and assesses potential shadow flicker effects resulting from the Revised Development on neighbouring residential and commercial receptors. 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 Revised Development in Chapter 3.

15.2.2 Shadow flicker occurs when, *"[In] 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"* (Scottish Government, 2014, Onshore Wind Turbines).

15.2.3 Any receptors which may potentially be affected have been identified and the risk of shadow flicker calculated.

15.2.4 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.

15.2.5 The flickering effect caused by shadow flicker also has the potential to induce epileptic seizures in patients with photosensitive epilepsy. The National Society for Epilepsy (NSE) advises that around 1 in 131 people have epilepsy and up to 5 % of these have photosensitive epilepsy (NSE, 2011). 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 less than 3 flashes per second and are therefore unlikely to cause epileptic seizures (Harding *et al*., 2008:

Smedley *et al*., 2010). Therefore, there are not considered to be any health effects associated with the Revised Development and this assessment will address the effects of shadow flicker related to local amenity.

15.2.6 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.

15.2.7 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 as well as the cumulative effect with other operational wind farms in the local area.

15.3 Legislation, Policy and Guidance

Legislation

15.3.1 There is no applicable legislation to this assessment.

Policy

15.3.2 Chapter 5 of the ES sets out the planning policy framework that is relevant to the EIA. The policies set out include those from the adopted Strategic Development Plan and Local Development Plan (LDP) that cover South Lanarkshire (2015), those relevant aspects of Scottish Planning Policy (SPP), National Planning Framework 3 (NPF3), Planning Advice Notes and other relevant guidance. Of relevance to the shadow flicker assessment presented within this chapter, regard has been had to the following policies:

- LDP Policy 19 Renewable Energy; and
- Paragraph 169 of SPP.

15.3.3 SLC Supplementary Guidance 10 on Renewable Energy (2015) sets out policies and other advice in support of wind developments in South Lanarkshire. Paragraph 6.76 (Development Management Considerations) states that the potential effects from shadow flicker on nearby dwellings within 10 rotor diameters should be assessed within the Environmental Statement (ES). Part 10c of the assessment checklist (Table7.1) also states that "*where turbines are within 10 rotor diameters of a residential property an assessment should be undertaken … to assess the potential effect due to shadow flicker*".

Guidance

15.3.4 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.

15.3.5 This assessment also takes into consideration the Scottish Government Online Renewables Planning Advice: Onshore Wind Turbines (Scottish Government, 2014).

15.4 Consultation

15.4.1 The intent to undertake a shadow flicker assessment for this project was originally outlined to SLC in March 2012 as part of a request for a scoping opinion. The SLC Scoping Opinion (refer to Appendix 4.1) requested that the ES *"should include an assessment of the potential of the proposal... to cause*

shadow flicker", taking cognisance of the Update of UK Shadow Flicker Evidence Base (DECC, 2011). It also states that where *"the assessment identifies property being affected by shadow flicker then the assessment shall include measures to mitigate this"*.

15.4.2 The SLC Environmental Health Officer (EHO) was re-consulted in July 2015 to confirm the proposed shadow flicker assessment methodology (refer to Appendix 4.2). The EHO was consulted again in 03 July 2017 and responded, email dated 28 July 2017, to confirm the proposed approach and methodology and noted that a shadow flicker protocol would need to be submitted to SLC, and approved, prior to the operation of the Revised Development.

15.4.3 Given that there are existing residential properties identified within the study area (refer to Section 15.5 below) that could potentially be affected by shadow flicker from the Revised Development, a shadow flicker assessment was carried out as part of the EIA process to assess the likely impacts.

15.5 Assessment Methodology and Significance Criteria

Consultation

15.5.1 Following a design freeze in June 2017 of the final 13 turbine locations, the SLC EHO was contacted to confirm the proposed methodology and requirement to undertake a shadow flicker assessment in respect to the Revised Development (refer to Section 15.4).

Study Area

15.5.2 The shadow flicker assessment has been carried out for the proposed 13 turbines at the locations identified in Chapter 3. As no specific turbine model has been identified by the Applicant, this assessment has chosen the worst-case scenario model, largest rotor diameter, from a short list of candidate turbines that could be installed at the site. Dimensions of the chosen model used for the purposes of the shadow flicker assessment can be found in Table 15.1.

Table 15.1 - Details of the Turbine Model Used for the Shadow Flicker Assessment (Gamesa 132-3.3MW)

Hub height	83.9 m
Rotor diameter	132 m
Swept Area	13,685 m²

15.5.3 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 Update of UK Shadow Flicker Evidence Base report (DECC, 2011) and agreed with the EHO (Appendix 4.3). In this assessment, the study area extends to 1.32 km from each turbine location. Figure 15.1 shows the extent of this area and those receptors that could potentially be affected by shadow flicker.

Desk Study

15.5.4 The desk based assessment identified six representative residential receptors within the study area. Table 15.2 summarises the locations of the receptors and the distance from each property/location to the nearest turbine.

Table 15.2 – Receptor Locations

Receptor ID	Address	Easting	Northing	Elevation (m)	Approx. Distance to Nearest Turbine (km)	Turbine
1	8 Middlemuir Road*	281014	634402	240.5	1.32	T02
2	Braehead	281196	634407	253.0	1.32	T04
3	West Toun House*	282860	633779	219.2	1.03	T06
4	Craigend	282805	633537	221.3	0.81	T06
5	Westerhouse	282803	633471	223.1	0.76	T06
6	Gunsgreen*	281010	633962	268.5	0.90	T02

* *Representative worst-case shadow receptor at location, in line with noise receptor locations.*

15.5.5 The consented Hargreaves Surface Mining Ltd housing development (planning permission in principle), on land at Gunsgreen to the southwest of Coalburn, has also been included within the shadow flicker assessment. Receptor 6 within Table 15.2 provides a representative location on the southern edge of the development for the purposes of the model.

15.5.6 Receptors 1 and 2 are located on the southern edge of Coalburn and provide representation locations for Middlemuir Road and Braehead.

15.5.7 Receptor 3 provides a representative point for the potential effects of shadow flicker from the Revised Development for the three dwellings at the location (refer to Appendix 6.4 Residential Visual Amenity Assessment).

15.5.8 It is noted that 3R Energy has recently been granted planning permission in principle (Planning Reference: CL/17/0157) for a phased industrial development within the eastern extent of the site (refer to Figure 3.2), in addition to the now operational wood gas combined heat and power (CHP) plant (Planning Reference: CL/16/0157). The development will comprise a mix of Class 4 (Business), 5 (General Industrial) and 6 (Storage or Distribution) uses including associated landscaping, service facilities, SUDS/drainage features, internal roadways, infrastructure, parking and other ancillary works. The development does not include for any residential land use and has therefore not been included within the shadow flicker assessment, in accordance with SLC Supplementary Guidance 10 on Renewable Energy (2015).

Assessment of Potential Effect Significance

15.5.9 There is no UK statutory guidance relating to the 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 the maximum limits of 30 hours per year or 30 minutes on the worst affect day.

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

Assessment Modelling

15.5.11 In assessing the effect of shadow flicker, the commercial software model WindPro 3.1.617 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.

15.5.12 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.

15.5.13 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 was 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 was present.

15.5.14 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).

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

- in reality, many of the houses within the study area 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;
- it is unlikely that there will be clear skies 365 days a year;
- receptors may not be occupied at the time that the shadow flicker impact is experienced; and
- screening, such as vegetation or curtains between the window and the turbine 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.

15.5.16 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.

15.5.17 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.

Theoretical Scenario

15.5.18 The modelling results for the theoretical scenario are typically considered to be a worst-case estimation of the actual impacts experienced, and use the assumptions listed in paragraph 15.5.13.

Realistic Scenario

15.5.19 In actuality, 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 above. Other factors such as the potential for screening by vegetation or structures will also reduce or prevent flicker incidence in practice. 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 and take into account any significant shielding of receptors by buildings and vegetation between the receptors and the turbines.

15.5.20 In order to estimate the impact of cloud cover, information available from the Met Office (2017) 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 site. In the case of the Revised Development this is the Eskdalemuir Met Office, situated approximately 50 km to the southeast (summarised data from the Met office website can be found in Appendix 15.1, Table A15.1).

15.5.21 Given the largely dynamic status of woodland over the life time of the Revised Development and between seasons, no vegetative screening was incorporated into the model. However, it is noted that there is mature woodland between the proposed turbines and Receptors 4 and 5 (refer to Figure 15.1) which is not commercial crop and likely to reduce any potential effects identified by the model.

15.5.22 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.

15.5.23 A single 16 degree sector was calculated for 7,446 hours of wind (assumes the Revised Development is operational for 85% of the year) based on meteorological mast data from the Revised Development site (refer to Appendix 15.1, Table A15.2). The WindPro model also employs a slightly simplistic assumption that sunshine probability and turbine operational probability are independent parameters. The model is therefore expected to yield conservative results; as bright and sunny weather conditions and low wind speeds generally tend to show some degree of correlation.

Limitations to Assessment

15.5.24 All assumptions made by the WindPro 3.0 are outlined within Section 15.5.

15.5.25 Given the absence of UK guidance towards shadow flicker, the assessment has adopted the generally accepted industry practised maximum figure of 30 hours per year or 30 minutes per day for permanent dwellings and commercial properties within 10 rotor diameters of the proposed turbines.

15.5.26 The realistic scenario results represent a long-term average as they are based on long-term historic metrological data (88 years, from 1929 to 2016). The variation between individual years can be significant and may lead to future observations differing from the predicted results.

15.6 Baseline Conditions

15.6.1 As per the methodology undertaken for the 2015 Application and agreed with the EHO no site visit was undertaken. Six receptors have been identified within the study area with the potential to experience shadow flicker and they are located to the north (receptors 1, 2, and 6) and northeast (receptors 3, 4 and 5) of the Revised Development.

15.6.2 The properties at receptors 1 and 2 are also predominantly orientated in a south east/north west direction, with the main living space for both properties facing south east or north west, i.e. not directly towards the Revised Development.

15.6.3 Small areas of woodland are located between the receptors 3, 4 and 5 and the proposed turbine locations which act as a visual screen. The woodland is mature and not a commercial crop, it is made up of a mix of species including Scots Pine and broadleaved trees. The properties are also predominantly orientated in a south east/north west direction, with the main living space for both properties facing east, west or north i.e. not directly towards the Revised Development.

15.6.4 No information on the layout and orientation of the proposed houses within the consented Gunsgreen development (receptor 6) is available.

15.6.5 For the purposes of the assessment it is assumed that all properties face onto the Revised Development and no local screening (vegetation and blinds/curtains) are considered.

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

15.7 Assessment of Potential Effects

Construction

15.7.1 No shadow flicker will occur during construction of the Revised Development.

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

Operation

Theoretical Modelling of Shadow Flicker Occurrence

15.7.3 The modelling results presented below represent the theoretical worst-case scenario discussed in Section 15.5. The results of the modelling are shown in Table 15.3. The theoretical duration of shadow flicker calculated is indicated to be significant at receptors 3, 4, 5, and 6 (highlighted in Table 15.3).

Table 15.3 – Worst-Case Scenario Shadow Flicker Occurrence at each Receptor (hrs/yr)

Receptor ID	Address	Shadow Hours per Year	Max Shadow Hours per Day
1	8 Middlemuir Road	09:47	00:20
2	Braehead	23:18	00:38
3	West Toun House	60:28	00:44
4	Craigend	106:43	01:08
5	Westerhouse	118:30	01:10
6	Gunsgreen	72:47	01:03

15.7.4 Graphs A15.1 to A15.6 within Appendix 15.2 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. Mitigation measures would therefore be required for certain turbines during specific times of the year.

15.7.5 However, in reality the duration of shadow flicker at each location is likely to be considerably less than that indicated above for the reasons outlined in Sections 15.5 and 15.6.

Realistic Modelling of Shadow Flicker Occurrence

15.7.6 The modelling results presented in Table 15.4 represent the realistic scenario discussed in paragraph 15.5.16. 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. The results indicate that all the receptors are likely to experience only limited shadow flicker that are significantly less than 30 hours per year (refer to Figure 15.1).

Table 15.4 - Realistic Scenario Shadow Flicker Occurrence for each Receptor (hrs/yr)

Receptor ID	Address	Shadow Hours per Year	Shadow Hours per Day
1	8 Middlemuir Road	01:26	00:03
2	Braehead	03:03	00:05
3	West Toun House	07:51	00:04
4	Craigend	13:59	00:11
5	Westerhouse	15:38	00:11
6	Gunsgreen	08:18	00:06

15.7.7 The results from the model show that all receptors fall well below the recommended limit of 30 hours per year or 30 minutes per day (on the worst affected day).

15.7.8 The model still does not take into consideration any local screening from vegetation, blinds or curtains, or true window orientation relative to the turbines. As discussed in Section 15.6 above, many of the receptors are orientated north west/south east, with the main living areas facing an easterly, westerly or northerly direction i.e. not directly towards the Revised Development. There are also small areas of woodland between the Revised Development and receptor locations 3, 4 and 5, which in reality will reduce further the potential time receptors are likely to experience shadow flicker over the course of the year.

15.7.9 Graphs A15.1 to A15.6 within Appendix 15.2 show that the expected periods of shadow flicker at the six receptor locations is predicted from October to March, winter months, when there is typically less sunshine due to cloud cover.

15.7.10 The results for the realistic scenario show a significant reduction in the potential shadow flicker effects on surrounding receptor locations. The reduction has shown that for all receptors the effect is expected to be of **no significance**.

Decommissioning

15.7.11 No shadow flicker impact can occur post-decommissioning of the Revised Development.

15.7.12 Given that any occurrence of shadow flicker during the short decommissioning period would replicate itself during operation of the Revised Development, it is considered appropriate to consider the decommissioning activities as part of the operational stage of the Revised Development.

15.8 Mitigation

Construction

15.8.1 No mitigation measures are required during the construction phase of the Revised Development.

Operation

15.8.2 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.

15.8.3 Nevertheless, there are a number of forms of mitigation available to developers to mitigate the effects of shadow flicker further, with one of the most effective means being selective automatic turbine shutdown during certain times of year and during certain weather conditions. This level of mitigation is, however, not always required.

15.8.4 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') shall be submitted to and approved in writing by SLC. This would set out mitigation measures to alleviate shadow flicker attributable to the Revised Development as well as a protocol for addressing a complaint received from a receptor within the study area. Operation of the turbines would require 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. This matter could be secured by way of an appropriately worded condition of consent.

Decommissioning

15.8.5 No mitigation measures are required during the decommissioning phase of the Revised Development.

15.9 Residual Effects

14.1.1 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 Revised Development.

15.10 Cumulative Assessment

15.10.1 In order to assess the potential for cumulative impact from other wind developments in the surrounding area or from turbines within the Revised Development, any turbines within 2.5 km of the site were noted. Shadow flicker impacts are considered to extend to 10 rotor diameters (Scottish Government, 2013) from turbine locations, a 2.5 km study for cumulative developments considers any potential for study area overlap between the Revised Development (1,320 m) and a cumulative development with a blade length up to 55 m.

15.10.2 There are six developments located within 2.5 km of the proposed turbine locations, which are as follows:

- Dalquhandy Wind Farm, consented, and located approximately 0.35 km to the west northwest of Turbine 01;

- Cumberhead Wind Farm, consented, and located approximately 2.12 km to the west of Turbine 01;
- Hagshaw Hill Extension, operational, and located approximately 0.84 km to the southwest of Turbine 12;
- Hazelside Farm, operational, and located approximately 1.34 km to the south of Turbine 14;
- Poniel Wind Farm, consented, and located approximately 1.59 km from Turbine 07; and
- Planning application CL/11/0453 (single 20 m to tip wind turbine at Middlefield Farm), consented and located approximately 2.2 km to the north of Turbine 04.

15.10.3 Shadow flicker study areas were calculated for the above developments based on the dimensions and locations detailed within the planning applications. There are two receptors (1 and 6) within the area of overlap between the study area of the Revised Development and Dalquahandy Wind Farm, as such, a cumulative shadow flicker assessment was undertaken. Table 15.5 details the expected total realistic hours of shadow flicker per year on the receptors as a result of the two developments being operational.

Table 15.5 – Cumulative Shadow Hours (Realistic Scenario) at Receptors 1 and 6

Receptor ID	Address	Shadow Hours per Year	Max Shadow Hours per Day
1	8 Middlemuir Road	02:22	00:06
6	Gunsgreen	08:48	00:08

15.10.4 The total number of hours remains well within the recommended limit of 30 hours per year or 30 minutes per day (on the worst affected day). These figures are likely to be conservative as the final orientation of the proposed houses at Gunsgreen is unknown as is any proposed landscaping and planting for the area. In conclusion, there are no anticipated significant cumulative shadow flicker effects with other wind farm developments in the vicinity of the Revised Development.

15.10.5 The cumulative shadow flicker residual effect across the study area is therefore predicted to be of **no significance**.

15.11 Summary

15.11.1 This assessment considers whether the effect known as 'shadow flicker' is likely to be caused by the Revised Development and assesses the potential for impact 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.

15.11.2 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 Revised Development, this area extends to 1,320 m from each turbine.

15.11.3 No shadow flicker impact can occur during the construction or the decommissioning of the turbines.

15.11.4 A shadow flicker assessment was undertaken at the six identified receptors within the study area with potential to experience flicker effects. Calculations have shown that the maximum occurrence of shadow flicker within the realistic scenario was at receptor 5 (Westerhouse) where the effect amounts to approximately 15 and a half hours per year or a maximum of 11 minutes per day, well within the accepted limits for shadow flicker, of either 30 minutes per day or less than 30 hours per year.

15.11.5 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.

15.11.6 Proposed mitigation measures in this case relate to the implementation of a Shadow Flicker Protocol to be agreed with SLC which could include a programme of selective automatic shutdown of certain turbine(s) under certain conditions, if required.

15.11.7 The residual effect of shadow flicker is, therefore, expected to be of **no significance** for all receptors during the operational phase of the Revised Development.

15.11.8 Turbine components will be covered in industry standard non-reflective paint to reduce the occurrence of glinting.

15.11.9 Table 15.6 below provides a summary of effects with regards to the shadow flicker effects resulting from the Revised Development.

Table 15.6 – Summary Table

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect		Comparison with the Consented Development
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse	
Shadow Flicker effects on 6 nearby residential receptors	Negligible	Adverse	Installation of a Shadow Flicker Protocol to be agreed with South Lanarkshire Council.	Negligible	Adverse	No Change

15.12 References

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