Hare Hill Windfarm Repowering and Extension

Shadow Flicker Summary Report

November 2025

1383509/B

ScottishPower Renewables

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Contents

1. Introduction

The Natural Power Consultants Limited ("Natural Power") was commissioned by ScottishPower Renewables (the "Applicant"), to conduct a shadow flicker assessment of the proposed Hare Hill Windfarm Repowering and Extension (the proposed Development).

This work is to determine the extent of the Worst-case and Real-case based on statistics ("Real-case") shadow flicker effects on nearby residential or commercial properties, henceforth called receptors. The receptors have been provided by the Applicant.

This report details the inputs and assumptions made when undertaking the analysis and presents the results and findings.

1.1. Site Description

The proposed Development is located approximately 4 km south-east of New Cumnock, located across both East Ayrshire and Dumfries & Galloway, Scotland. Maps illustrating the site layout and the proposed Development location with respect to the surrounding region are shown in **Appendix A**. The surrounding areas consist of undulating hills with large areas of forestry surrounding the site.

The Client provided the following turbine and layout scenarios for consideration:

Table 1.1: Turbine scenario considered for the proposed Development.

Scenario	Hub height (m)	Maximum tip height (m)	Rotor diameter (m)	Elevation (m ASL)
1	82 - 119	150 - 200	136 - 162	480 - 556

The project is surrounded by a number of settlements which could potentially be impacted by shadow flicker. Natural Power has been provided with a reference point/representative location for each settlement to be considered in this analysis, where 30 locations were provided[1] in total. Receptor locations were selected to represent a worst-case and real-case scenario for the settlements near the proposed Development. The locations of the 30 receptors are presented in Appendix A and the layout of the 23 proposed turbines along with 30 receptors are illustrated in **Figure A.1**. A worst-case scenario map detailing the areas potentially impacted by shadow flicker, represented as propagation patterns from each turbine at the Hare Hill site, is presented in **Figure A.2**. The real-case scenario is presented in Figure A.3. Cumulative shadow flicker effects from the existing Whiteside Hill, Sanquhar I and Sandy Knowe wind farms alongside the Pencloe, Sandy Knowe Extension and Sanquhar II wind farms (under construction/consented at the time of reporting) have been accounted for in this analysis, and are presented in **Figure A.4** and **Figure A.5**.

Maximum tip heights were provided for each turbine location, ranging from 150 m to 200 m. These are provided for each turbine in **Table 1.1**. For the case of this assessment, both Vestas V162 and V136 have been modelled for the relevant tip height restrictions at turbine locations. This assessment should be reviewed and updated should the turbine specifications change, where this will likely result in a change in turbine blade width.

[1] "HHR - EIA Note To Authors - Statement of Agreed Terms", email from James Lightbody to Morgan Leatherbarrow, 15/01/20245

2. Shadow Model

Shadow flicker may occur under certain combinations of geographical position and time of day when the sun passes behind the blades of a wind turbine and casts a shadow over the neighbouring properties. As the blades rotate, a dynamic shadow effect occurs, known as shadow flicker. The effect occurs inside buildings where the flicker appears, generally through a narrow window opening. The likelihood and duration of the effect is dependent upon several variable factors:

- Location of the property relative to the turbine. Please note that Natural Power's methodology for worst case shadow flicker modelling does not take into consideration the orientation of properties or the presence of windows/openings and their dimensions/orientations. Therefore, each receptor is modelled as a worst-case (glasshouse) scenario. Equally the model assumes no sheltering from vegetation or other obstacles is present between the turbine and the receptor.
- Distance from turbine. The further an observer is from the turbine, the less pronounced the effect will be.
- Wind speed and direction. The wind speed at the turbine will need to be greater than the cut-in wind speed of the turbine (typically 3 m/s), and below the cut-out wind speed, in order for the blades to be rotating. In the worst-case scenario modelling, the turbines have been assumed to be rotating at all times. Furthermore, the shape of the shadow will be determined by the position of the sun relative to the blades, which will be yawed to face the wind under normal turbine operation.
- Turbine height and rotor diameter.
- Time of year and day as this determines the height and angle (azimuth and zenith) of the sun in the sky.
- Weather conditions at the time – direct sunshine is required to create the flicker effect and therefore cloud cover reduces the risk of shadow flicker.

While all these factors impact the prevalence of shadow flicker effect occurring at a site, not all factors can be effectively modelled, and a number of assumptions need to be made as part of the modelling process.

2.1. Assessment Methodology

When assessing the impact of shadow flicker at a site, two possible conditions can be considered:

- Worst-case – this determines the maximum number theoretical hours of shadow flicker that can occur, not accounting for the likelihood of direct sunshine occurring in the region, coinciding with periods where shadow flicker is possible. This is a geometric-based calculation, dependant on the location of the sun with respect to the turbine blade, and alignment with the receptor of interest. Outside of these periods, irrespective of the cloud cover and sunshine status, flicker cannot physically occur. The outcome of this process is the maximum number of hours (per annum) at which flicker could, in theory, occur.
- Real-case based on statistics – this takes the worst-case scenario and then adjusts the duration of the total potential flicker events by the likelihood that direct sunshine occurs in a region. Typically, this utilises sunshine data from a ground-based meteorological station to apply monthly scaling factors to the worst-case scenario results. This results in a more accurate representation of the number of hours per year, that a receptor location may experience shadow flicker. The turbines are still modelled as though they are always yawed perpendicularly to the line between the receptor and the sun, inducing maximum shadow effect. The real-case does take topographic shadows into consideration but do not take into account the wind direction and its influence on the shadows.

The scope of this assessment is to determine the real-case scenario. The model makes the following assumptions:

- The turbines are always rotating.
- The sun can be represented as a single point.
- The turbine rotor is modelled as a sphere around the hub to account for all possible turbine yaw directions relative to the line of sight with the position of the sun.

- Terrain effects are considered although this is assumed to be bare terrain and therefore surface effects from cover such as forestry or other buildings are not considered.
- The calculation is purely geometric and does not account for the sensitivity of perception of the observer.
- The likelihood of wind direction and speed is not taken into account.
- Shadow flicker is calculated for a height of 2 m Above Ground Level (AGL) to represent an observer at a ground floor window.
- The shadow receptors are simulated as mounted vertical plates always facing directly at each turbine simultaneously, representing the worst-case scenario (glasshouse) while real windows would be facing towards a particular, selective direction.
- The simulations have been carried out with a resolution of 1 minute.
- The shadow flicker effects have been calculated for the area within the radius of approximately 2053 m from the centre of each turbine at the 180 m and 200 m tip height turbines. The shadow flicker effects have been calculated for the area within the radius of approximately 1811 m for the 150 m tip height turbines. This area is based on a calculated length that the shadows are likely to persist. This is calculated from the average thickness of turbine blades with dimensions matching those provided by the Applicant, from a turbine specifications database.

2.2. **Results**

The results for the worst-case and real-case shadow flicker assessment are detailed in **Table B.1**. In addition, the number of days per year where any shadow flicker could occur, and the turbines which contribute to the flicker effect, are also shown in **Table B.2** and **Table B.3**. The cumulative shadow flicker impacts for neighbours are shown in **Table B.4.**

The results indicate that across affected receptors, the worst-case impact is between zero and 101.9 hours per year. One (R13) of the total thirty receptors experience shadow flicker above the maximum allowed 30 minutes/day and 30 hours/year. However, when considering the real-case assessment, no receptors breach the maximum limits of shadow flicker in terms of total hours per year. When assessing cumulative shadow flicker affects from neighbouring farms, Natural Power found that there were no increases in effect at any of the receptors considered in this analysis that would put any of the locations over the recommended limits. Cumulative assessment results are provided in **Table B.4.**

Table B.2 and **Table B.3** show a list of the days that the real-case shadow flicker on receptors R4 and R13 cause shadow flicker. At receptor R4 there are no days during which the minutes of shadow flicker exceed the daily allowance of 30 minutes, however at R13, approximately 40% of the days that shadow flicker occurs exceed the limit of 30 minutes. It is recommended that further details regarding the orientation and dimensions of the windows at R13 are sourced to update the analysis to assess any further reductions in the shadow flicker events recorded at the receptor.

Natural Power recommends updating the assessment if the consented layout is different from the current layout used for this assessment and presented in **Table A.2**.

3. Conclusion and Recommendations

The Client is advised of the following conclusions and recommendations:

- For the basis of the assessment, Natural Power have been provided locations to include in the assessment of the proposed wind farm and modelled these as receptors location in this analysis, with 30 locations ultimately selected. Receptor locations were selected to represent a worst-case scenario for the settlements near the proposed development.
- The shadow model makes a number of assumptions with respect to the shadow receptors, including the assumption that they have windows directly facing the wind farm, that the direction of the wind is aligned with the line between the receptor and the sun at all times, and that there is no screening from vegetation or buildings which would otherwise mitigate the potential shadow flicker effect. It is recommended that, as specific dwellings are modelled, the affected dwellings are visited to confirm the conditions for shadow flicker are present, and if not, then these receptors are removed from inclusion in the curtailment calculation.
- At receptor R4 there are no days during which the minutes of shadow flicker exceed the daily allowance of 30 minutes, however at R13, approximately 40% of the days that shadow flicker occurs exceed the limit of 30 minutes. It is recommended that further details regarding the orientation and dimensions of the windows at R13 are sourced to update the analysis to assess any further reductions in the shadow flicker events recorded at the receptor.
- Natural Power recommends updating the assessment if the consented layout is different from the current layout used for this assessment and presented in **Table A.2.**
- The ability to implement shutdown of turbines to mitigate potential shadow flicker effects, requires the appropriate shadow module / sunshine sensors to be installed on the turbine and programmed into the turbine SCADA. As such, once the real-case assessment has been carried out with inputs from the site visit regarding the orientation/dimension of the receptors; it is recommended that this equipment is installed on turbines which have been predicted to cause an impact.

Appendices

A. Site Layout and Receptor Locations

Table A.1: Shadow receptor locations used in analysis

Receptor ID	Easting	Northing	Elevation (m ASL)	Distance to nearest turbine (km)
R1	263442	606454	286	2.4
R2	263308	606510	294	2.5
R3	263158	606402	311	2.7
R4	263350	608200	272	1.8
R5	262292	609447	240	2.3
R6	261851	609529	260	2.4
R7	261907	610700	234	2.7
R8	262637	611992	286	2.7
R9	264115	612373	264	2.7
R10	265100	613120	213	2.0
R11	266000	613120	205	2.5
R12	266600	613000	223	2.4
R13	268201	608890	383	2.1
R14	273558	609504	242	1.0
R15	273981	609926	220	5.8
R16	270530	606420	340	6.3
R17	272946	607130	294	2.8
R18	272952	607067	290	5.0
R19	270796	606363	330	5.0
R20	268100	612870	200	3.1
R21	268741	612330	224	2.2
R22	268609	612167	240	2.2
R23	269679	612348	212	2.0
R24	270095	612388	200	3.0
R25	270443	611937	215	3.4
R26	272088	610469	258	3.5
R27	271866	603844	328	4.8
R28	270038	603129	365	5.5
R29	268688	602320	360	4.3
R30	266850	600875	296	3.9

Note that coordinates are in British National Grid.

Table A.2: Hare Hill Windfarm Repowering and Extension turbine locations

Turbine ID	Easting	Northing	Modelled Hub height (m AGL)	Tip Height (m AGL)	Base Elevation (m ASL)
T1	267299	610340	99	180	509
T2	266898	610678	119	200	509
T3	266400	610307	82	150	540
T4	266737	609943	99	180	520
T5	267351	609887	99	180	524
T6	264968	610589	99	180	532
T7	264499	609964	99	180	530
T8	264822	609655	82	150	542
T9	265107	608209	82	150	550
T10	266180	606783	119	200	489
T11	265656	605822	119	200	508
T12	266503	605539	82	150	544
T13	266806	606087	99	180	480
T14	267451	607244	82	150	550
T15	268025	607750	99	180	504
T16	265771	609567	82	150	556
T17	266368	609452	99	180	520
T18	265466	608824	119	200	500
T19	266613	608924	99	180	520
T20	266440	608389	119	200	488
T21	267212	608646	119	200	510
T22	266157	607818	119	200	510
T23	266952	608114	82	150	550

Note that coordinates are in British National Grid.

Table A.3: Pencloe turbine locations

Turbine ID	Easting	Northing	Hub height (m AGL)
T01	261284	607224	82
T02	261240	606828	82
T03	261219	606412	82
T04	261572	606326	82
T05	261365	605944	82
T06	260977	605598	82
T07	261100	605193	82
T08	260686	605784	82
T09	260515	606055	82
T10	260253	606260	82

Turbine ID	Easting	Northing	Hub height (m AGL)
T11	260182	606617	82
T12	260008	606898	82
T13	260382	607050	82
T14	259717	605357	82
T15	259215	605384	82
T16	259090	605686	82
T17	259134	606033	82
T18	259463	605922	82
T19	259740	605785	82

Note that coordinates are in British National Grid.

Table A.4: Sandy Knowe turbine locations

Turbine ID	Easting	Northing	Hub height (m AGL)
T1	269572	611396	69
T2	269201	611337	69
T3	269055	611108	69
T4	268892	610887	69
T5	269005	610574	69
T6	268807	610399	69
T7	268724	610140	69
T8	268633	609877	69
T9	269488	611065	69
T10	269408	610668	69
T11	269198	610102	69
T12	269048	609834	69
T13	269893	610767	69
T14	269962	610498	69
T15	269724	610136	69
T16	269685	609866	69
T17	270428	610753	69
T18	270382	610471	69
T19	270402	610182	69
T20	270151	610007	69
T21	270147	609641	69
T22	270579	609876	69
T23	270830	610051	69
T24	270764	610503	69

Note that coordinates are in British National Grid.

Table A.5: Sandy Knowe Extension turbine locations

Turbine ID	Easting	Northing	Hub height (m AGL)
T1	269572	611396	69
T2	269201	611337	69
T3	269055	611108	69
T4	268892	610887	69
T5	269005	610574	69
T6	268807	610399	69

Table A.6: Sanquhar I turbine locations

Turbine ID	Easting	Northing	Hub height (m AGL)
T1	271343	607571	74
T2	271398	607240	74
T3	270967	607108	74
T4	270476	607158	74
T5	270745	607985	74
T6	270086	607069	74
T7	269714	607527	74
T8	269085	607945	74
T9	268760	607612	74

Table A.7: Sanquhar II turbine locations

Turbine ID	Easting	Northing	Hub height (m AGL)
T1	269049	607171	125
T2	268288	607015	125
T3	267673	606542	125
T4	267437	605867	125
T5	266682	605196	125
T6	266119	604768	125
T7	265660	604150	125
T8	265306	604543	125
T9	264993	604941	125
T10	264947	605469	125
T11	266055	603373	125
T12	266769	603637	125
T13	267282	603469	125
T14	267993	604117	125
T15	268463	604679	125
T16	268566	603463	125
T17	268793	604105	125

Turbine ID	Easting	Northing	Hub height (m AGL)
T18	269493	603801	125
T19	270303	603801	125
T20	270823	603554	125
T21	269912	601914	125
T22	270398	601312	125
T23	270767	600999	125
T24	271405	600887	125
T25	272015	600451	125
T26	272602	600916	125
T27	272622	600262	125
T28	273200	600051	125
T29	273949	599815	125
T30	274648	599339	125
T31	270939	601845	125
T32	271536	602419	125
T33	271853	601945	125
T34	272117	602837	125
T35	272772	603135	125
T36	273344	603022	125
T37	272471	602341	125
T38	272850	602033	125
T39	273291	601732	125
T40	273960	601934	125
T41	273709	601388	125
T42	274058	601025	125
T43	271644	608084	94
T44	271979	607680	94

Table A.8: Whiteside Hill turbine locations

Turbine ID	Easting	Northing	Hub height (m AGL)
T1	270905	604899	69.5
T2	271047	604579	69.5
T3	271528	604749	69.5
T4	271748	605145	69.5
T5	271764	605490	69.5
T6	270979	605290	69.5
T7	271920	604847	69.5
T8	272351	605270	69.5
T9	272494	605657	69.5
T10	272692	606090	69.5

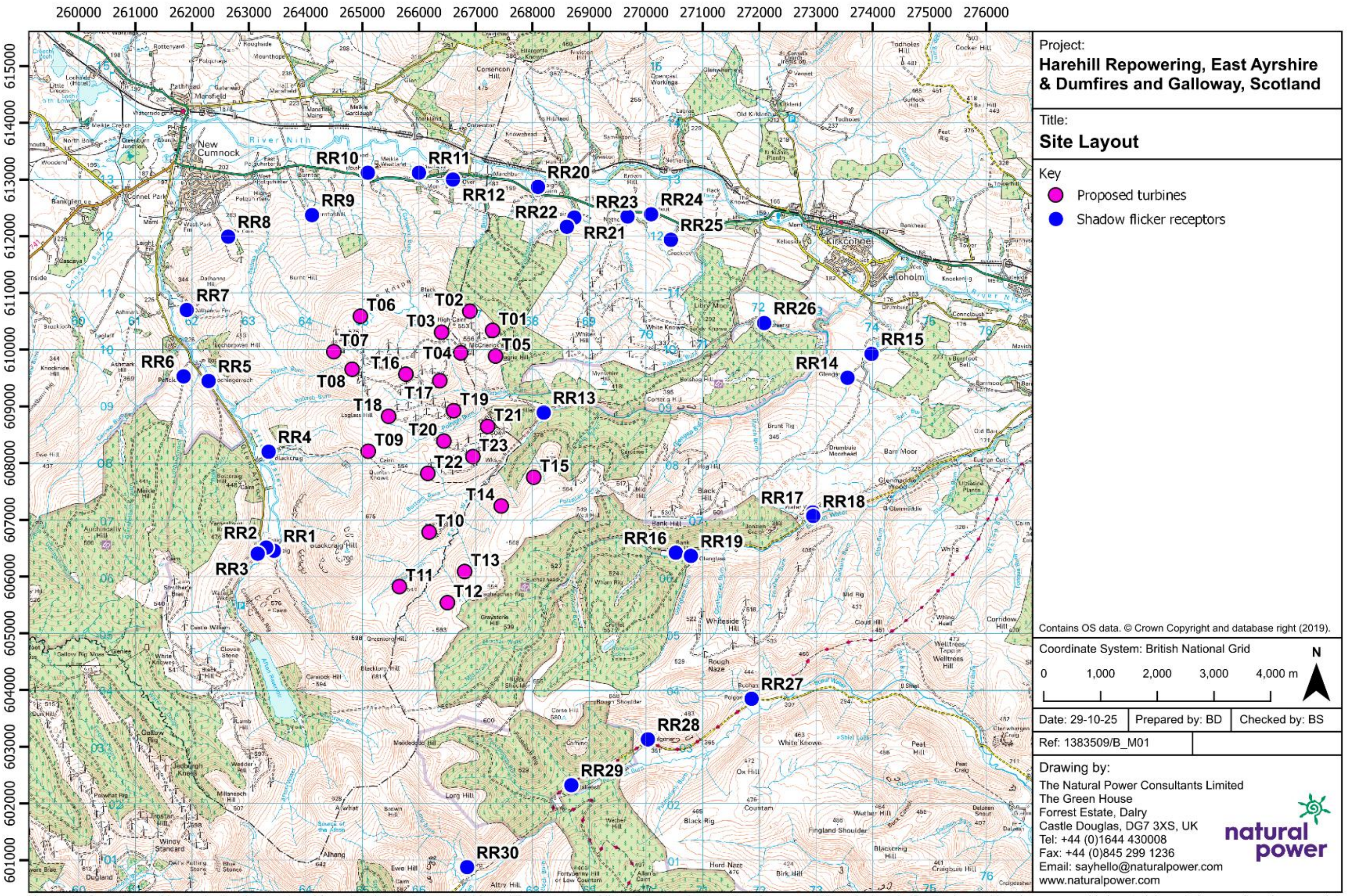

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Figure A.1: Hare Hill Windfarm Repowering and Extension 23-turbine site layout (T1-T23) with receptors (R1-R30)[2]

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[2] Receptors are denoted as "RR" as provided by the Client, where in the rest of the document they are denoted as "R" (standing for Receptor). For example, "RR1" is equivalent to "R1".

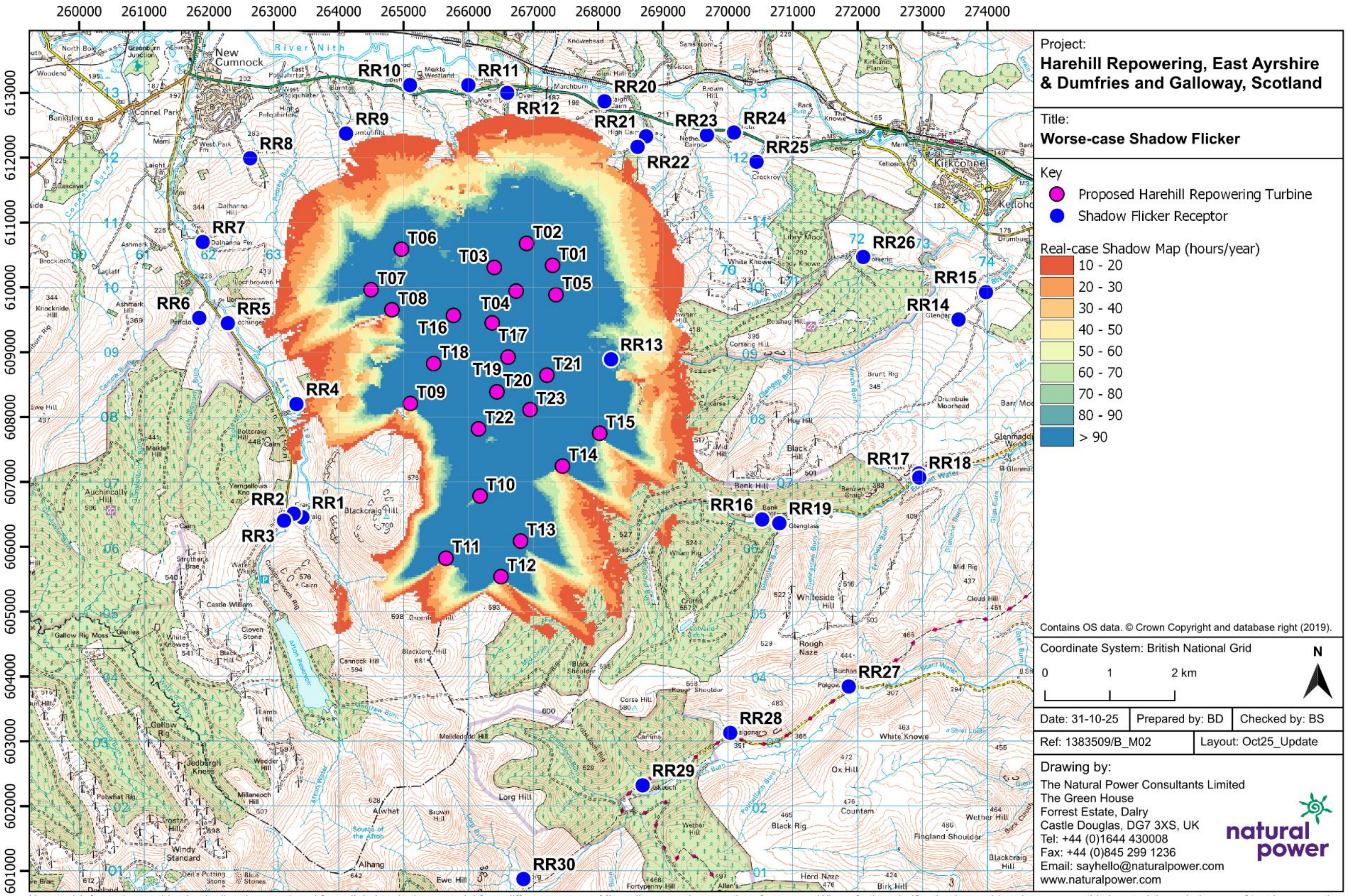

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Figure A.2: **Hare Hill Windfarm Repowering and Extension worst-case shadow flicker map**

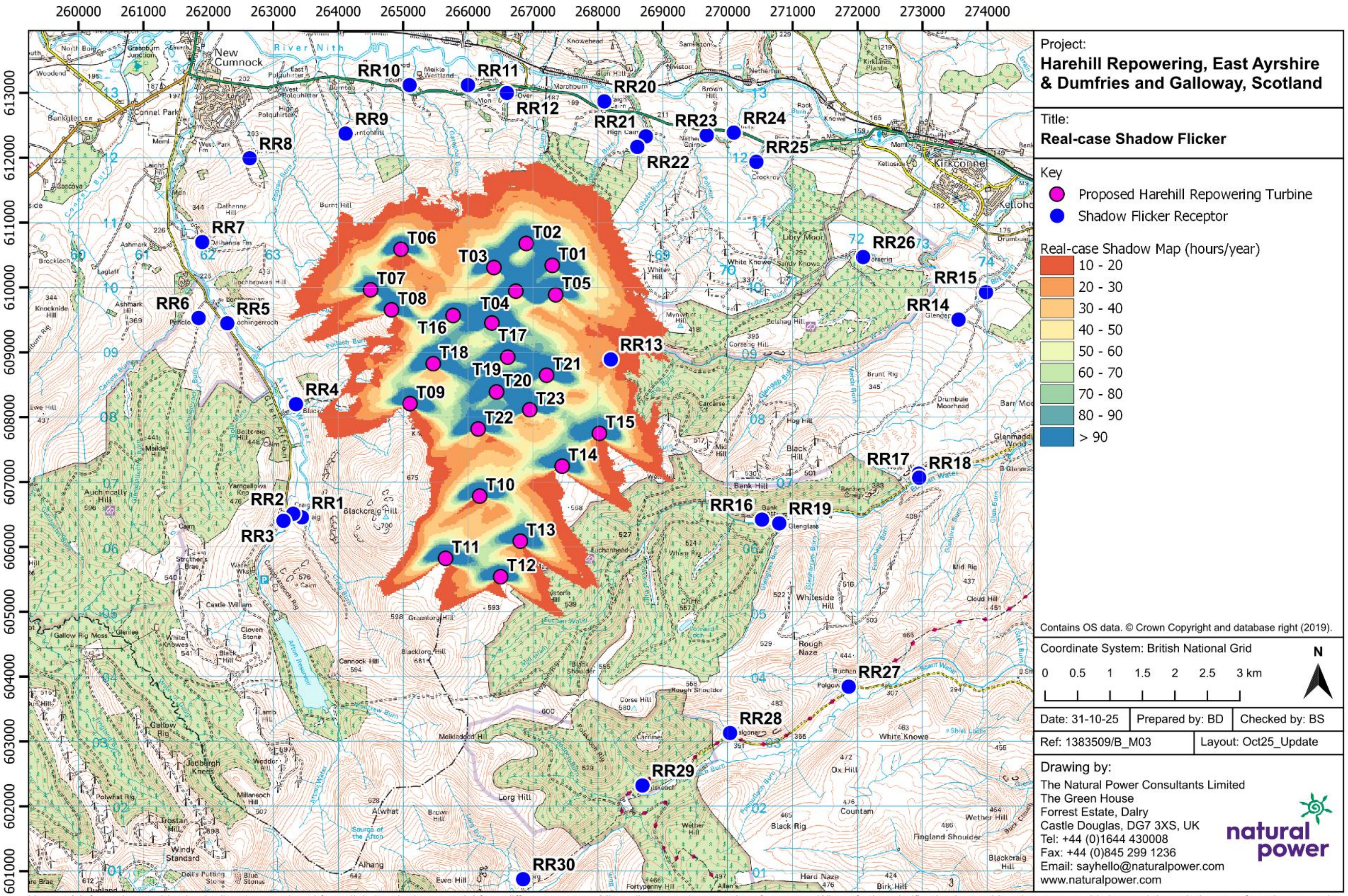

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Figure A.3: **Hare Hill Windfarm Repowering and Extension real-case shadow flicker map**

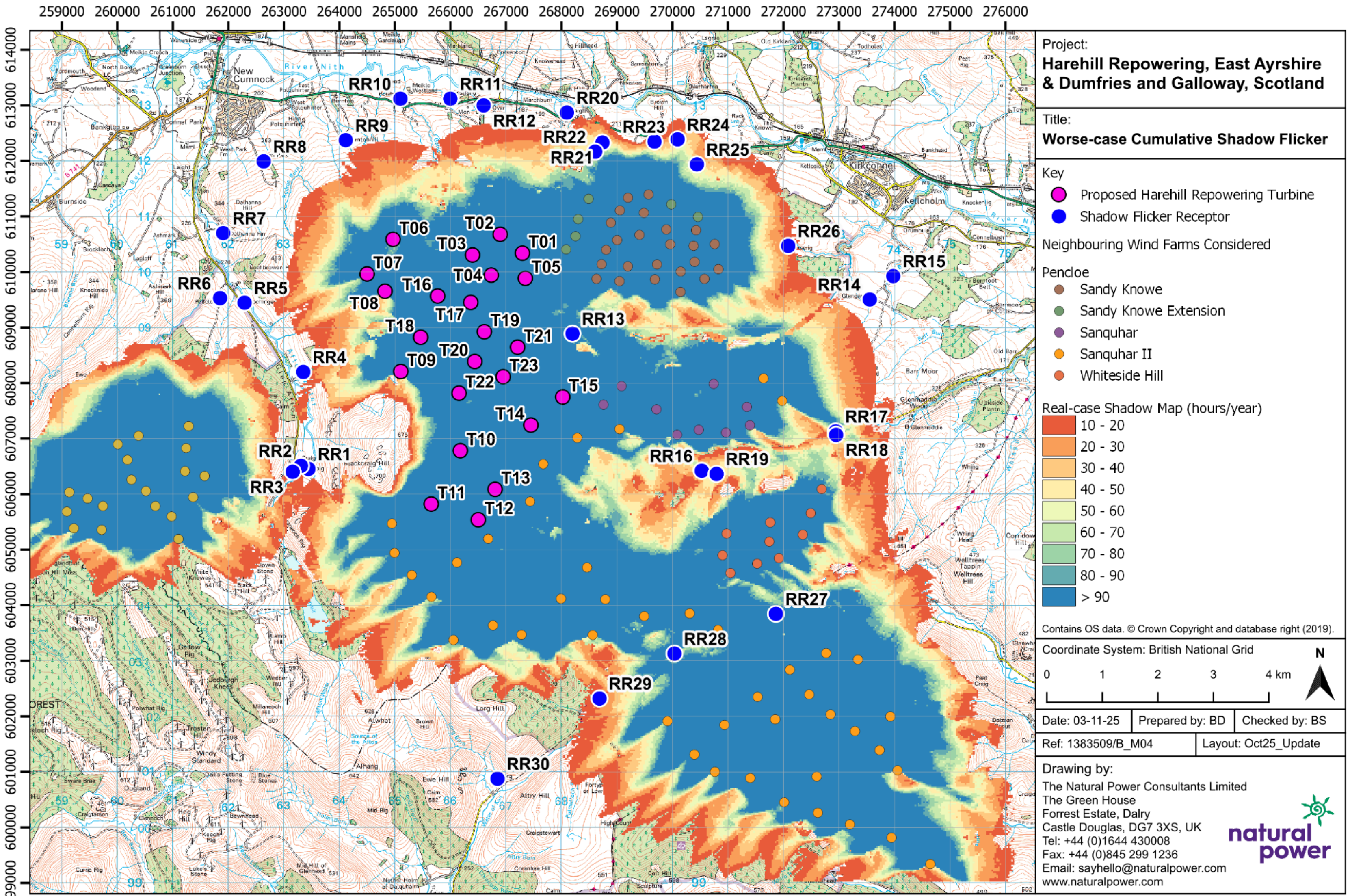

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Figure A.4: **Hare Hill Windfarm Repowering and Extension worst-case cumulative shadow flicker map**

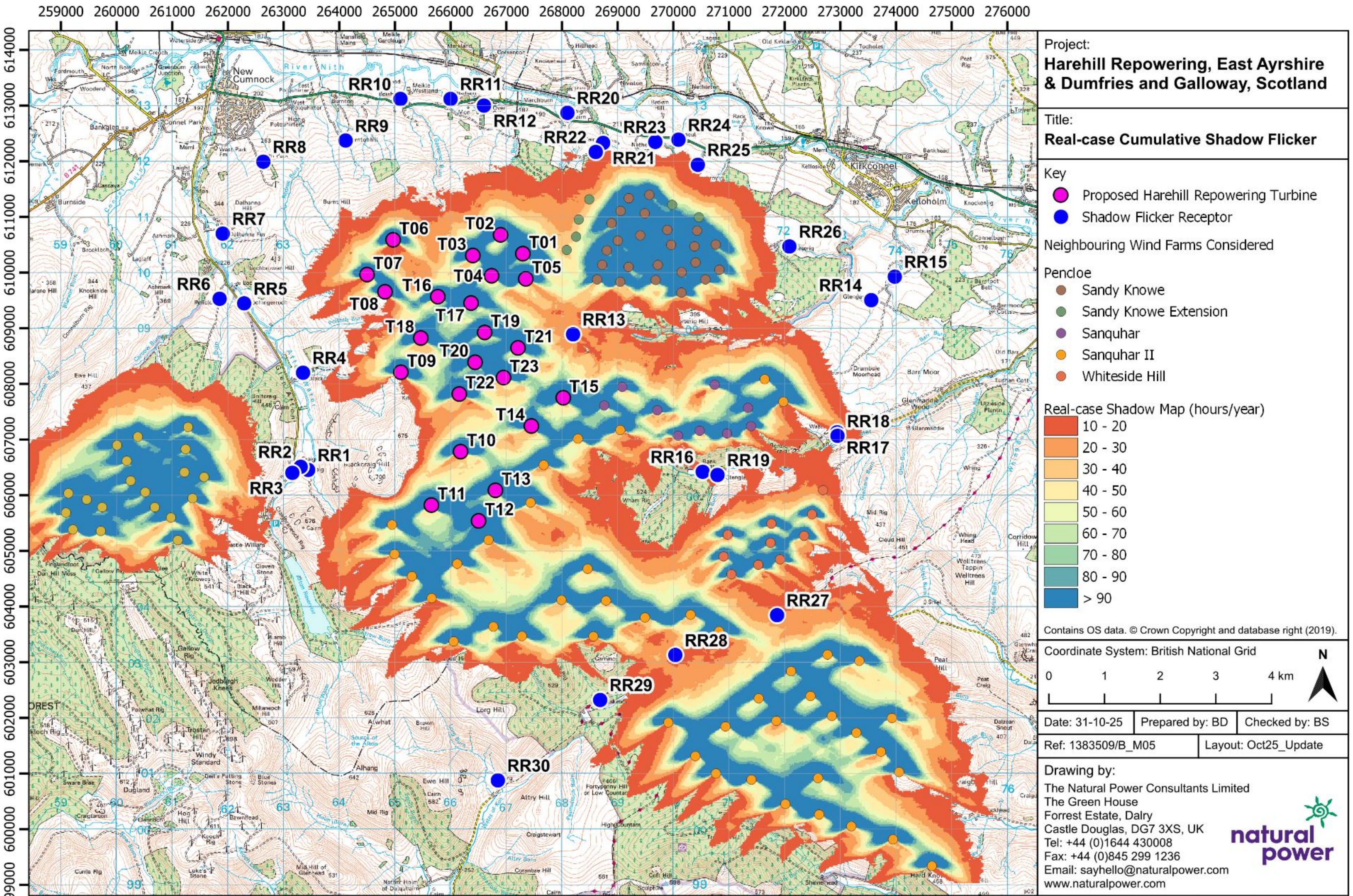

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Figure A.5: Hare Hill Windfarm Repowering and Extension real-case cumulative shadow flicker map

B. Shadow Flicker Results

Table B.1: Results of shadow flicker assessment at each receptor

ID	No. of days with shadow flicker occurrences	Worst-case maximum shadow flicker (mins/day)	Worst-case shadow flicker (hours/annum)	Real-case shadow flicker (hours/annum)
R1	0	0	0.0	0.0
R2	0	0	0.0	0.0
R3	0	0	0.0	0.0
R4	30	21	8.2	2.4
R5	0	0	0.0	0.0
R6	0	0	0.0	0.0
R7	0	0	0.0	0.0
R8	0	0	0.0	0.0
R9	0	0	0.0	0.0
R10	0	0	0.0	0.0
R11	0	0	0.0	0.0
R12	0	0	0.0	0.0
R13	205	**56**	**101.9**	15.6
R14	0	0	0.0	0.0
R15	0	0	0.0	0.0
R16	0	0	0.0	0.0
R17	0	0	0.0	0.0
R18	0	0	0.0	0.0
R19	0	0	0.0	0.0
R20	0	0	0.0	0.0
R21	0	0	0.0	0.0
R22	0	0	0.0	0.0
R23	0	0	0.0	0.0
R24	0	0	0.0	0.0
R25	0	0	0.0	0.0
R26	0	0	0.0	0.0
R27	0	0	0.0	0.0
R28	0	0	0.0	0.0
R29	0	0	0.0	0.0
R30	0	0	0.0	0.0

Table B.2: List of days of shadow flicker exceeding maximum hourly limit for Receptor R4

Day	Minutes of Shadow Flicker	Turbines causing flicker
10-Apr	8	T09
11-Apr	12	T09
12-Apr	14	T09
13-Apr	17	T09
14-Apr	18	T09
15-Apr	21	T09
16-Apr	21	T09
17-Apr	21	T09
18-Apr	21	T09
19-Apr	20	T09
20-Apr	18	T09
21-Apr	16	T09
22-Apr	14	T09
23-Apr	10	T09
24-Apr	4	T09
19-Aug	5	T09
20-Aug	11	T09
21-Aug	15	T09
22-Aug	17	T09
23-Aug	19	T09
24-Aug	20	T09
25-Aug	21	T09
26-Aug	21	T09
27-Aug	21	T09
28-Aug	21	T09
29-Aug	19	T09
30-Aug	16	T09
31-Aug	14	T09
01-Sep	12	T09
02-Sep	7	T09

Table B.3: List of days of shadow flicker exceeding maximum hourly limit for Receptor R13

Day	Minutes of Shadow Flicker	Turbines causing flicker
01-Jan	**55**	T14, T15
02-Jan	**55**	T14, T15
03-Jan	**55**	T14, T15
04-Jan	**54**	T14, T15
05-Jan	**53**	T14, T15
06-Jan	**53**	T14, T15
07-Jan	**51**	T14, T15
08-Jan	**49**	T14, T15
09-Jan	**48**	T14, T15
10-Jan	**46**	T14, T15
11-Jan	**43**	T14, T15
12-Jan	**38**	T14, T15
13-Jan	**34**	T15
14-Jan	**33**	T15
15-Jan	**33**	T15
16-Jan	**32**	T15
17-Jan	**31**	T15
18-Jan	**30**	T15
19-Jan	29	T15
20-Jan	28	T15
21-Jan	26	T15
22-Jan	24	T15
23-Jan	22	T15
24-Jan	18	T15
25-Jan	15	T15
26-Jan	9	T15
15-Feb	3	T23
16-Feb	7	T23
17-Feb	10	T23
18-Feb	12	T23
19-Feb	15	T23
20-Feb	17	T23
21-Feb	19	T23
22-Feb	20	T23
23-Feb	22	T23
24-Feb	24	T23
25-Feb	25	T23
26-Feb	23	T23
27-Feb	21	T23

Day	Minutes of Shadow Flicker	Turbines causing flicker
28-Feb	19	T23
01-Mar	15	T23
02-Mar	9	T23
14-Mar	3	T21
15-Mar	8	T21
16-Mar	12	T21
17-Mar	16	T21
18-Mar	19	T21
19-Mar	21	T21
20-Mar	25	T21
21-Mar	27	T21
22-Mar	29	T21
23-Mar	**31**	T21
24-Mar	**34**	T21
25-Mar	**35**	T21
26-Mar	**36**	T21
27-Mar	**35**	T21
28-Mar	**34**	T21
29-Mar	**32**	T21
30-Mar	**31**	T21
31-Mar	29	T21
01-Apr	26	T21
02-Apr	23	T21
03-Apr	19	T21
04-Apr	12	T21
08-Apr	3	T19
09-Apr	5	T19
10-Apr	7	T19
11-Apr	9	T19
12-Apr	10	T19
13-Apr	10	T19
14-Apr	7	T19
29-Apr	1	T17
30-Apr	3	T17
01-May	6	T17
02-May	9	T17
03-May	12	T17
04-May	15	T17
05-May	13	T17
06-May	10	T17

Day	Minutes of Shadow Flicker	Turbines causing flicker
07-May	4	T17
06-Aug	7	T17
07-Aug	11	T17
08-Aug	14	T17
09-Aug	13	T17
10-Aug	11	T17
11-Aug	9	T17
12-Aug	5	T17
13-Aug	2	T17
29-Aug	8	T19
30-Aug	11	T19
31-Aug	10	T19
01-Sep	8	T19
02-Sep	7	T19
03-Sep	5	T19
04-Sep	3	T19
08-Sep	12	T21
09-Sep	18	T21
10-Sep	23	T21
11-Sep	26	T21
12-Sep	28	T21
13-Sep	**31**	T21
14-Sep	**32**	T21
15-Sep	**34**	T21
16-Sep	**35**	T21
17-Sep	**35**	T21
18-Sep	**36**	T21
19-Sep	**34**	T21
20-Sep	**31**	T21
21-Sep	29	T21
22-Sep	27	T21
23-Sep	25	T21
24-Sep	23	T21
25-Sep	19	T21
26-Sep	16	T21
27-Sep	13	T21
28-Sep	9	T21
29-Sep	5	T21
11-Oct	2	T23
12-Oct	13	T23

Day	Minutes of Shadow Flicker	Turbines causing flicker
13-Oct	17	T23
14-Oct	20	T23
15-Oct	22	T23
16-Oct	24	T23
17-Oct	25	T23
18-Oct	23	T23
19-Oct	22	T23
20-Oct	20	T23
21-Oct	18	T23
22-Oct	16	T23
23-Oct	14	T23
24-Oct	12	T23
25-Oct	9	T23
26-Oct	6	T23
27-Oct	2	T23
16-Nov	9	T15
17-Nov	15	T15
18-Nov	18	T15
19-Nov	22	T15
20-Nov	24	T15
21-Nov	26	T15
22-Nov	28	T15
23-Nov	29	T15
24-Nov	**30**	T15
25-Nov	**31**	T15
26-Nov	**32**	T15
27-Nov	**33**	T15
28-Nov	**33**	T15
29-Nov	**33**	T15
30-Nov	**39**	T14, T15
01-Dec	**43**	T14, T15
02-Dec	**45**	T14, T15
03-Dec	**49**	T14, T15
04-Dec	**49**	T14, T15
05-Dec	**51**	T14, T15
06-Dec	**52**	T14, T15
07-Dec	**53**	T14, T15
08-Dec	**53**	T14, T15
09-Dec	**55**	T14, T15
10-Dec	**55**	T14, T15

Day	Minutes of Shadow Flicker	Turbines causing flicker
11-Dec	55	T14, T15
12-Dec	55	T14, T15
13-Dec	55	T14, T15
14-Dec	55	T14, T15
15-Dec	55	T14, T15
16-Dec	56	T14, T15
17-Dec	55	T14, T15
18-Dec	56	T14, T15
19-Dec	55	T14, T15
20-Dec	56	T14, T15
21-Dec	55	T14, T15
22-Dec	55	T14, T15
23-Dec	55	T14, T15
24-Dec	55	T14, T15
25-Dec	55	T14, T15
26-Dec	55	T14, T15
27-Dec	55	T14, T15
28-Dec	55	T14, T15
29-Dec	55	T14, T15
30-Dec	55	T14, T15
31-Dec	55	T14, T15

Table B.4: Results of cumulative shadow flicker assessment at each receptor

ID	Worst-case maximum shadow flicker (mins/day)		Real-case shadow flicker (hours/annum)		Comment
	Total Hours with Relevant Neighbours Considered	Hours caused by Hare Hill Windfarm Repowering and Extension Development	Total Hours with Relevant Neighbours Considered	Hours caused by Hare Hill Windfarm Repowering and Extension Development	
R1	21	0	0.2	0.0	Flicker entirely from Sanquhar II
R2	19	0	0.7	0.0	Flicker entirely from Sanquhar II
R3	19	0	1.3	0.0	Flicker entirely from Sanquhar II
R4	21	21	2.4	2.4	Flicker Entirely from Hare Hill Repowering
R5	0	0	0.0	0.0	No Shadow Flicker recorded
R6	0	0	0.0	0.0	No Shadow Flicker recorded
R7	0	0	0.0	0.0	No Shadow Flicker recorded
R8	0	0	0.0	0.0	No Shadow Flicker recorded
R9	0	0	0.0	0.0	No Shadow Flicker recorded
R10	0	0	0.0	0.0	No Shadow Flicker recorded
R11	0	0	0.0	0.0	No Shadow Flicker recorded
R12	0	0	0.0	0.0	No Shadow Flicker recorded
R13	87	56	17.6	15.6	Flicker mostly from Hare Hill Repowering and the remaining is from Sanquhar I, Sanquhar II
R14	0	0	0.0	0.0	No Shadow Flicker recorded

ID	Worst-case maximum shadow flicker (mins/day) Total Hours with Relevant Neighbours Considered	Worst-case maximum shadow flicker (mins/day) Hours caused by Hare Hill Windfarm Repowering and Extension Development	Real-case shadow flicker (hours/annum) Total Hours with Relevant Neighbours Considered	Real-case shadow flicker (hours/annum) Hours caused by Hare Hill Windfarm Repowering and Extension Development	Comment
R15	0	0	0.0	0.0	No Shadow Flicker recorded
R16	27	0	11.2	0.0	Flicker entirely from Whiteside Hill and Sanquhar II
R17	**30**	0	3.5	0.0	Flicker entirely from Whiteside Hill, Sanquhar I, Sanquhar II
R18	29	0	4.8	0.0	Flicker entirely from Whiteside Hill, Sanquhar I, Sanquhar II
R19	**32**	0	9.3	0.0	Flicker entirely from Whiteside Hill, Sanquhar I, Sanquhar II
R20	0	0	0.0	0.0	No Shadow Flicker recorded
R21	**55**	0	7.7	0.0	Flicker entirely from Sandy Knowe
R22	**56**	0	10.8	0.0	Flicker entirely from Sandy Knowe
R23	**35**	0	3.8	0.0	Flicker entirely from Sandy Knowe
R24	**34**	0	5.1	0.0	Flicker entirely from Sandy Knowe
R25	**41**	0	7.8	0.0	Flicker entirely from Sandy Knowe
R26	27	0	3.3	0.0	Flicker entirely from Sandy Knowe

ID	Worst-case maximum shadow flicker (mins/day)		Real-case shadow flicker (hours/annum)		Comment
	Total Hours with Relevant Neighbours Considered	Hours caused by Hare Hill Windfarm Repowering and Extension Development	Total Hours with Relevant Neighbours Considered	Hours caused by Hare Hill Windfarm Repowering and Extension Development	
R27	77	0	22.8	0.0	Flicker entirely from Sanquhar II
R28	43	0	13.8	0.0	Flicker entirely from Sanquhar II
R29	29	0	4.3	0.0	Flicker entirely from Sanquhar II
R30	0	0	0.0	0.0	No Shadow Flicker recorded

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