

# APPENDIX - 11

## SHADOW FLICKER ASSESSMENT RESULTS

Project Reference	200445-g Coole ABP Further Information
Date & Time	19.10.2022
Subject	Shadow Flicker Assessment Results
Author(s)	Emily Lynch, James Newell, Ellen Costello

### Introduction

MKO has been commissioned to conduct a Shadow Flicker Assessment of 3 no. scenarios (Scenarios 1, 2 and 3) in relation to turbine dimensions for the Proposed Coole Wind Farm Development following receipt of a request for Further Information from An Bord Pleanála (ref: ABP-309770-21).

Three turbine scenarios have been assessed, the results of which are presented below:

- **Scenario 1** as modelled and assessed in Chapter 5 of the Environmental Impact Assessment Report (EIAR) lodged and as submitted to An Bord Pleanála in 2021 (2021 EIAR).
- **Scenario 2**
- **Scenario 3**

*Table 1 Turbine Scenarios*

Label	Tip Height (m)	Hub Height (m)	Blade Length (m)	Rotor Diameter (m)
<b>Scenario 1 (2021 EIAR)</b>	175	97.5	77.5	155
<b>Scenario 2</b>	175	100	75	150
<b>Scenario 3</b>	175	100.5	74.5	149

The Shadow Flicker Assessment was carried out by Emily Lynch an Environmental Scientist, and James Newell a Graphics Technician, both of MKO. This Shadow Flicker Assessment has been reviewed by Ellen Costello, a Project Environmental Scientist of MKO.

### Shadow Flicker Prediction Methodology

Shadow Flicker occurs only under certain, combined circumstances. Where shadow flicker does occur, it is generally short-lived.

The occurrence of shadow flicker can be precisely predicted using specialist computer software programmes specifically developed for the wind energy industry, such as WindFarm (ReSoft) or WindFarmer (DNV.GL) or AWS OpenWind or WindPro.

The computer modelling of the occurrence and magnitude of shadow flicker is made possible by the fact that the sun rises and sets in the same position in the sky on every day each year.

Any potential impact can be precisely modelled to give the start and end time (accurate to the second) of any incidence of shadow flicker, at any location, on any day or all days of the year when it

might occur. Where a shadow flicker impact is predicted to occur, the total maximum daily and annual durations can be predicted, along with the total number of days.

For the purposes of this shadow flicker assessment, the software package ReSoft WindFarm Version 5.0.1.2 has been used to predict the level of shadow flicker associated with the Coole Wind Farm Development.

The total annual shadow flicker calculated for each property assumes 100% sunshine during daytime hours. However, weather data for this region shows that the sun shines on average for 30.1% of the daylight hours per year. This percentage is based on Met Eireann data recorded at Mullingar over the 30-year period from 1981 to 2010 ([www.met.ie](http://www.met.ie)). The actual sunshine hours at the Coole Wind Farm Site and therefore the percentage of time shadow flicker could actually occur is 30.1%.

The shadow flicker model does not consider that the turbine will not always be yawed such that the rotor is in the worst-case orientation. In order to include the probability of the rotor being orientated within the sun turbine vector, a wind directionality factor has also been applied. Three-years wind direction frequency distribution has been collected from the Coole met mast (PI ref 18/1624) and correlated with MERRA 5 node data from a 20 year period to produce an estimate of the long-term wind direction frequency in the region of the Wind Farm Site. Using this data, it is possible to estimate the probability of the rotor being orientated within 30 degrees of a vector parallel to the sun turbine vector. This probability is estimated at a reduction of 37% based on the most onerous wind direction.

The assessment tables below therefore lists the annual shadow flicker calculated for each property when corrected for the regional average of 30.1% sunshine and wind reduction factor of 37%, to give a more accurate annual average shadow flicker prediction.

The assessment tables below outlines whether a shadow flicker mitigation strategy is required for any property within the study area which may be impacted by shadow flicker.

## Guidance

The current, adopted guidance for shadow flicker in Ireland is derived from the '*Wind Energy Development Guidelines for Planning Authorities 2006*' (DoEHLG), and the '*Best Practice Guidelines for the Irish Wind Energy Industry*' (Irish Wind Energy Association, 2012). The 2006 DoEHLG Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The DoEHLG 2006 wind energy guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year or 30 minutes per day. As detailed in Chapter 5 Population & Human Health, Section 5.7.2, there are no occupied dwellings within 500m of any proposed turbine location. The closest occupied dwelling H14 (i.e. dwelling not involved with the proposed development) is located at a distance of approx. 700 metres from the nearest proposed turbine T11. There are 2 no. dwellings, H18 and H24 which are located at distances of 638m and 679m from T15 respectively however these are individuals involved with the proposed development.

The adopted 2006 DoEHLG guidelines are currently under review. The DoHPLG released the 'Draft Revised Wind Energy Development Guidelines' in December 2019 for public consultation. The Draft 2019 guidelines recommend local planning authorities and/or An Bord Pleanála impose conditions to ensure that:



*“no existing dwelling or other affected property will experience shadow flicker as a result of the wind energy development subject of the planning application and the wind energy development shall be installed and operated in accordance with the shadow flicker study submitted to accompany the planning application, including any mitigation measures required.”*

The Draft 2019 Guidelines are based on the recommendations set out in the ‘Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review’ (December 2013) and the ‘Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach’ (June 2017).

The applicant is aware that the Department of the Environment, Heritage and Local Government (DoEHLG) Wind Energy Development Planning Guidelines (2006) are currently being revised. The assessment herein is based on compliance with the DoEHLG Guidelines limit (30 hours per year or 30 minutes per day) however in line with the commitment made for the permitted development and following continuing engagement with the local community, Coole Wind Farm Ltd is committing to zero shadow flicker at occupied residential receptors within 10 rotor diameters of the proposed development.

## Study Area

The study area for the shadow flicker assessment is ten times rotor diameter, as set out in the ‘*Wind Energy Development Guidelines for Planning Authorities*’, DoEHLG, 2006. The study area for the Proposed Coole Wind Farm under all three scenarios modelled is as follows:

Table 2: Study Area

Label	Rotor Diameter (m)	Study Area (m)
Scenario 1 (2021 EIAR)	155	1550
Scenario 2	150	1500
Scenario 3	149	1490

All residential properties located within ten rotor diameters of the Coole Wind Farm have been included within this assessment.



## Processing Results

### Scenario 1 – Maximum Rotor Diameter of 155m

Table 1 Maximum Potential Daily and Annual Shadow Flicker for Scenario 1 (2021 EIAR)

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine and Wind Direction (hrs:min:sec)	Turbine(s) Giving Rise to Exceedance	Mitigation Strategy Required?
1	640265	773572	Dwelling	1189	14	00:00:00	0:00:00	0:00:00	-	No
2	638979	775866	Dwelling	1127	11	00:35:24	52:42:00	10:59:22	8, 10, 11	Yes
3	639016	775795	Dwelling	1054	11	00:37:12	55:18:00	11:31:54	8, 10, 11	Yes
4	640289	773649	Dwelling	1113	14	00:00:00	0:00:00	0:00:00	-	No
5	640330	773542	Dwelling	1175	14	00:00:00	0:00:00	0:00:00	-	No
6	640947	773562	Dwelling	956	14	00:00:00	0:00:00	0:00:00	-	No
7	641116	774222	Derelict	323	14	00:40:12	44:42:00	9:19:17	12	No
8	640084	773521	Dwelling	1264	12	00:00:00	0:00:00	0:00:00	-	No
9	642272	774530	Dwelling	1237	15	00:30:00	13:00:00	2:42:39	14	No
10	642185	774543	Dwelling	1200	14	00:31:48	26:30:00	5:31:34	13, 14	Yes
11	641937	774707	Dwelling	970	14	00:39:00	52:18:00	10:54:22	9, 13, 14	Yes
12	641910	774724	Dwelling	948	14	00:39:36	54:06:00	11:16:53	9, 13, 14	Yes
13	641664	775254	Dwelling	822	5	01:14:24	217:24:00	<b>45:20:04</b>	8, 9, 10, 12, 13, 14, 15	Yes
14	639601	775807	Dwelling	703	11	01:17:24	190:18:00	<b>39:41:00</b>	7, 8, 9, 10, 11, 12, 13	Yes

15	642951	776614	Dwelling	970	15	00:39:00	55:06:00	11:29:24	3, 4, 5	Yes
16	642901	776844	Dwelling	910	4	00:47:24	67:36:00	14:05:48	2, 3, 4, 5	Yes
17	642806	776444	Dwelling	784	15	00:43:12	91:12:00	19:01:05	3, 4, 5, 15	Yes
18	642756	776340	Dwelling	679	15	00:39:36	89:24:00	18:38:33	3, 4, 5	Yes
19	642706	776361	Dwelling	703	15	00:39:00	87:06:00	18:09:47	3, 4, 5	Yes
20	642682	776398	Dwelling	743	15	00:54:36	98:18:00	20:29:55	2, 3, 4, 5, 6, 15	Yes
21	642653	776542	Dwelling	754	4	00:53:24	115:42:00	24:07:37	2, 3, 4, 5	Yes
22	642667	776522	Dwelling	776	4	00:51:36	109:36:00	22:51:18	2, 3, 4, 5	Yes
23	642579	776502	Dwelling	713	4	00:58:12	109:12:00	22:46:17	2, 3, 4, 5, 6	Yes
24	642733	776298	Dwelling	638	15	00:46:12	88:00:00	18:21:02	3, 4, 5	Yes
25	642155	778365	Dwelling	1322	2	00:25:48	13:42:00	2:51:25	2	No
26	642239	778362	Derelict	1368	2	00:27:36	18:48:00	3:55:13	2	No
27	642260	775081	Derelict	774	15	00:28:12	38:30:00	8:01:42	6, 9, 13, 14	No
28	638928	775869	Dwelling	1169	11	00:34:12	37:42:00	7:51:42	10, 11	Yes
29	639065	775820	Dwelling	1032	11	00:38:24	61:36:00	12:50:44	8, 10, 11	Yes
30	639192	775658	Derelict	831	11	00:46:12	81:42:00	17:02:13	8, 10, 11, 12	No
31	640310	773582	Derelict	1154	14	00:00:00	0:00:00	0:00:00	-	No
32	642886	776870	Derelict	893	4	00:45:00	68:48:00	14:20:49	2, 3, 4, 5	No
33	643163	777432	Dwelling	1282	4	00:30:36	15:36:00	3:15:11	4	Yes
34	641308	775128	Derelict	564	13	01:27:36	193:18:00	<b>40:18:32</b>	10, 11, 12, 13, 14	No
42	642644	776514	Dwelling	761	4	00:55:48	117:00:00	24:23:53	2, 3, 4, 5, 6	Yes
43	642454	777256	Derelict	577	4	01:27:36	123:48:00	25:48:58	2, 3, 4, 5	No
44	640763	773492	Dwelling	1049	14	00:00:00	0:00:00	0:00:00	-	No
46	643256	776221	Dwelling	740	15	00:49:12	109:48:00	22:53:48	4, 5, 15	Yes
47	643616	775360	Dwelling	896	15	00:43:12	45:18:00	9:26:47	15	Yes
48	643678	776105	Dwelling	1009	15	00:37:48	25:36:00	5:20:18	15	Yes

49	642295	774677	Dwelling	1094	15	00:29:24	13:00:00	2:42:39	14	No
50	643720	776266	Dwelling	1125	15	00:34:48	23:06:00	4:49:01	15	Yes
51	643849	775245	Dwelling	1155	15	00:34:12	26:24:00	5:30:19	15	Yes
52	644046	775197	Dwelling	1356	15	00:29:24	17:36:00	3:40:12	15	No
53	640421	773230	Dwelling	1406	14	00:00:00	0:00:00	0:00:00	-	No
54	642467	774281	Dwelling	1414	15	00:25:48	8:00:00	1:40:06	14	No
55	640496	773182	Dwelling	1422	14	00:00:00	0:00:00	0:00:00	-	No
56	640508	773129	Dwelling	1468	14	00:00:00	0:00:00	0:00:00	-	No
57	641611	773183	Dwelling	1474	14	00:00:00	0:00:00	0:00:00	-	No
58	644197	775241	Dwelling	1486	15	00:27:00	13:00:00	2:42:39	15	No
59	643867	776669	Dwelling	1489	15	00:28:12	22:18:00	4:39:01	15	No
60	643363	777513	Dwelling	1497	4	00:26:24	11:24:00	2:22:38	4	No
61	640609	773065	Dwelling	1500	14	00:00:00	0:00:00	0:00:00	-	No
62	643862	776714	Dwelling	1516	15	00:27:36	24:12:00	5:02:47	15	No
63	641588	773109	Dwelling	1532	14	00:00:00	0:00:00	0:00:00	-	No

## Scenario 2 - Median Rotor Diameter of 150m

Table 2 Maximum Potential Daily and Annual Shadow Flicker

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daly Shadow Flicker Exceedance	Mitigation Strategy Required (Annual)
1	640265	773572	Dwelling	1189	14	00:00:00	0:00:00	0:00:00		No
2	638979	775866	Dwelling	1127	11	00:34:12	40:06:00	8:21:43	11	Yes
3	639016	775795	Dwelling	1054	11	00:36:00	42:00:00	8:45:30	11	Yes
4	640289	773649	Dwelling	1113	14	00:00:00	0:00:00	0:00:00		No
5	640330	773542	Dwelling	1175	14	00:00:00	0:00:00	0:00:00		No
6	640947	773562	Dwelling	956	14	00:00:00	0:00:00	0:00:00		No
7	641116	774222	Derelict	323	14	00:39:00	42:36:00	8:53:00	12	Yes
8	640084	773521	Dwelling	1264	12	00:00:00	0:00:00	0:00:00		No
9	642272	774530	Dwelling	1237	15	00:28:48	12:36:00	2:37:39		No
10	642185	774543	Dwelling	1200	14	00:30:36	14:24:00	3:00:10	14	Yes
11	641937	774707	Dwelling	970	14	00:37:48	50:06:00	10:26:50	13,14	Yes
12	641910	774724	Dwelling	948	14	00:38:24	51:42:00	10:46:52	13,14	Yes
13	641664	775254	Dwelling	822	5	01:12:00	208:36:00	<b>43:29:58</b>	9,13,14,15	Yes
14	639601	775807	Dwelling	703	11	01:15:36	155:06:00	<b>32:20:35</b>	8,10,11	Yes
15	642951	776614	Dwelling	970	15	00:37:48	53:06:00	11:04:23	4	Yes
16	642901	776844	Dwelling	910	4	00:40:12	53:36:00	11:10:38	4	Yes
17	642806	776444	Dwelling	784	15	00:42:00	87:12:00	18:11:02	4,5	Yes
18	642756	776340	Dwelling	679	15	00:37:48	85:24:00	17:48:30	4,5,15	Yes
19	642706	776361	Dwelling	703	15	00:36:36	82:36:00	17:13:28	4,5,15	Yes
20	642682	776398	Dwelling	743	15	00:40:12	82:18:00	17:09:43	3,4,5	Yes

21	642653	776542	Dwelling	754	4	00:52:12	110:36:00	23:03:48	3,4,5	Yes
22	642667	776522	Dwelling	776	4	00:50:24	104:42:00	21:49:59	3,4,5	Yes
23	642579	776502	Dwelling	713	4	00:57:00	102:48:00	21:26:13	3,4,5	Yes
24	642733	776298	Dwelling	638	15	00:45:00	83:54:00	17:29:44	5,15	Yes
25	642155	778365	Dwelling	1322	2	00:25:12	13:24:00	2:47:39		No
26	642239	778362	Derelict	1368	2	00:27:36	18:36:00	3:52:43		No
27	642260	775081	Derelict	774	15	00:27:00	26:48:00	5:35:19		No
28	638928	775869	Dwelling	1169	11	00:33:00	35:54:00	7:29:10	11	Yes
29	639065	775820	Dwelling	1032	11	00:37:12	59:24:00	12:23:12	11	Yes
30	639192	775658	Derelict	831	11	00:45:00	78:36:00	16:23:26	10,11	Yes
31	640310	773582	Derelict	1154	14	00:00:00	0:00:00	0:00:00		No
32	642886	776870	Derelict	893	4	00:40:48	54:30:00	11:21:54	4	Yes
33	643163	777432	Dwelling	1282	4	00:29:24	15:00:00	3:07:41		No
34	641308	775128	Derelict	564	13	01:26:24	185:42:00	<b>38:43:26</b>	10,12,13,14	Yes
42	642644	776514	Dwelling	761	4	00:51:00	101:24:00	21:08:42	3,4,5	Yes
43	642454	777256	Derelict	577	4	01:26:24	117:00:00	24:23:53	2,3,4	Yes
44	640763	773492	Dwelling	1049	14	00:00:00	0:00:00	0:00:00		No
46	643256	776221	Dwelling	740	15	00:47:24	95:36:00	19:56:08	15	Yes
47	643616	775360	Dwelling	896	15	00:42:00	42:54:00	8:56:45	15	Yes
48	643678	776105	Dwelling	1009	15	00:36:36	24:24:00	5:05:17	15	Yes
49	642295	774677	Dwelling	1094	15	00:28:12	12:30:00	2:36:24		No
50	643720	776266	Dwelling	1125	15	00:33:36	22:06:00	4:36:31	15	Yes
51	643849	775245	Dwelling	1155	15	00:33:00	25:18:00	5:16:33	15	Yes
52	644046	775197	Dwelling	1356	15	00:28:48	16:54:00	3:31:27		No
53	640421	773230	Dwelling	1406	14	00:00:00	0:00:00	0:00:00		No
54	642467	774281	Dwelling	1414	15	00:25:12	7:54:00	1:38:51		No
55	640496	773182	Dwelling	1422	14	00:00:00	0:00:00	0:00:00		No
56	640508	773129	Dwelling	1468	14	00:00:00	0:00:00	0:00:00		No
57	641611	773183	Dwelling	1474	14	00:00:00	0:00:00	0:00:00		No
58	644197	775241	Dwelling	1486	15	00:25:48	12:30:00	2:36:24		No



59	643867	776669	Dwelling	1489	15	00:27:00	21:36:00	4:30:15		No
60	643363	777513	Dwelling	1497	4	00:25:48	11:06:00	2:18:53		No
61	640609	773065	Dwelling	1500	14	00:00:00	0:00:00	0:00:00		No
62*	643862	776714	Dwelling	1516						
63*	641588	773109	Dwelling	1532						

\*Property is beyond the shadow flicker study area limit of 1500m

### Scenario 3 - Minimum Rotor Diameter of 149m

Table 3 Maximum Potential Daily and Annual Shadow Flicker

House ID	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (metres)	Nearest Proposed Turbine No.	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Proposed Turbine(s) Giving Rise to Daily Shadow Flicker Exceedance	Mitigation Strategy Required (Annual)
1	640265	773572	Dwelling	1189	14	00:00:00	0:00:00	0:00:00		No
2	638979	775866	Dwelling	1127	11	00:34:12	39:42:00	7:21:52	11	Yes
3	639016	775795	Dwelling	1054	11	00:36:00	41:30:00	7:41:54	11	Yes
4	640289	773649	Dwelling	1113	14	00:00:00	0:00:00	0:00:00		No
5	640330	773542	Dwelling	1175	14	00:00:00	0:00:00	0:00:00		No
6	640947	773562	Dwelling	956	14	00:00:00	0:00:00	0:00:00		No
7	641116	774222	Derelict	323	14	00:39:00	42:12:00	7:49:41	12	Yes
8	640084	773521	Dwelling	1264	12	00:00:00	0:00:00	0:00:00		No
9	642272	774530	Dwelling	1237	15	00:28:48	12:30:00	2:19:08		No
10	642185	774543	Dwelling	1200	14	00:30:36	14:18:00	2:39:10	14	Yes
11	641937	774707	Dwelling	970	14	00:37:12	49:42:00	9:13:10	13,14	Yes
12	641910	774724	Dwelling	948	14	00:38:24	51:06:00	9:28:45	13,14	Yes
13	641664	775254	Dwelling	822	5	01:11:24	206:36:00	<b>38:19:27</b>	9, 13, 14, 15	Yes
14	639601	775807	Dwelling	703	11	01:15:00	153:42:00	28:30:41	8, 10, 11	Yes
15	642951	776614	Dwelling	970	15	00:37:12	42:24:00	7:51:55	4	Yes
16	642901	776844	Dwelling	910	4	00:40:12	53:06:00	9:51:00	4	Yes
17	642806	776444	Dwelling	784	15	00:41:24	86:24:00	16:01:38	4,5	Yes
18	642756	776340	Dwelling	679	15	00:37:12	84:30:00	15:40:29	4, 5,15	Yes

19	642706	776361	Dwelling	703	15	00:36:00	81:42:00	15:09:19	4, 5,15	Yes
20	642682	776398	Dwelling	743	15	00:39:36	81:12:00	15:03:45	3,4,5	Yes
21	642653	776542	Dwelling	754	4	00:51:36	109:36:00	20:19:51	3,4,5	Yes
22	642667	776522	Dwelling	776	4	00:49:48	103:42:00	19:14:11	3,4,5	Yes
23	642579	776502	Dwelling	713	4	00:56:24	101:36:00	18:50:48	3, 4,5	Yes
24	642733	776298	Dwelling	638	15	00:45:00	82:54:00	15:22:41	5, 15	Yes
25	642155	778365	Dwelling	1322	2	00:25:12	13:18:00	2:28:02		No
26	642239	778362	Derelict	1368	2	00:27:36	18:30:00	3:25:54		No
27	642260	775081	Derelict	774	15	00:27:00	12:48:00	2:22:28		No
28	638928	775869	Dwelling	1169	11	00:33:00	35:36:00	6:36:14	11	Yes
29	639065	775820	Dwelling	1032	11	00:37:12	58:42:00	10:53:20	11	Yes
30	639192	775658	Derelict	831	11	00:45:00	77:48:00	14:25:55	10,11	Yes
31	640310	773582	Derelict	1154	14	00:00:00	0:00:00	0:00:00		No
32	642886	776870	Derelict	893	4	00:40:48	54:06:00	10:02:08	4	Yes
33	643163	777432	Dwelling	1282	4	00:29:24	14:54:00	2:45:50		No
34	641308	775128	Derelict	564	13	01:26:24	184:06:00	<b>34:09:02</b>	10, 12, 13, 14	Yes
42	642644	776514	Dwelling	761	4	00:51:00	100:24:00	18:37:27	3, 4,5	Yes
43	642454	777256	Derelict	577	4	01:25:48	115:36:00	21:26:38	2,3,4	Yes
44	640763	773492	Dwelling	1049	14	00:00:00	0:00:00	0:00:00		No
46	643256	776221	Dwelling	740	15	00:46:48	94:42:00	17:34:01	15	Yes
47	643616	775360	Dwelling	896	15	00:42:00	42:24:00	7:51:55	15	Yes
48	643678	776105	Dwelling	1009	15	00:36:36	24:06:00	4:28:14	15	Yes
49	642295	774677	Dwelling	1094	15	00:28:12	12:30:00	2:19:08	15	No
50	643720	776266	Dwelling	1125	15	00:33:36	21:54:00	4:03:45	15	Yes
51	643849	775245	Dwelling	1155	15	00:33:00	25:00:00	4:38:15	15	Yes
52	644046	775197	Dwelling	1356	15	00:28:12	16:42:00	3:05:52		No
53	640421	773230	Dwelling	1406	14	00:00:00	0:00:00	0:00:00		No
54	642467	774281	Dwelling	1414	15	00:00:00	0:00:00	0:00:00		No
55	640496	773182	Dwelling	1422	14	00:00:00	0:00:00	0:00:00		No

56	640508	773129	Dwelling	1468	14	00:00:00	0:00:00	0:00:00		No
57	641611	773183	Dwelling	1474	14	00:00:00	0:00:00	0:00:00		No
58	644197	775241	Dwelling	1486	15	00:25:48	12:24:00	2:18:01		No
59	643867	776669	Dwelling	1489	15	00:27:00	21:30:00	3:59:18		No
60*	643363	777513	Dwelling	1497	4					
61*	640609	773065	Dwelling	1500	14					
62*	643862	776714	Dwelling	1516	15					
63*	641588	773109	Dwelling	1532	14					

\*Property is beyond the shadow flicker study area limit of 1490m

## Summary

As presented in the summary tables the variance in results between each of the scenarios is minimal ( $\pm 1$  no. dwellings) with the greatest number of exceedances of the DoEHLG 2006 wind energy guidelines daily (30 minutes) and annual (30-hours) limits occurring from Turbine Scenario 1. Turbine Scenario 1, which has been assessed within the EIAR using the precautionary principle, has the largest proposed rotor diameter (155m – based on the longest rotor blade) and the minimum hub height (97.5m) (therefore providing a tip height of 175m). Daily and annual shadow flicker exceedances arise at a reduced number of properties for remaining Turbine Scenarios (Scenario 2 and 3) which is to be expected considering their reduced rotor diameter. Irrespective of which Turbine Scenario (combination of hub height and rotor diameter) within the range outlined above is installed on site, the significance of residual landscape and visual effects will not be altered

It should also be noted that the phenomenon of Shadow Flicker is entirely controllable, and that in the event of favourable consideration it is standard practice for an appropriate planning condition to be imposed. Any future turbine installed on site in the event of favourable consideration must comply with any such condition, and as detailed in Section 5.7.2 of the EIAR, in line with the commitment made for the permitted Coole Wind Farm development and following continuing engagement with the local community requirements Coole Wind Farm Ltd. is committing to zero shadow flicker at occupied residential receptors within 10 rotor diameters of the Proposed Development.