

Project: Pinewoods Wind Farm	Description: Sunshine statistics based on data from 1969-1993 from Kilkenny Met Station which is located 20km from the proposed site. Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.	Printed/Page: 01/05/2020 12:24 / 1 Licensed user: Gaitech Energy Services Cootehill Enterprise Park, Cootehill IE-CO. Cavan +353 86 8222803 Calculated: 01/05/2020 12:20/2.8.579
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SHADOW - Main Result

Calculation: Shadow Flicker Predictions (Rev 01 - May 2020)

Assumptions for shadow calculations

Maximum distance for influence
 Calculate only when more than 20 % of sun is covered by the blade
 Please look in WTG table

Minimum sun height over horizon for influence: 3 °
 Day step for calculation: 1 days
 Time step for calculation: 1 minutes

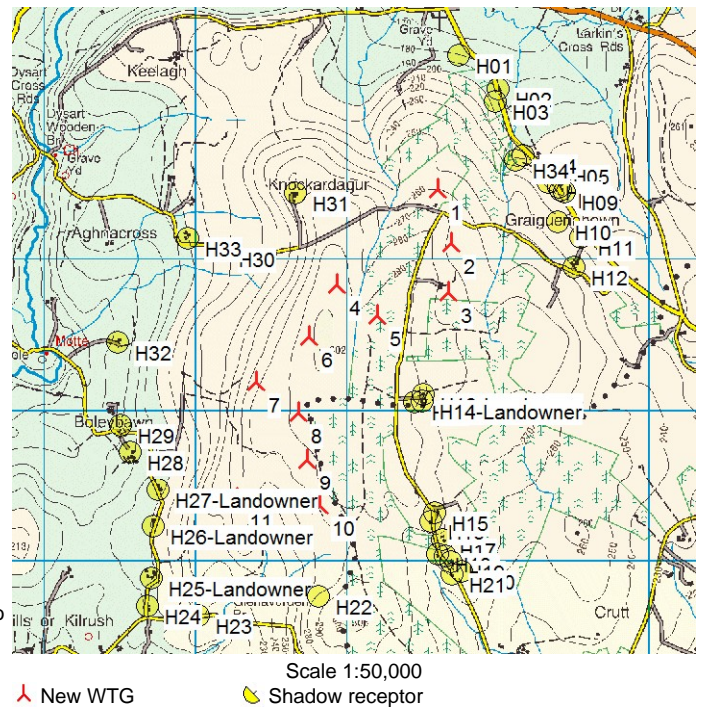
Sunshine probability S (Average daily sunshine hours) [KILKENNY]
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 1.68 2.20 3.08 4.72 5.31 4.94 4.67 4.36 3.78 2.74 2.15 1.32

Operational time
 N NNE NE ENE E ESE SE SSE S SSW SW WSW
 205 237 241 239 162 254 897 481 739 775 838 1,100

 W WNW NW NNW Sum
 1,051 812 440 289 8,760

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
 Height contours used: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo
 Obstacles used in calculation
 Eye height: 1.5 m
 Grid resolution: 10.0 m



WTGs

	Irish Grid (IG)-IRELAND65 (IE)			Row data/Description	WTG type		Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
	East	North	Z		Valid	Manufact.					Calculation distance [m]	RPM [RPM]
1	251,604	182,460	258.7	T1	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
2	251,693	182,105	267.5	T2	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
3	251,676	181,781	273.2	T3	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
4	250,937	181,833	297.7	T4	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
5	251,205	181,628	299.3	T5	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
6	250,756	181,489	302.7	T6	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
7	250,403	181,186	278.9	T7	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
8	250,682	180,984	292.8	T8	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
9	250,742	180,675	291.0	T9	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
10	250,826	180,372	287.6	T10	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8
11	250,276	180,413	260.8	T11	Yes	GE WIND ENERGY	GE 3.2 -103-3,200	3,200	103.0	85.0	1,600	14.8

Shadow receptor-Input

No.	Name	Irish Grid (IG)-IRELAND65 (IE)			Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
		East	North	Z						
A	H01	251,747	183,345	179.5	2.0	2.0	0.5	0.0	90.0	"Green house mode"
B	H02	252,003	183,118	189.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
C	H03	251,985	183,038	196.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
D	H04	252,171	182,682	208.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
E	H05	252,389	182,614	212.0	2.0	2.0	0.5	0.0	90.0	"Green house mode"
F	H06	252,334	182,504	217.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"

To be continued on next page...

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Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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SHADOW - Main Result**Calculation: Shadow Flicker Predictions (Rev 01 - May 2020)**

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No.	Name	Irish Grid (IG-IRELAND65 (IE))			Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
		East	North	Z						
G	H07	252,407	182,475	217.6	2.0	2.0	0.5	0.0	90.0	"Green house mode"
H	H08	252,419	182,452	218.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
I	H09	252,443	182,442	219.0	2.0	2.0	0.5	0.0	90.0	"Green house mode"
J	H10	252,398	182,245	230.0	2.0	2.0	0.5	0.0	90.0	"Green house mode"
K	H11	252,554	182,144	226.2	2.0	2.0	0.5	0.0	90.0	"Green house mode"
L	H12	252,505	181,946	240.1	2.0	2.0	0.5	0.0	90.0	"Green house mode"
M	H13-Landowner	251,509	181,108	286.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
N	H14-Landowner	251,504	181,064	286.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
O	H15	251,584	180,317	281.7	2.0	2.0	0.5	0.0	90.0	"Green house mode"
P	H16	251,563	180,264	282.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
Q	H17	251,638	180,140	276.5	2.0	2.0	0.5	0.0	90.0	"Green house mode"
R	H18	251,603	180,046	273.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
S	H19	251,691	179,992	270.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
T	H20	251,763	179,930	266.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
U	H21	251,697	179,912	266.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
V	H22	250,816	179,769	278.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
W	H23	250,021	179,640	215.1	2.0	2.0	0.5	0.0	90.0	"Green house mode"
X	H24	249,684	179,702	193.7	2.0	2.0	0.5	0.0	90.0	"Green house mode"
Y	H25-Landowner	249,712	179,885	196.4	2.0	2.0	0.5	0.0	90.0	"Green house mode"
Z	H26-Landowner	249,723	180,232	200.3	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AA	H27-Landowner	249,755	180,471	197.1	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AB	H28	249,570	180,722	179.3	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AC	H29	249,506	180,906	170.2	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AD	H30	250,173	182,064	215.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AE	H31	250,665	182,436	264.8	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AF	H32	249,491	181,450	162.3	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AG	H33	249,951	182,134	198.5	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AH	H34	252,119	182,649	215.9	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AI	H35	251,454	181,054	289.1	2.0	2.0	0.5	0.0	90.0	"Green house mode"
AJ	H36	251,654	180,035	272.0	2.0	2.0	0.5	0.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case			Shadow, expected values	
		Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]	
A	H01	3:55	20	0:15	0:24	
B	H02	37:54	86	0:33	4:54	
C	H03	47:08	97	0:50	6:25	
D	H04	80:30	164	0:42	12:11	
E	H05	51:56	146	0:30	8:16	
F	H06	64:29	152	0:48	10:56	
G	H07	50:28	133	0:36	8:48	
H	H08	49:39	131	0:36	8:46	
I	H09	47:09	125	0:36	8:22	
J	H10	63:04	153	0:46	11:35	
K	H11	40:01	114	0:30	7:48	
L	H12	62:17	161	0:41	12:01	
M	H13-Landowner	91:37	252	0:31	15:50	
N	H14-Landowner	85:05	248	0:31	14:46	
O	H15	40:54	130	0:32	8:23	
P	H16	50:58	140	0:33	10:12	

To be continued on next page...

Project:

Pinewoods Wind Farm

Description:

Sunshine statistics based on data from 1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

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SHADOW - Main Result**Calculation: Shadow Flicker Predictions (Rev 01 - May 2020)**

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No.	Name	Shadow, worst case		Shadow, expected values	
		Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
Q	H17	43:36	130	0:30	8:34
R	H18	32:50	115	0:30	6:33
S	H19	27:49	109	0:27	5:32
T	H20	24:13	104	0:25	4:47
U	H21	31:38	96	0:27	6:07
V	H22	0:00	0	0:00	0:00
W	H23	0:00	0	0:00	0:00
X	H24	13:05	48	0:20	2:33
Y	H25-Landowner	14:29	55	0:21	3:00
Z	H26-Landowner	88:30	124	1:04	18:08
AA	H27-Landowner	67:06	140	0:47	13:45
AB	H28	45:49	133	0:48	8:42
AC	H29	67:57	196	0:40	13:02
AD	H30	53:48	154	0:44	9:12
AE	H31	78:54	157	1:06	10:22
AF	H32	50:59	194	0:25	8:15
AG	H33	48:10	127	0:42	6:30
AH	H34	93:03	170	0:48	14:11
AI	H35	87:33	236	0:31	14:42
AJ	H36	31:31	113	0:29	6:15

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	T1	199:08	35:34
2	T2	145:00	24:56
3	T3	115:09	17:19
4	T4	83:57	12:24
5	T5	73:01	10:38
6	T6	103:11	18:50
7	T7	62:30	11:26
8	T8	72:45	13:14
9	T9	134:47	25:44
10	T10	189:10	35:50
11	T11	154:11	28:55

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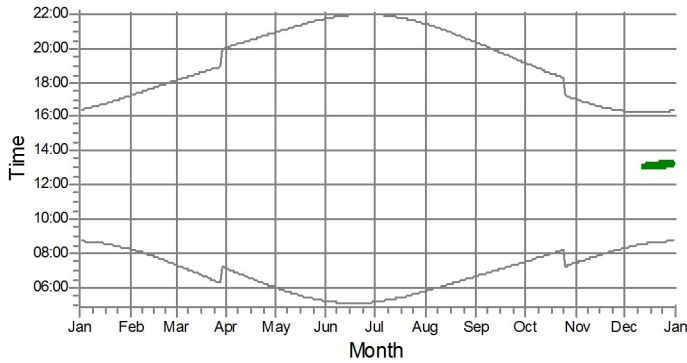
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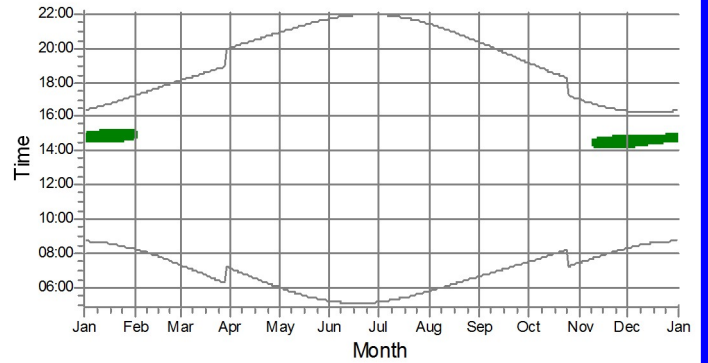
SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions (Rev 01 - May 2020)

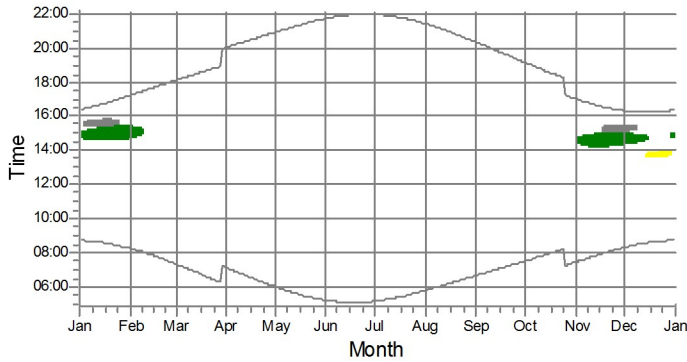
A: H01



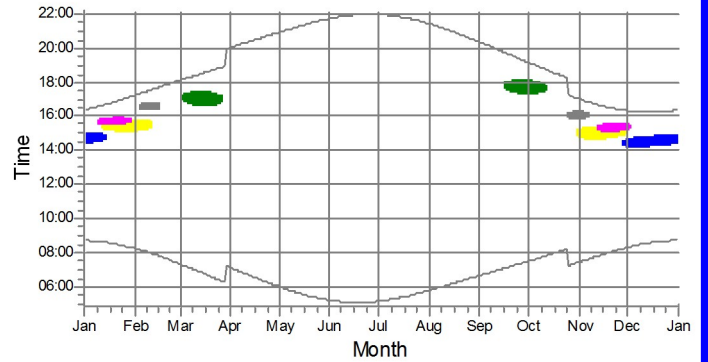
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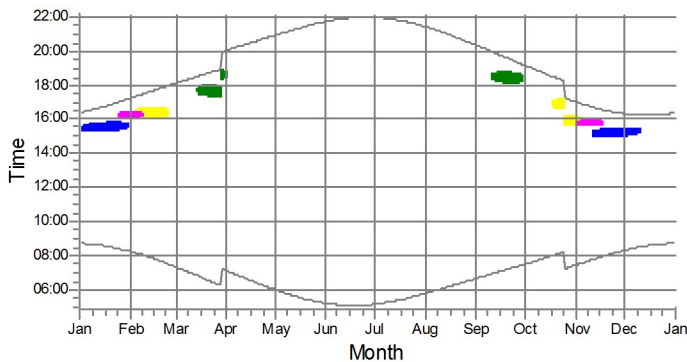
C: H03



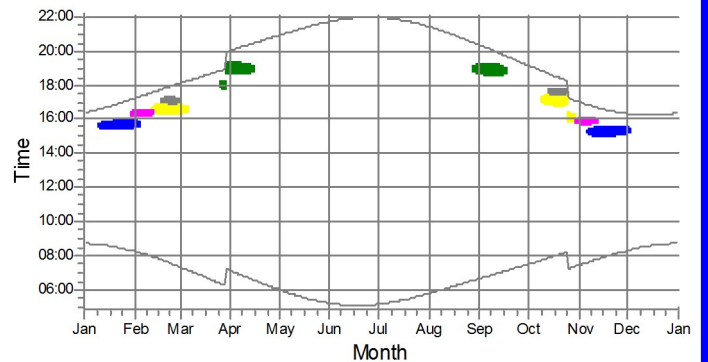
D: H04



E: H05



F: H06



WTGs



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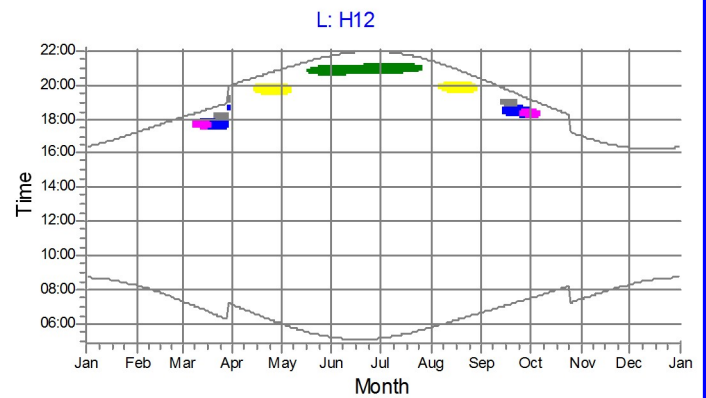
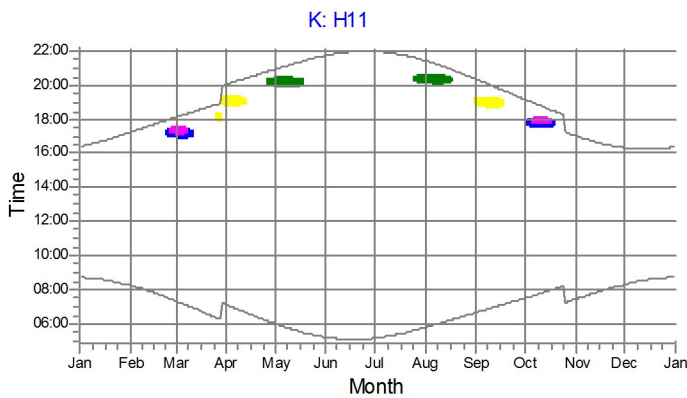
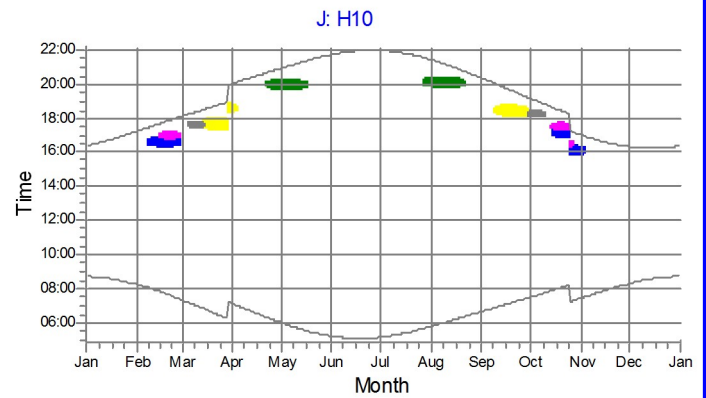
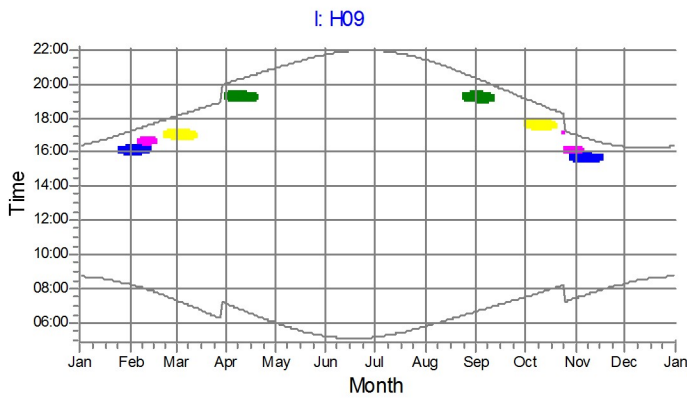
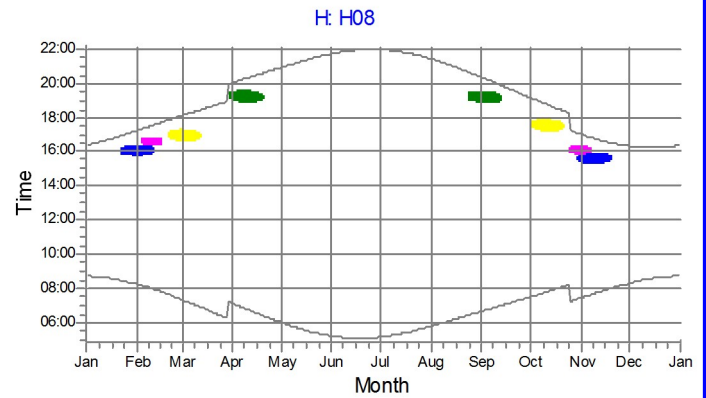
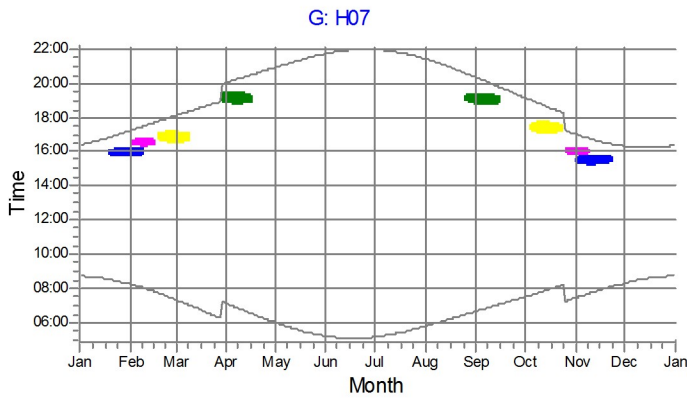
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SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions (Rev 01 - May 2020)



WTGs



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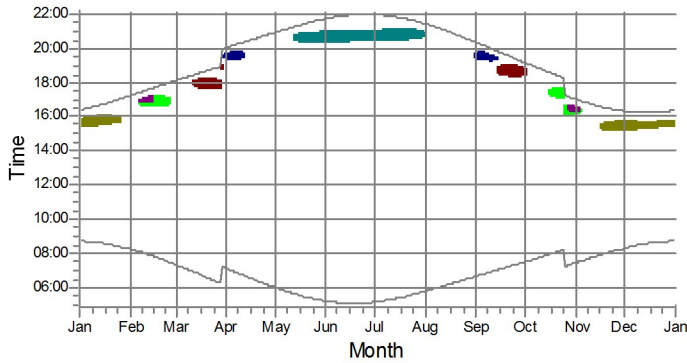
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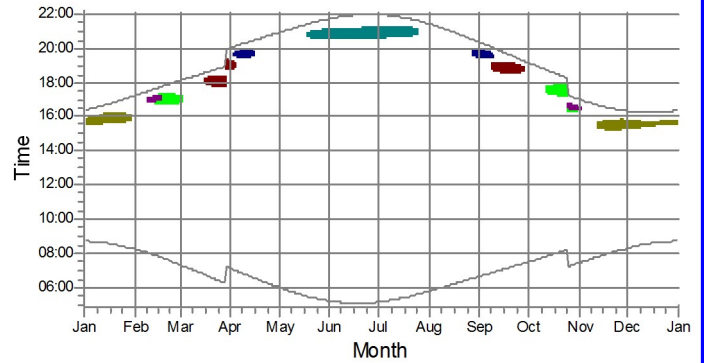
SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions (Rev 01 - May 2020)

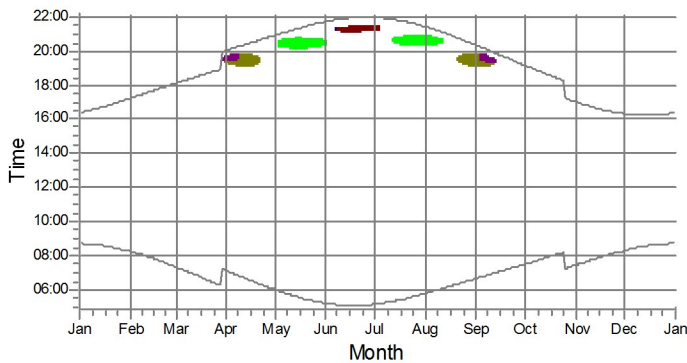
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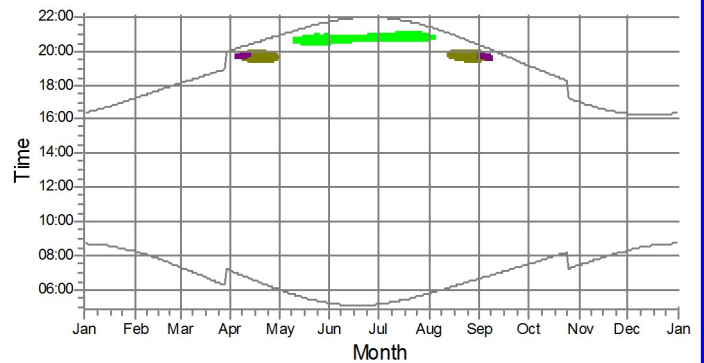
N: H14-Landow ner



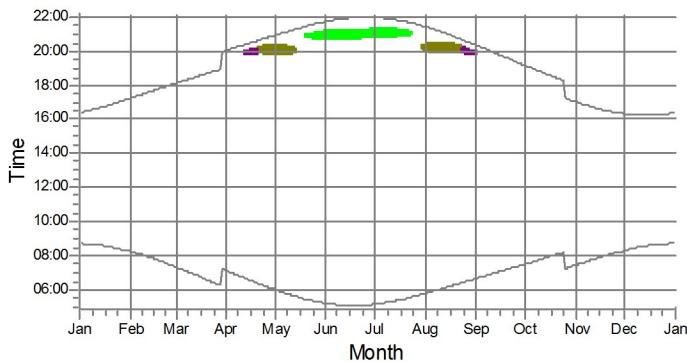
O: H15



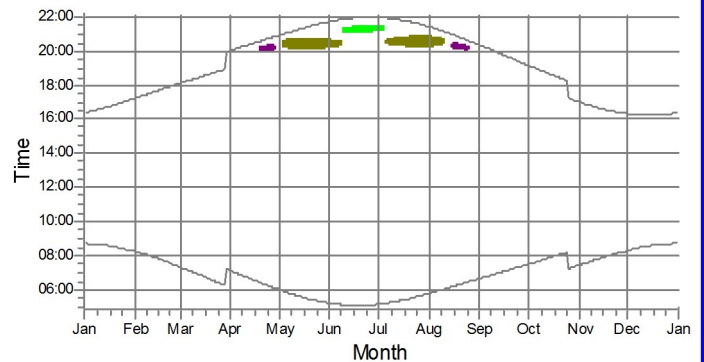
P: H16



Q: H17



R: H18



WTGs

	6: T6		8: T8		10: T10
	7: T7		9: T9		11: T11

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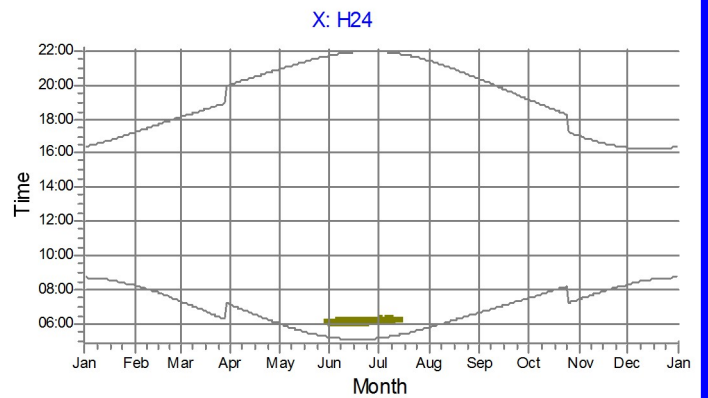
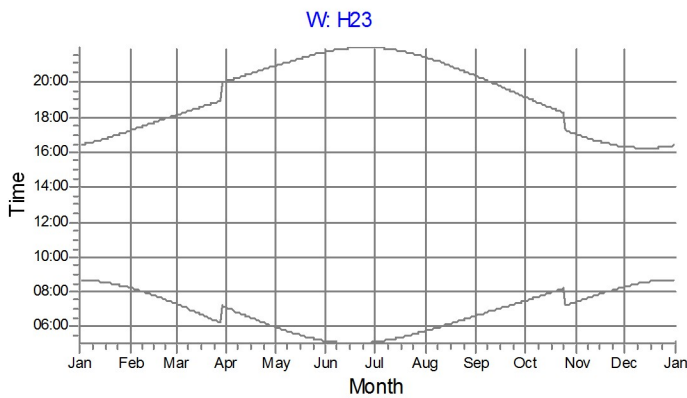
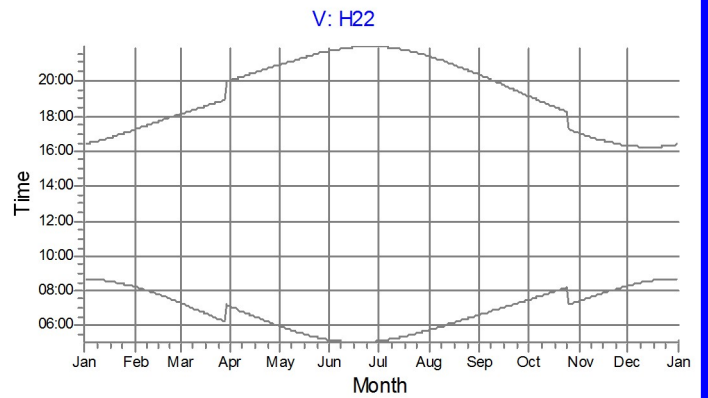
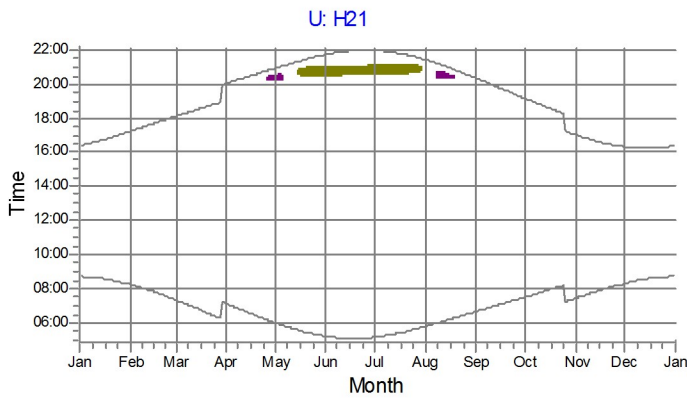
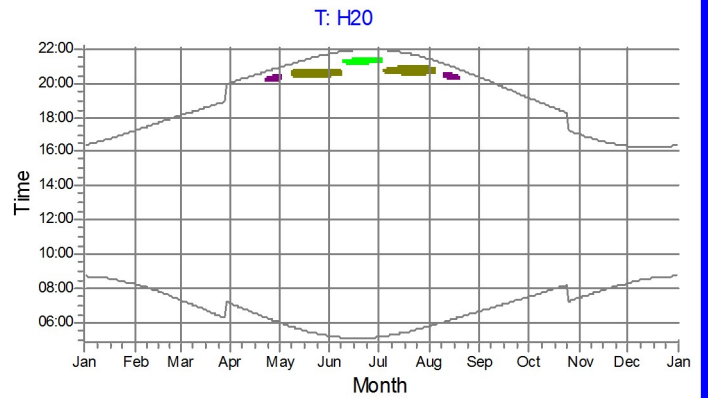
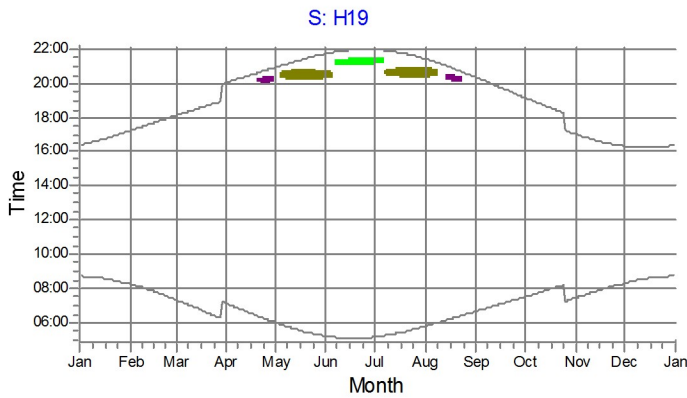
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SHADOW - Calendar, graphical

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WTGs

9: T9

10: T10

11: T11

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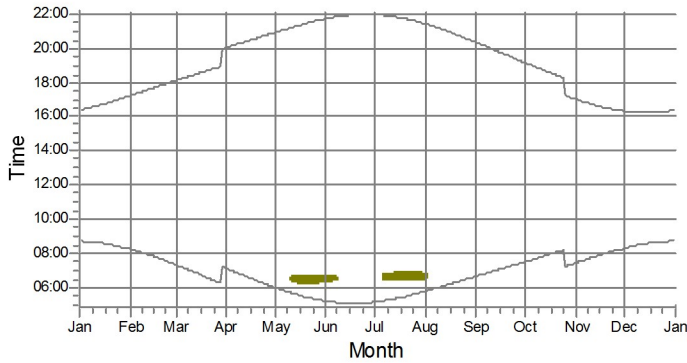
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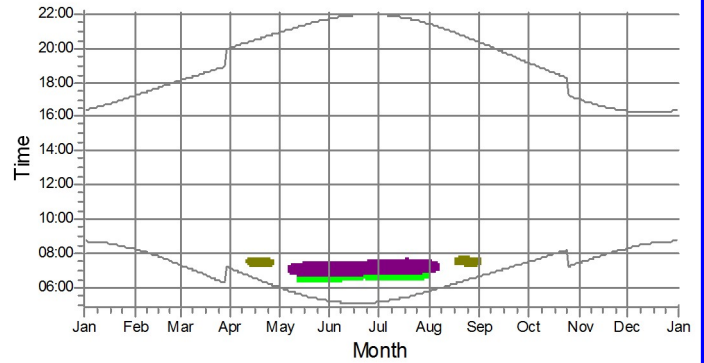
SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions (Rev 01 - May 2020)

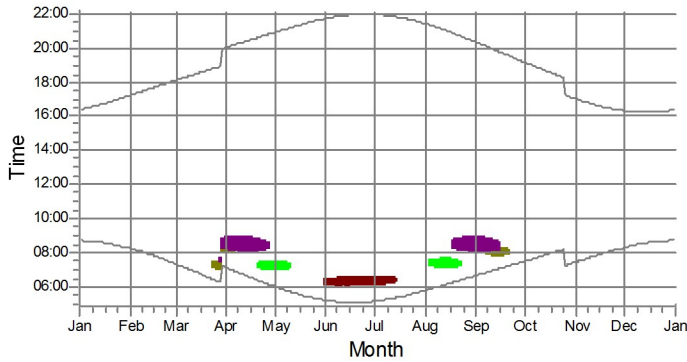
Y: H25-Landow ner



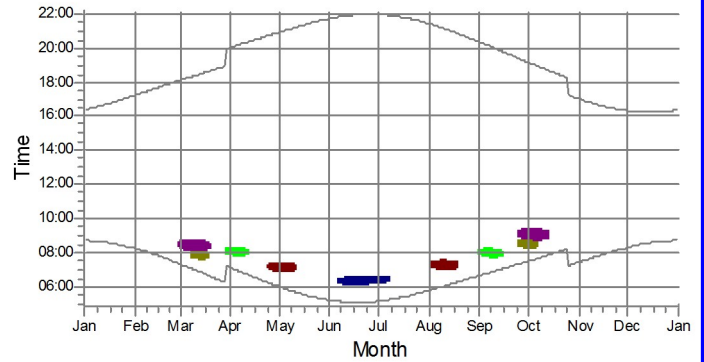
Z: H26-Landow ner



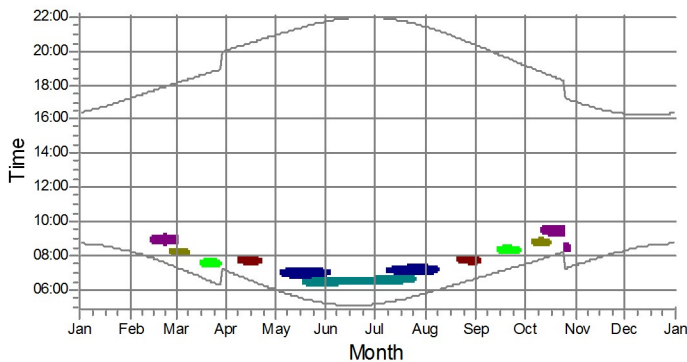
AA: H27-Landow ner



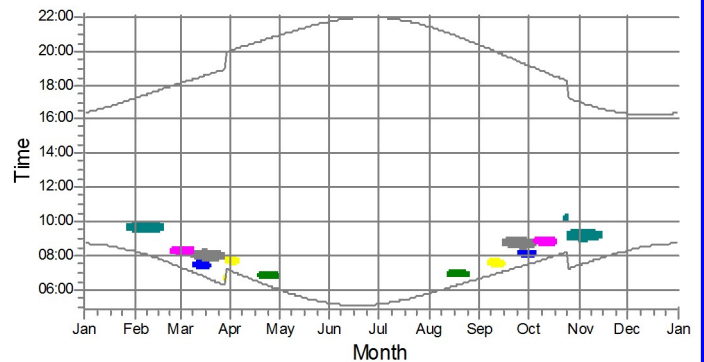
AB: H28



AC: H29



AD: H30



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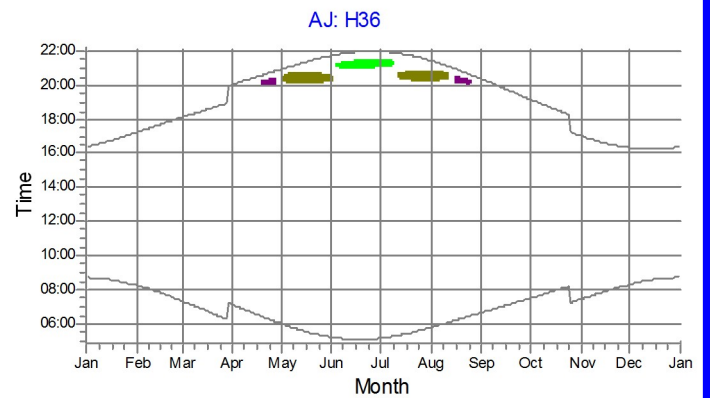
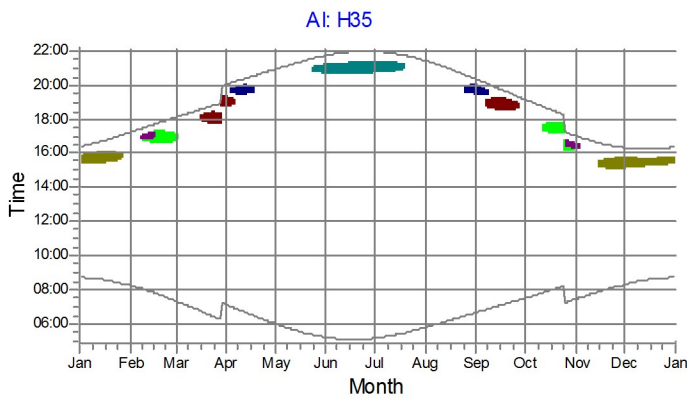
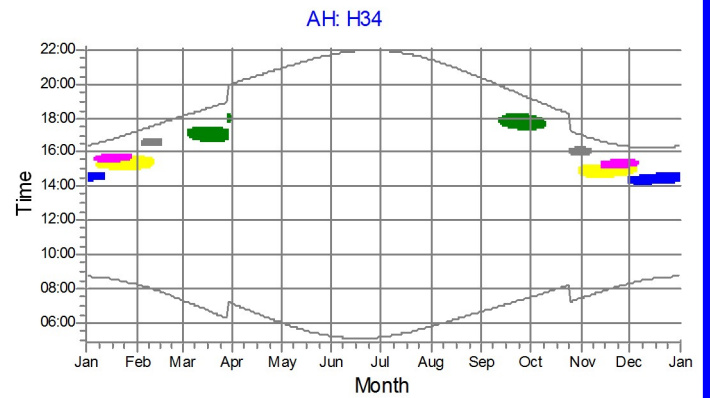
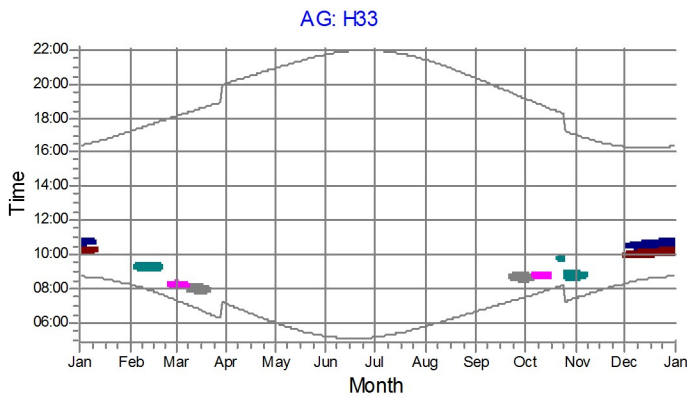
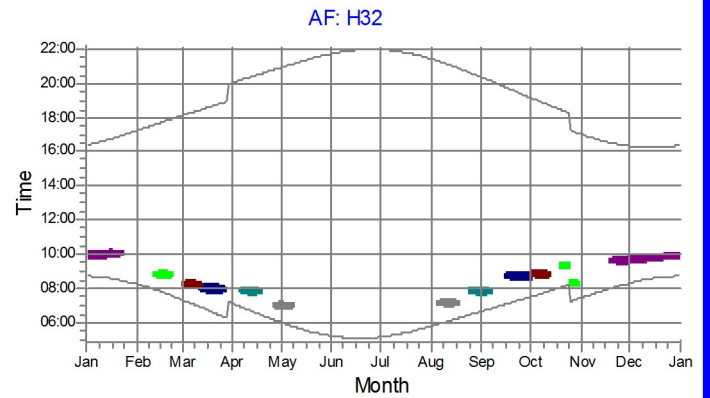
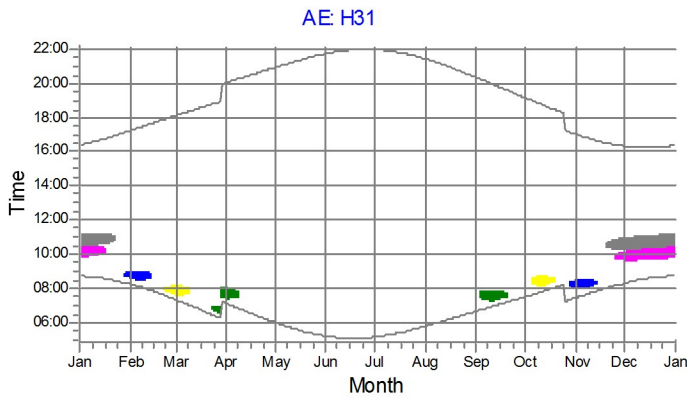
Cootehill Enterprise Park, Cootehill
IE-CO. Cavan
+353 86 8222803

Calculated:



01/05/2020 12:20/2.8.579

SHADOW - Calendar, graphical

Calculation: Shadow Flicker Predictions (Rev 01 - May 2020)



WTGs

- | | | | |
|---|---|---|---|
|  1: T1 |  4: T4 |  7: T7 |  10: T10 |
|  2: T2 |  5: T5 |  8: T8 |  11: T11 |
|  3: T3 |  6: T6 |  9: T9 | |

Project:
Pinewoods Wind Farm

Description:
Sunshine statistics based on data from 1969-1993 from Kilkenny Met Station which is located 20km from the proposed site.
Wind Rose data based on 24 months data from an 80meter mast located on the proposed site.

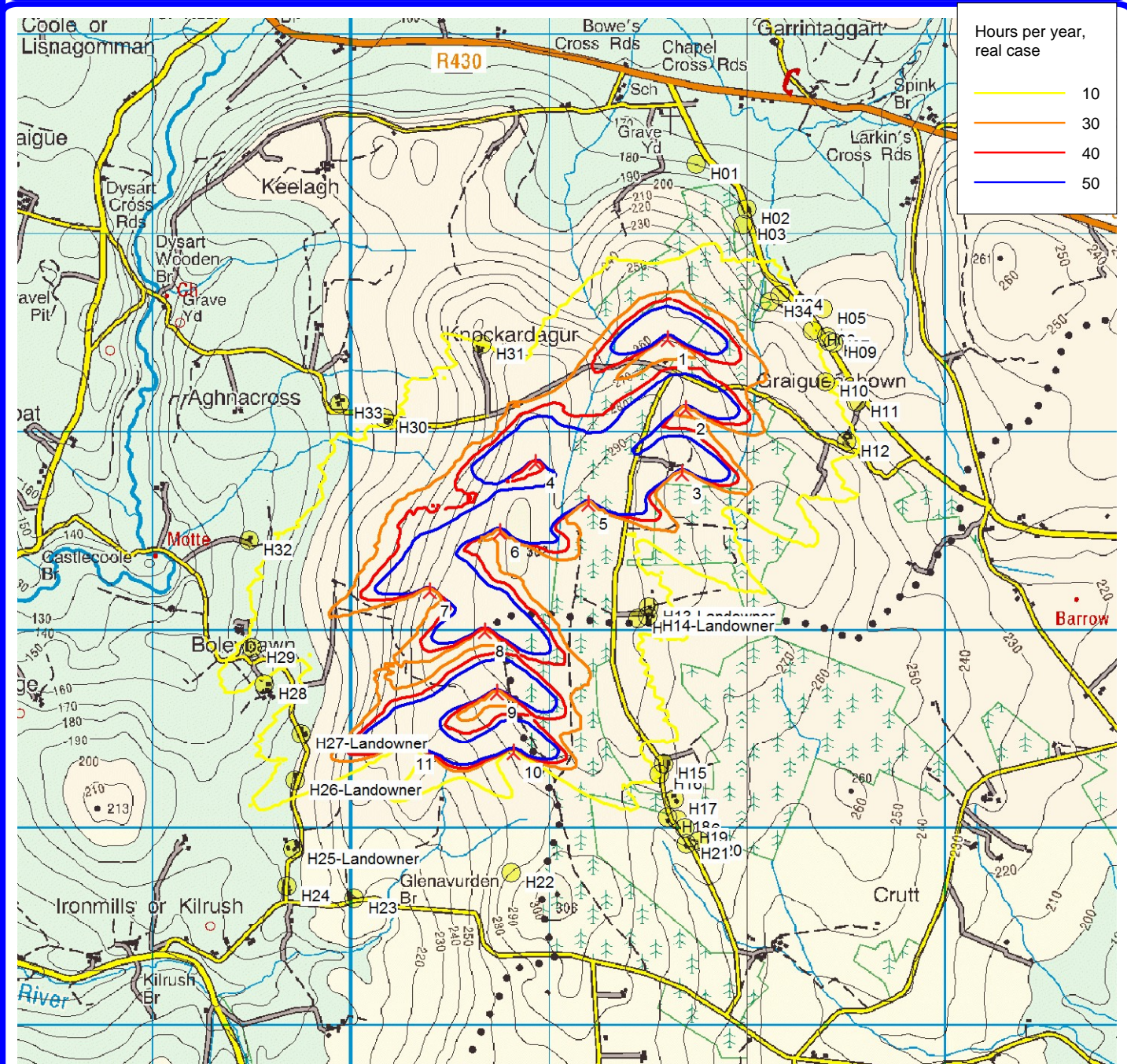
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+353 86 8222803

Calculated:
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SHADOW - Map

Calculation: Shadow Flicker Predictions (Rev 01 - May 2020)



Map: 50,000 Map , Print scale 1:30,000, Map center Irish Grid (IG)-IRELAND65 (IE) East: 251,060 North: 181,400
 New WTG Shadow receptor
 Flicker map level: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo (1)