Appendix C

Shadow Flicker Assessment

Wocawson Energy Project
Shadow Flicker Assessment
September 2018

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Introduction

Natural Forces Wind Inc. has undertaken a shadow flicker impact assessment for the proposed Wocawson Energy Project to assess the potential impact of shadow flicker on the surrounding shadow receptors. Details outlining the shadow receptors, prediction methodology and assumptions made for the assessment are included herein, with the WindPRO results supplied in the annexes. This report also provides background information on the shadow flicker effect.

Under the *Additional Information Requirements for Wind Turbines* document published by New Brunswick Ministry of Environment and Local Government pursuant to Section 5(2) of the *Environmental Impact Assessment Regulation* of the Clean Environment Act, requirements regarding Visual Impacts due to shadow flicker must be limited to 30 hours per year for a maximum of 30 minutes per day based on a "worst case" calculation where mitigation is not feasible. The worst-case calculation is defined in the requirements document as the maximum shadow between sun rise and sun set on a cloudless day. These conditions have been adopted for this study.

Prior to determining the predicted amount of shadow flicker effect of a project, careful site design in the first instance is recommended, followed by industry accepted mitigation strategies. This assessment will be used as supporting documentation to demonstrate that shadow flicker is being assessed and that compliance can be reached with careful planning and mitigation.

This shadow flicker analysis was conducted using the Shadow module of the software package, WindPRO version 3.1.

Background

Flicker is caused by incident light rays on a moving object which then casts an intermittent shadow on a receptor. This intermittent shadow, perceived as a change in light intensity to an observer, as it pertains to wind turbine generators (WTG), is referred to as shadow flicker. Shadow flicker is caused by incident sun rays on the rotor blades as they turn.

For shadow flicker to occur, the following criteria must be met:

1. The sun must be shining and not obscured by any cloud cover.
2. The wind turbine must be between the sun and the shadow receptor.
3. The line of sight between the turbine and the shadow receptor must be clear. Light-impermeable obstacles, such as vegetation, buildings, awnings etc., will prevent shadow flicker from occurring at the receptor.
4. The shadow receptor has to be close enough to the turbine to be in the shadow of the rotor.

Policy and Guidelines

As previously stated, there are provincial requirements for the acceptable amount of shadow flicker. These requirements are set out in the *Additional Information Requirements for Wind Turbines* document published by New Brunswick Ministry of Environment and Local Government pursuant to Section 5(2) of the *Environmental Impact Assessment Regulation* of the Clean Environment Act.

Under the requirements, mitigation measures should be applied to mitigate the shadow flicker effect on sensitive receptors such as relocation of turbines, screening of the receptors and operational controls. Where the proponent demonstrates that the mitigation of any shadow flicker effect on sensitive receptors is not feasible, the amount of shadow flicker must be limited to:

- 30 hours per year for a maximum "worst case" calculation; and
- 30 minutes per day also based on a "worst case" calculation.

The requirements also state that the "worst case" scenario describes a model that uses maximum shadow between sun rise and sun set; and assumes cloudless skies throughout the year.

Source of shadow

The proposed Wocawson Energy Project assessment consists of 6-12 turbines located 19 km northeast of the Town of Sussex and 5 km southwest of the community of Portage Vale, New Brunswick. The project site is situated also in proximity to the communities of Lindys, Springdale, South Branch, Upper Goshen and Goshen. A map of the project area with the proposed WTG layout is illustrated in Appendix A.

There are no existing wind turbines or known proposed wind farm projects within 5km of the Wocawson Energy Project, therefore it is unlikely any cumulative shadow flicker effects will occur.

The model of WTG being considered for the proposed wind project is the Enercon E-141 EP4 4,200kW. The E-141 turbines have a 141m rotor diameter with a maximum hub height of 135m. This model utilizes a horizontal axis, upwind, 3-bladed, and a microprocessor pitch control system. Table 1 below outlines their main characteristics.

Table 1: Enercon E-141 EP4 4,200kW turbine characteristics.

Generator Type	Rotor Diameter (m)	Hub Height (m)	Swept area (m^2)	Rated Output (MW)
E-141 4.2	141	135	15,615	4.2

Receptors

There are 43 points of reception taken into consideration for this shadow flicker assessment. The receptors are mostly residential buildings, some seasonal residences and a few local businesses located within 2 km of the proposed WTG. A map of the project area with the receptors is illustrated in Appendix A.

Impact Assessment

Prediction Methodology

The shadow flicker impact was calculated for the 12 turbine layout at each receptor using the Shadow module of the software package, WindPRO version 3.1. The model simulates the Earth's orbit and rotation, to provide the astronomical maximum shadow, also known as the astronomical worst-case scenario. The astronomical maximum shadow calculation assumes that for every day of the year:

1. The sky is cloudless between sunrise and sunset,
2. The turbines are always in operation, and
3. The wind direction changes throughout the day such that the rotor plane is perpendicular to the incident sun rays at all times causing the maximum amount of shadow.

The position of the sun relative to the wind turbine rotor plane and the resulting shadow is calculated in steps of one-minute intervals throughout a complete year. If the rotor plane, assumed to be a solid disk equivalent in size to the swept area shown in Table 1 casts a shadow on a receptor window during one of these intervals, it is registered as one minute of potential shadow impact.

The impact of shadow flicker on surrounding receptors is limited by two factors; the first being that the angle of the sun over the horizon must be greater than 3 degrees, due to optic conditions in the atmosphere which cause the shadow to dissipate before it could potentially reach a receptor and the second is that the blade of the wind turbine must cover at least 20% of the incident solar rays in order to have a noticeable effect.

Each receptor was treated as a 'greenhouse' with 3m high by 3 m wide windows for 360° of the building. Furthermore, no topographical shielding (other buildings, barns, trees, awnings, etc.) has been considered between the wind turbines and receptors for the worst-case scenario. This worst-case assumption results in a conservative prediction of the potential shadow flicker impacts.

Results of Shadow Flicker Predictions

The desired results of the shadow flicker prediction model at each receptor is to prove compliance with the New Brunswick requirements of no more than 30 hours per year of shadow, and no more than 30 minutes on the worst day of shadow under a "worst case" scenario where mitigation is not feasible.

The worst-case study of this project demonstrates that all the receptors located within 2 km of the 12 turbine project design are subject to no more than 30hrs/year and 30mins/day. The detailed results of the shadow assessment study for all receptors are included in Appendix B.

The results show that of 43 receptors, only 7 are predicted to experience any shadow flicker under worst-case scenario. Table 2 shows the results of the receptors that are predicted to experience shadow flicker.

Table 2: Predicted preliminary worst case shadow flicker for E-141 at 135 m hub height for receptors predicted to experience shadow flicker.

Receptor ID	Shadow hours per year (h/year)	Max shadow hours per day (h/day)
AL	19:03	0:26
D	22:53	0:24
F	18:49	0:24
AM	11:43	0:24
E	13:52	0:22
Z	14:49	0:20
AH	16:46	0:20

Proposed Mitigation

As required in the *Additional Information Requirements for Wind Turbines* report for New Brunswick, this shadow flicker assessment report also provides a description of the mitigation measures to be used to mitigate effects on sensitive receptors should they experience shadow flicker. These measures described in the following sections include tracking the events and screening of receptors using vegetation and awnings.

Tracking the shadow flicker

Should receptors experience shadow flicker and formalize a complaint, the complaint will be addressed following the Complaint Resolution Plan. The steps included in the Complaint Resolution Plan describe the study that will occur following a complaint. To begin, the specific date, the time and the local weather conditions will be noted for each incident of shadow flicker as well as the duration of the event. Following this step, the Operation Team for the project will determine the direction of the wind relative to the receptor and the wind speed during the event. Finally, the details of the event will be tracked to analyze the specific conditions that cause shadow flicker at a receptor.

If the conditions causing shadow flicker are reoccurring and causing issues at the receptor, screening and using vegetation and awnings may be considered to mitigate the situation.

Screening

Existing vegetation and revegetating efforts are a feasible, effective mitigation measure for reducing shadow flicker impact. It is further proposed that if local residents observe an annoyingly high amount of shadow

flicker impact during operation, the Proponent could propose screening methods that will provide shade to buildings and windows effectively reducing shadow flicker annoyance.

Screening can be accomplished with existing vegetation, revegetation and planting additional vegetation to the area which is experiencing shadow flicker. As well, similar results can also be obtained by installing awnings and window coverings if it would provide better screening under specific conditions or if it would be preferred by those experiencing the impact.

Discussion and Conclusions

Natural Forces Wind Inc. has completed an assessment to evaluate the astronomical worst-case shadow flicker impact of the proposed Wocawson Energy Project at receptor locations within 2 km of a proposed wind turbine generator.

Based on the modelled results, the amount of shadow flicker predicted at each receptor will pass the requirements set out by New Brunswick's Ministry of Environment and Local Government.

As per the *Additional Information Requirements for Wind Turbines* document published by New Brunswick Ministry of Environment and Local Government pursuant to Section 5(2) of the *Environmental Impact Assessment Regulation* of the Clean Environment Act, various measures may be used to mitigate effect of shadow flicker perceived at receptors such as adjacent lands and public road ways. These mitigation methods may include tracking shadow flicker events and screening of receptors using natural barriers, awnings or other structures.

The Proponent feels confident that receptors will not receive exceeding amounts of shadow flicker as demonstrated in the modelled worst-case scenario. However, the Proponent will work closely with land and businesses owners to observe occurrences of real-case shadow flicker impact during operation and apply mitigation as mentioned.

References

New Brunswick Ministry of Environment and Local Government. *Environmental Impact Assessment Regulation – Clean Environment Act.* New Brunswick.

New Brunswick Ministry of Environment and Local Government. *Additional Information Requirements For Wind Turbines– Clean Environment Act.* New Brunswick.

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Nielson, P. (2012). *Windpro 3.1 user guide*. (1st ed.). Denmark: EMD International A/S.

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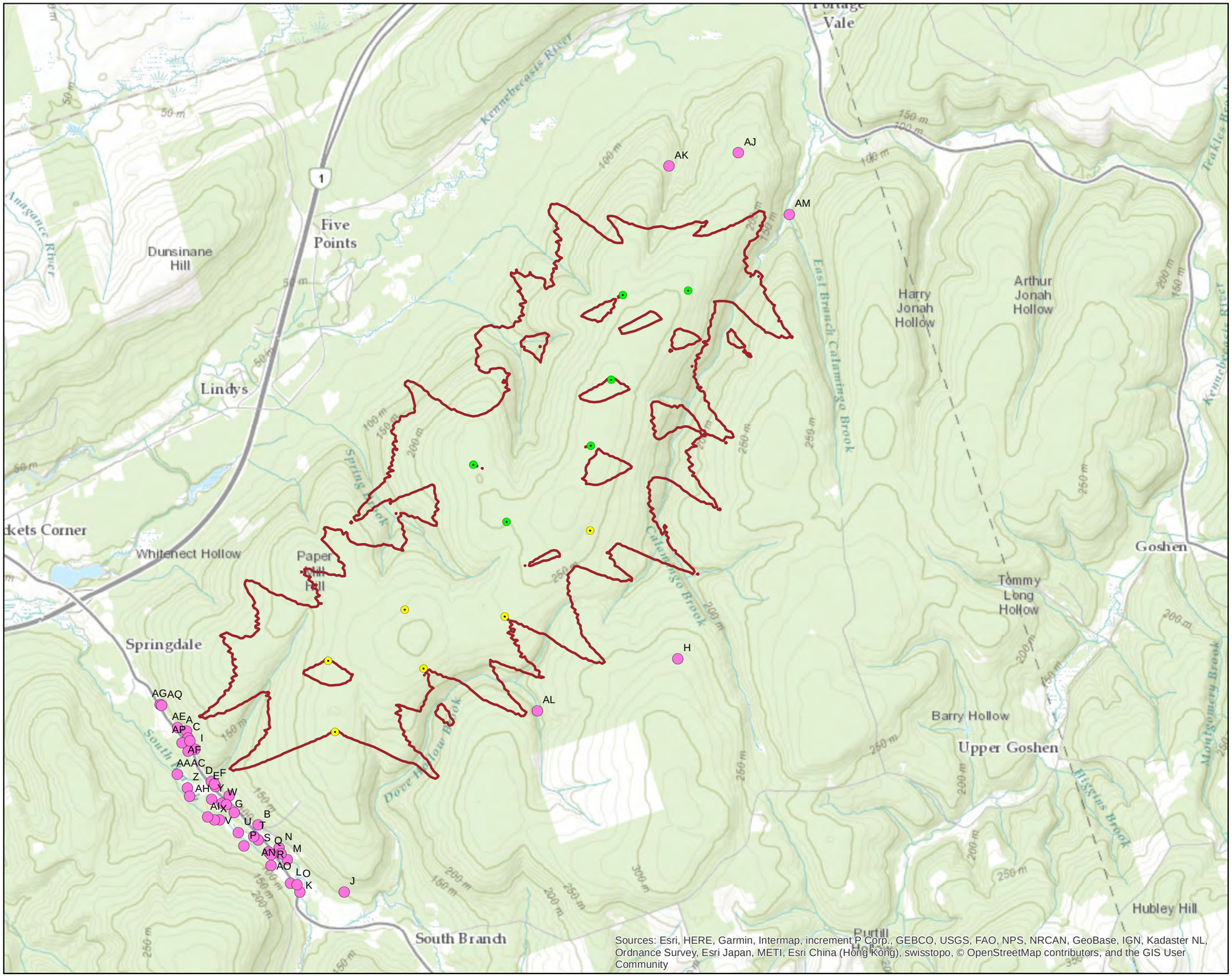
APPENDIX A

Site Layout Map



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Wocawson Energy Project

Preliminary Shadow Flicker Impact Assessment

Legend

- Receptors
- Proposed Turbines
- Proposed Alternate/Expansion Turbines
- 30 hrs/yr

Notes

N

1:60,000

0 900 1,800 2,700

Metres

WGS 1984 Web Mercator Auxiliary Sphere

Production Date: Sep 6, 2018

naturalforces

APPENDIX B

WindPRO v3.1, Shadow Module Calculation Results

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Calculated:
2018-09-06 9:31 AM/3.1.633

SHADOW - Main Result

Calculation: Wocawson Sept 06

Assumptions for shadow calculations

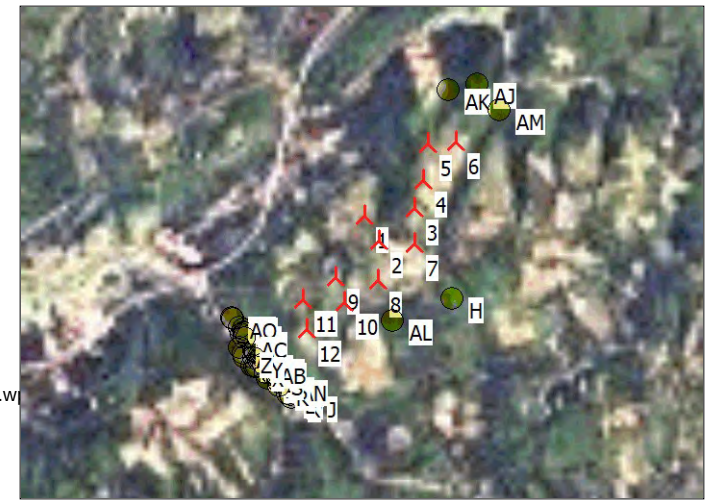
Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

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_Sussex East August 2018_0.w
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10.0 m

All coordinates are in
UTM (north)-NAD83 (US+CA) Zone: 20



Scale 1:200,000
New WTG
Shadow receptor

WTGs

	Easting	Northing	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	323,390	5,073,700	248.0	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
2	323,747	5,073,046	248.0	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
3	324,721	5,073,876	263.2	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
4	324,974	5,074,613	264.0	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
5	325,132	5,075,563	240.6	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
6	325,871	5,075,590	240.3	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
7	324,689	5,072,925	257.3	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
8	323,695	5,071,983	244.9	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
9	322,570	5,072,091	246.9	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
10	322,762	5,071,426	241.6	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
11	321,686	5,071,543	224.5	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6
12	321,742	5,070,736	232.0	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (T...	Yes	ENERCON	E-141 EP4-4,200	4,200	141.0	135.0	1,835	10.6

Shadow receptor-Input

No.	Name	Easting	Northing	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Receptor	320,064	5,070,797	104.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
B	Receptor	320,844	5,069,716	101.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
C	Receptor	320,081	5,070,721	99.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
D	Receptor	320,329	5,070,222	85.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
E	Receptor	320,371	5,070,159	91.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
F	Receptor	320,362	5,070,192	89.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
G	Receptor	320,526	5,070,054	104.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
H	Receptor	325,639	5,071,452	271.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
I	Receptor	320,153	5,070,590	100.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
J	Receptor	321,793	5,068,934	114.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
K	Receptor	321,293	5,068,944	89.4	3.0	3.0	1.0	0.0	90.0	"Green house mode"
L	Receptor	321,188	5,069,050	90.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
M	Receptor	321,160	5,069,316	88.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
N	Receptor	321,073	5,069,448	88.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
O	Receptor	321,263	5,069,031	87.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
P	Receptor	320,676	5,069,482	94.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
Q	Receptor	320,953	5,069,412	85.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
R	Receptor	320,976	5,069,254	93.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
S	Receptor	320,838	5,069,545	86.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
T	Receptor	320,790	5,069,584	85.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"

To be continued on next page...

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SHADOW - Main Result

Calculation: Wocawson Sept 06

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No.	Name	Easting	Northing	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
U	Receptor	320,618	5,069,635	84.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
V	Receptor	320,406	5,069,782	81.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
W	Receptor	320,440	5,069,973	97.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
X	Receptor	320,351	5,069,786	83.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
Y	Receptor	320,327	5,070,020	90.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
Z	Receptor	320,055	5,070,156	73.5	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AA	Receptor	319,948	5,070,314	71.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AB	Receptor	320,578	5,069,863	95.8	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AC	Receptor	320,075	5,070,570	81.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AD	Receptor	320,490	5,069,955	97.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AE	Receptor	319,966	5,070,836	90.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AF	Receptor	320,010	5,070,661	81.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AG	Receptor	319,775	5,071,106	86.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AH	Receptor	320,078	5,070,063	76.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AI	Receptor	320,274	5,069,819	86.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AJ	Receptor	326,482	5,077,125	177.2	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AK	Receptor	325,694	5,076,997	126.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AL	Receptor	324,033	5,070,911	198.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AM	Receptor	327,038	5,076,416	99.0	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AN	Receptor	321,094	5,069,385	87.3	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AO	Receptor	320,978	5,069,373	85.7	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AP	Receptor	320,100	5,070,686	100.6	3.0	3.0	1.0	0.0	90.0	"Green house mode"
AQ	Receptor	319,792	5,071,092	88.9	3.0	3.0	1.0	0.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

		Shadow, worst case		
No.	Name	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
A	Receptor	0:00	0	0:00
B	Receptor	0:00	0	0:00
C	Receptor	0:00	0	0:00
D	Receptor	22:53	66	0:24
E	Receptor	13:52	45	0:22
F	Receptor	18:49	55	0:24
G	Receptor	0:00	0	0:00
H	Receptor	0:00	0	0:00
I	Receptor	0:00	0	0:00
J	Receptor	0:00	0	0:00
K	Receptor	0:00	0	0:00
L	Receptor	0:00	0	0:00
M	Receptor	0:00	0	0:00
N	Receptor	0:00	0	0:00
O	Receptor	0:00	0	0:00
P	Receptor	0:00	0	0:00
Q	Receptor	0:00	0	0:00
R	Receptor	0:00	0	0:00
S	Receptor	0:00	0	0:00
T	Receptor	0:00	0	0:00
U	Receptor	0:00	0	0:00
V	Receptor	0:00	0	0:00
W	Receptor	0:00	0	0:00
X	Receptor	0:00	0	0:00
Y	Receptor	0:00	0	0:00
Z	Receptor	14:49	61	0:20
AA	Receptor	0:00	0	0:00
AB	Receptor	0:00	0	0:00
AC	Receptor	0:00	0	0:00
AD	Receptor	0:00	0	0:00
AE	Receptor	0:00	0	0:00
AF	Receptor	0:00	0	0:00
AG	Receptor	0:00	0	0:00
AH	Receptor	16:46	57	0:20

To be continued on next page...

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SHADOW - Main Result

Calculation: Wocawson Sept 06

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No.	Name	Shadow, worst case: Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
AI	Receptor	0:00	0	0:00
AJ	Receptor	0:00	0	0:00
AK	Receptor	0:00	0	0:00
AL	Receptor	19:03	59	0:26
AM	Receptor	11:43	38	0:24
AN	Receptor	0:00	0	0:00
AO	Receptor	0:00	0	0:00
AP	Receptor	0:00	0	0:00
AQ	Receptor	0:00	0	0:00

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

No.	Name	Worst case [h/year]
1	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (37)	0:00
2	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (38)	0:00
3	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (39)	0:00
4	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (40)	0:00
5	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (41)	0:00
6	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (42)	11:43
7	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (43)	0:00
8	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (44)	0:00
9	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (45)	0:00
10	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (46)	19:03
11	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (47)	0:00
12	ENERCON E-141 EP4 4200 141.0 !-! hub: 135.0 m (TOT: 205.5 m) (48)	33:36

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

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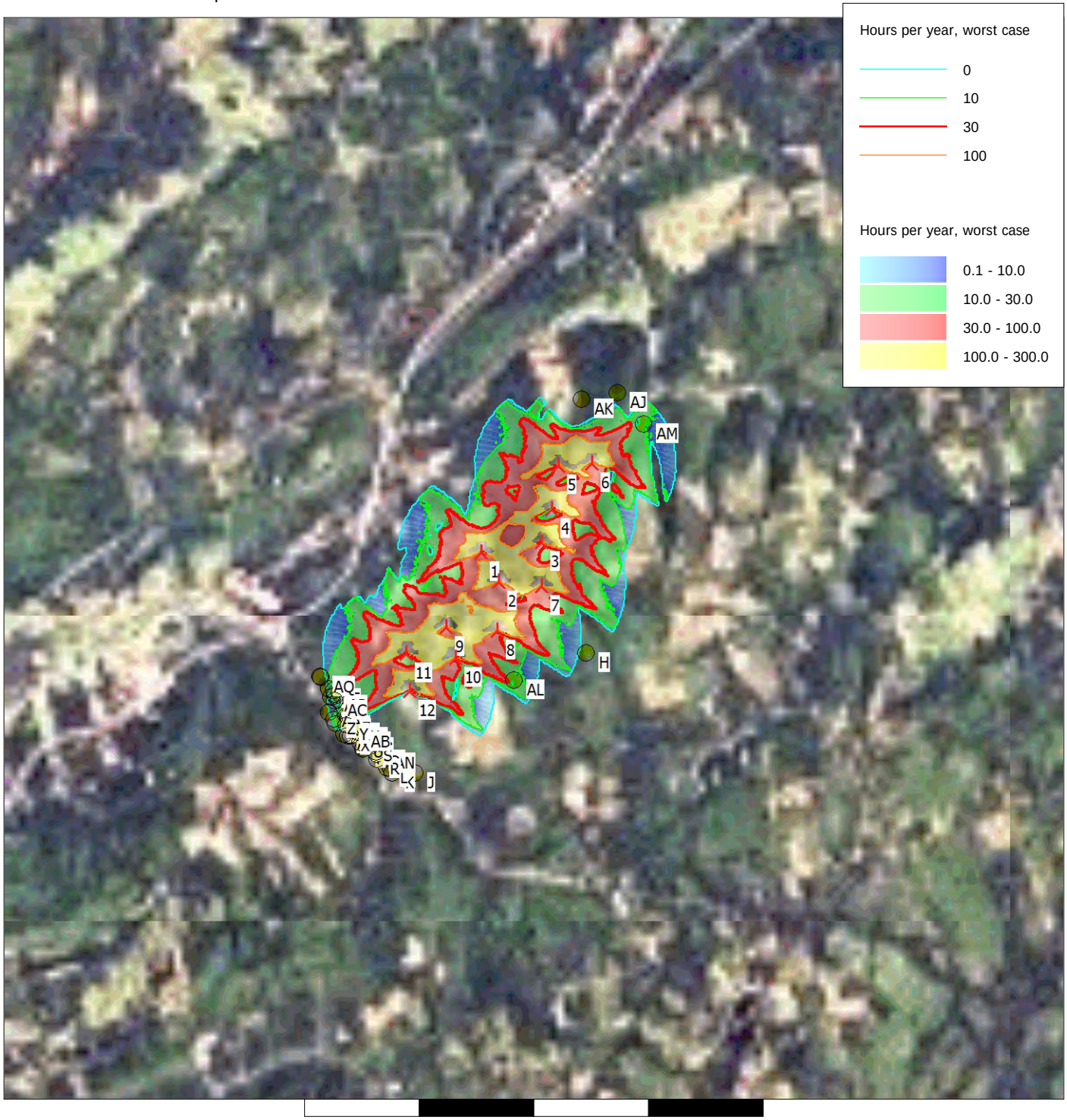
Calculated:
2018-09-06 9:31 AM/3.1.633

SHADOW - Map

Calculation: Wocawson Sept 06



Map: Google Earth overlay Map 001 , Print scale 1:125,000, Map center UTM (north)-NAD83 (US+CA) Zone: 20 East: 324,810 North: 5,073,930

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Sussex East August 2018_0.wpo (22)