

TUULIVOIMAPUISTO VÖYRINKANGAS OY / MEGATUULI OY

## **Suolakankaan tuulivoimahanke**

Varjostusmallinnukset "E-150" x 9 x HH155

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17.8.2016

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## Suolakankaan tuulivoimahanke

### 1 Varjostusmallinnuksen tavoitteet

Kauhajoen kaupungin alueelle suunnitteilla olevan Suolakankaan tuulivoimahankkeen aiheuttamia varjostusvaikutuksia on arvioitu laatimalla mallinnukset tuulivoimaloiden aiheuttamista varjostuksista.

Mallinnusten tavoitteena on osoittaa, kuinka laajalle alueelle kyseiset vaikutukset ulottuvat ja arvioida vaikutukset läheiselle asutukselle tai loma-asutukselle.

Tuulivoimaloiden aiheuttamat varjostusvaikutukset on mallinnettu WindPro-ohjelman SHADOW-moduulilla alustavien voimalanpaikkojen sijoitusten mukaisesti. Varjostusmallinnukset on laatinut FCG Suunnittelu ja Tekniikka Oy Ins. Hans Vadbäck ja laaduntarkistuksesta vastaa aluepäällikkö Jakob Kjellman.

#### 1.1 Varjostusmallinnus

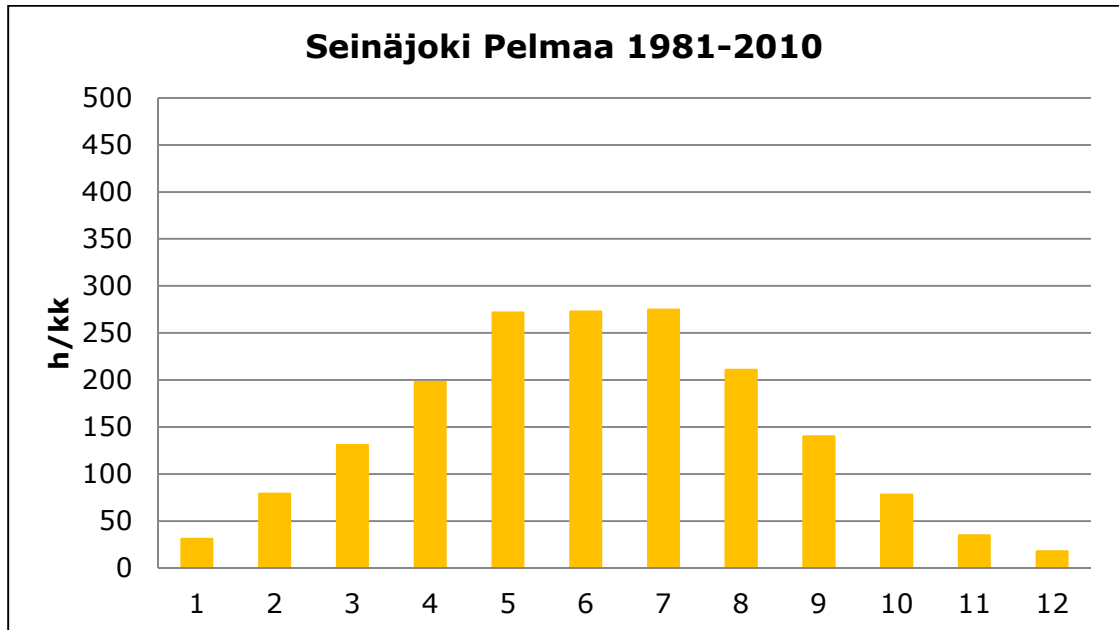
Tuulivoimaloiden varjostusvaikutuksia mallinnettiin WindPRO-ohjelman Shadow-moduulilla. Varjostulaskennassa hyödynnettiin Enercon E-141 voimalaa. Voimalan E-141 roottorin halkaisija on 141 metriä, mutta tässä mallinnuksessa siipien pituutta on pidennetty siten että roottorin halkaisijaksi saadaan 150 metriä. Voimaloiden napakorkeutena on soviteluonnoksissa käytetty 155 metriä, jolloin voimaloiden kokonaiskorkeudeksi muodostuu 230 metriä.

Mallinnus tehtiin niin sanotulle todelliselle tilanteelle (real case). Mallinnoissa tehtiin kaksi eri laskentatilannetta:

- 1) Todellinen tilanne, jossa puuston suojaavaa vaikutusta ei huomioitu (real case, no forest) voimaloiden napakorkeus = 155 m (HH155)
- 2) Todellinen tilanne, jossa puuston suojaavaa vaikutusta on huomioitu (real case, forest luke) voimaloiden napakorkeus = 155 m (HH155). Puuston korkeustiedot perustuvat Luonnonvarakeskus (Luke) vuoden 2013 monilähteisestä valtakunnan metsien inventoinnista (MVMi), jossa käytetään Valtakunnan metsien inventoinnin (VMI) maastomittausten lisäksi satelliittikuvia ja muita tietolähteitä, kuten Maanmittauslaitoksen numeerista maastotietokantaa ja korkeusmallia. Vuoden 2013 metsävarakartoissa karttateemojen maastoelementin koko on nyt 16 x 16 metriä.

Auringon keskimääräiset paistetunnit perustuvat Seinäjoen Pelmaan sääaseman pitkäaikaisiin mitattuihin säätietoihin 1981-2010 (Kuva 1). Laskentojen tuulen suunta ja nopeusjakamana käytettiin NASA:n julkaisemaa MERRA-satelliittidataan perustuvaa tuulidataa (E22.668-N62.500).

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**Kuva 1. Seinäjoen Pelmaan sääaseman kuukauden keskimääräiset auringonpaistetunnit vuosina 1981-2010 (Lähde: Ilmatieteenlaitos raportti 2012:1).**

Varjostusmallinnuksen tuloksia on havainnollistettu kartan avulla. Kartalla esitetään varjostusvaikutuksen (1, 8, 10 ja 20 tuntia vuodessa) laajuus. Sen lisäksi mallinnuksessa on erikseen laskettu vaikutus tuulivoimapuistoalueen ympäristössä oleviin herkkiin kohteisiin.

Laskennoissa varjot huomioidaan, jos aurinko on yli 3 astetta horisontin yläpuolella ja varjoksi lasketaan, kun siipi peittää vähintään 20 % auringosta.

Varjostusmallin laskennassa on huomioitu hankealueen korkeustiedot, tuulivoimaloiden sijainnit esisuunnitelman mukaan, tuulivoimalan napakorkeudet ja roottorin halkaisija ja hankealueen aikavyöhyke. Mallinnuksessa otettiin huomioon auringon asema horisontissa eri kellon- ja vuodenaikoina, pilvisuus kuukausittain eli kuinka paljon aurinko paistaa ollessaan horisontin yläpuolella sekä tuulivoimalaitosten arvioitu vuotuinen käyntiaika.

Varjostuksen tarkastelukorkeutena lähialueen asuin- tai lomarakennusten pihapiirissä käytettiin 2,0 metriä ja laskenta-alueen kokoa 5,0 x 5,0 metriä.

## 1.2 Raja- ja ohjearvot

Suomessa ei ole viranomaisten antamia yleisiä määräyksiä tuulivoimaloiden muodostaman varjostuksen enimmäiskestoista eikä varjonmuodostuksen arviointiperusteista. Ympäristöministeriön tuulivoimarakentamisen suunnitteluohjeistuksessa esitetään käytettäväksi muiden maiden suosituksia välkkeen rajoittamisesta (Ympäristöministeriö 2012).

Useissa maissa on annettu raja-arvoja tai suosituksia hyväksyttävän välkevaikutuksen määrästä. Esimerkiksi Tanskassa sovelletaan todellisen tilanteen raja-arvona enintään kymmenen tuntia vuodessa. Ruotsissa vastaava suositus on kahdeksan tuntia vuodessa ja 30 minuuttia päivässä.

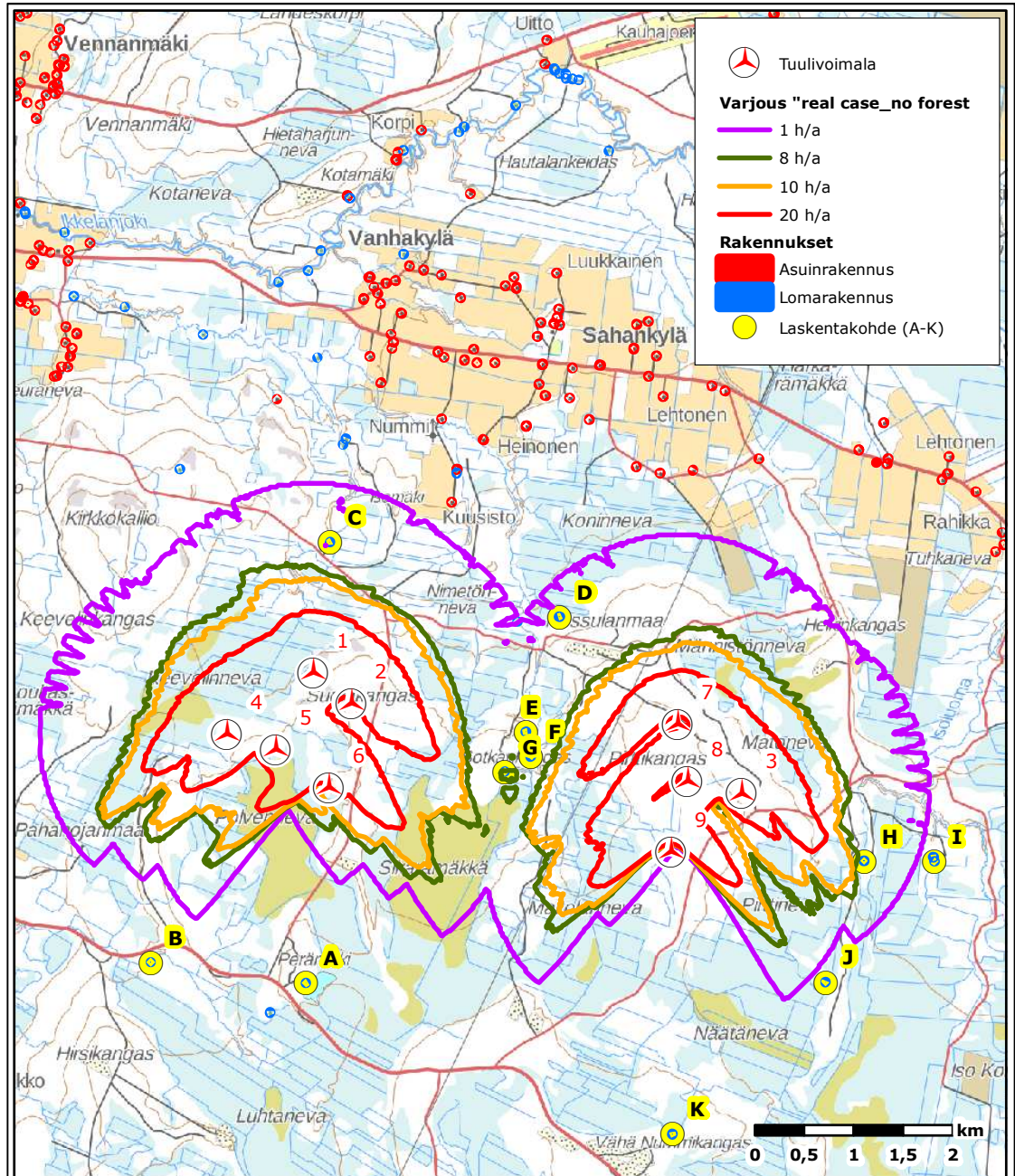


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### 1.3 Varjostusmallinnusten tulokset

#### Real case, no forest

Tuulivoimaloiden läheisyydessä sijaitsevien asuin- ja lomarakennusten kohdalla varjostustunnit ovat "real case, no forest"-laskentatulosten perusteella noin 8 tuntia yhden vapaa-ajan asunnon kohdalla (kohde "G"), muissa kohteissa vaikutukset ovat tätä pienemmät. Katso tarkemmat laskentatulokset liitteestä 1.



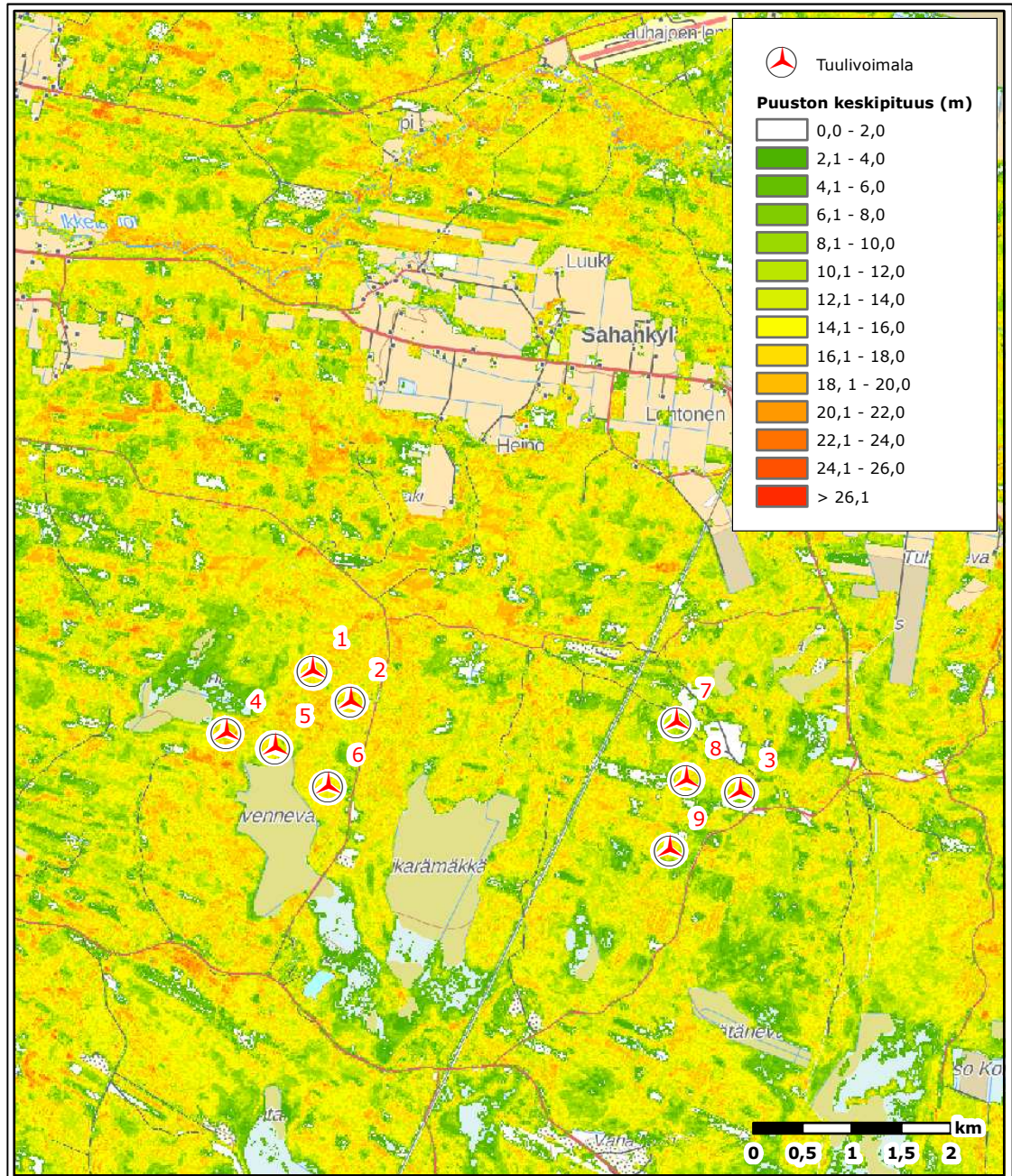
Kuva 2. Varjostusmallinnus "E-150" x 9 x HH155, puuston suojaavaa vaikutusta ei huomioitu.



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Real case, forest luke

Varjostusmallinnuksessa puuston korkeustiedot perustuvat Luonnonvarakeskus (Luke) vuoden 2013 monilähteisestä valtakunnan metsien inventoinnista, (Kuva 3).



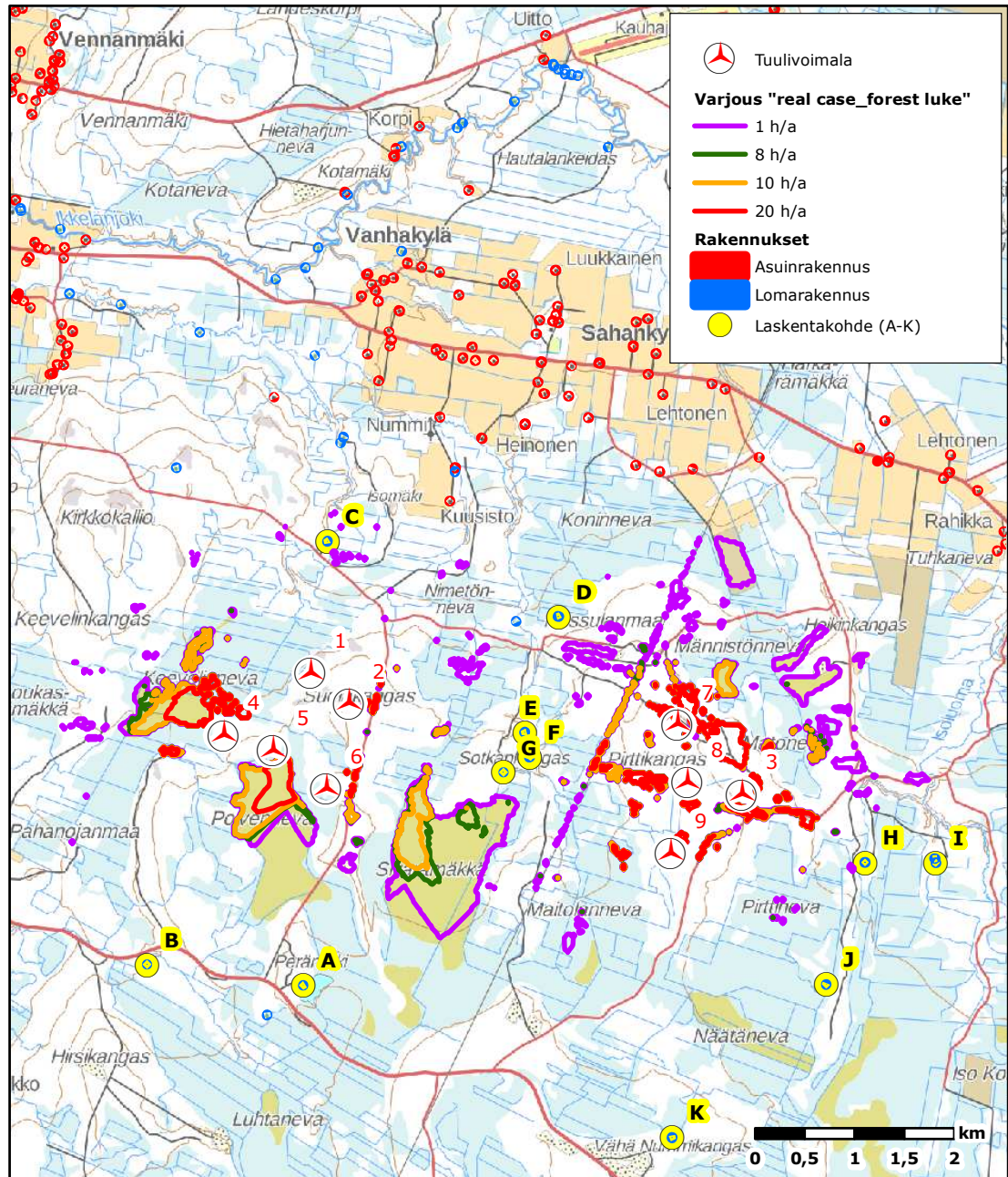
**Kuva 3. Varjostusmallinnuksessa käytetyt puuston korkeudet, perustuvat Luonnonvarakeskus (Luke) vuoden 2013 monilähteisestä valtakunnan metsien inventoinnista.**

Kun puuston suojaava vaikutus huomioidaan, laskentatuloksista nähdään, että varjostusvaikutukset ovat merkittävästi lievemmät (Kuva 4).



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Tuulivoimaloiden läheisyydessä sijaitsevien asuin- ja lomarakennusten kohdalla varjostustunnit ovat "real case, forest luke"-laskentatulosten perusteella alle 1 tuntia vuodessa kaikissa tarkastelukohteissa (A-K). Katso tarkemmat laskentatulokset liitteestä 2.



Kuva 4. Varjostusmallinnus "E-150" x 9 x HH155, puuston suojaava vaikutus on huomioitu.

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**Taulukko 1. Laskennalliset varjostustunnit vuodessa lähialueen laskentapisteissä, kun puuston suojaava vaikutus ei ole huomioitu "real case, no forest"**

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-ikkuna (m)	Varjostus (h/a)
A Lomarakennus (Perämäki)	258 941	6 924 744	171,2	5 x 5	0:00
B Lomarakennus (Nummikankaantie 218)	257 371	6 924 948	149,3	5 x 5	0:00
C Lomarakennus (Heikinkatu 25)	259 185	6 929 195	135,0	5 x 5	4:53
D Lomarakennus (Ressulanmaa)	261 505	6 928 439	146,0	5 x 5	1:34
E Lomarakennus (Sotkankangas I)	261 168	6 927 279	162,5	5 x 5	6:39
F Lomarakennus (Sotkankangas II)	261 217	6 927 029	160,0	5 x 5	7:45
G Lomarakennus (Sotkankangas III)	260 951	6 926 878	160,8	5 x 5	8:21
H Lomarakennus (Ruostetuoma)	264 587	6 925 975	157,5	5 x 5	4:39
I Lomarakennus (Heikinkankaantie 135)	265 298	6 925 969	153,1	5 x 5	0:00
J Lomarakennus (Pukinharju)	264 198	6 924 751	163,2	5 x 5	0:00
K Lomarakennus (Vähä Nummikangas)	262 649	6 923 216	187,5	5 x 5	0:00

**Taulukko 2. Laskennalliset varjostustunnit vuodessa lähialueen laskentapisteissä, kun puuston suojaava vaikutus on huomioitu "real case, forest luke"**

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-ikkuna (m)	Varjostus (h/a)
A Lomarakennus (Perämäki)	258 941	6 924 744	171,2	5 x 5	0:00
B Lomarakennus (Nummikankaantie 218)	257 371	6 924 948	149,3	5 x 5	0:00
C Lomarakennus (Heikinkatu 25)	259 185	6 929 195	135,0	5 x 5	0:00
D Lomarakennus (Ressulanmaa)	261 505	6 928 439	146,0	5 x 5	0:00
E Lomarakennus (Sotkankangas I)	261 168	6 927 279	162,5	5 x 5	0:00
F Lomarakennus (Sotkankangas II)	261 217	6 927 029	160,0	5 x 5	0:00
G Lomarakennus (Sotkankangas III)	260 951	6 926 878	160,8	5 x 5	0:00
H Lomarakennus (Ruostetuoma)	264 587	6 925 975	157,5	5 x 5	0:00
I Lomarakennus (Heikinkankaantie 135)	265 298	6 925 969	153,1	5 x 5	0:00
J Lomarakennus (Pukinharju)	264 198	6 924 751	163,2	5 x 5	0:00
K Lomarakennus (Vähä Nummikangas)	262 649	6 923 216	187,5	5 x 5	0:00

Varjostusmallinnustulosten perusteella tuulivoimaloista aiheutuvat varjostusvaikutukset eivät ulotu yhdellekään vapaa-ajan tai asuinrakennuksen kohdalle kun alueella kasvava puusto huomioidaan. Katso laskentatulokset liitteessä 2.

## FCG Suunnittelu ja Tekniikka Oy

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Ins. Laatija

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**Liite 1: Varjostusmallinnusten tulokset "real case, no forest"**



## SHADOW - Main Result

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forest  
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) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational hours are calculated from WTGs in calculation and wind distribution:  
MERRA\_basic\_E22.668\_N62.500

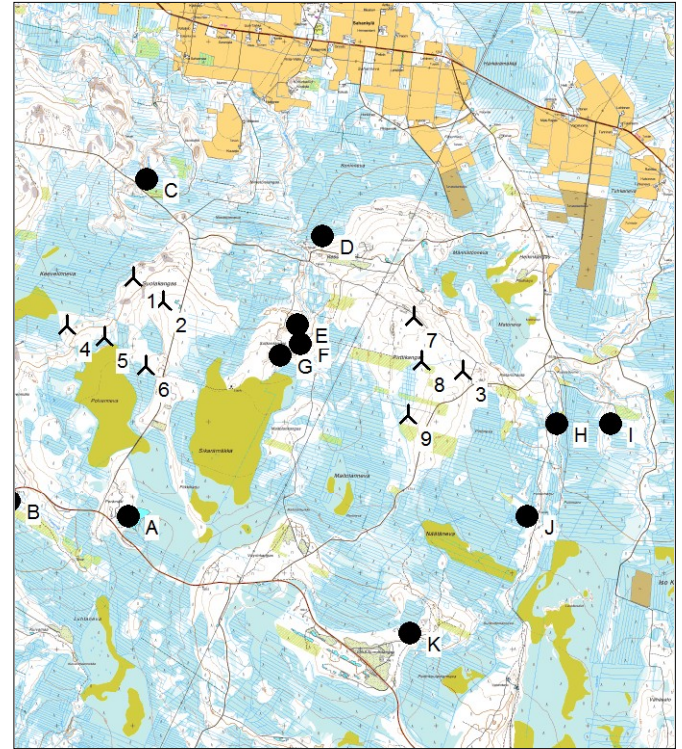
Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

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: Korkeuskäyrät\_Kauhajoki.wpo (1)  
Obstacles used in calculation  
Eye height: 1,5 m  
Grid resolution: 10,0 m

All coordinates are in  
Finish TM ETRS-TM35FIN-ETRS89

### WTGs

	East	North	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
1	259 015	6 927 893	155,0	ENERCON E-150 4200 150.0 !-I hub: ... Yes	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
2	259 400	6 927 582	167,5	ENERCON E-150 4200 150.0 !-I hub: ... Yes	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
3	263 350	6 926 671	167,4	ENERCON E-150 4200 150.0 !-I hub: ... Yes	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
4	258 141	6 927 267	153,8	ENERCON E-150 4200 150.0 !-I hub: ... Yes	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
5	258 635	6 927 116	162,2	ENERCON E-150 4200 150.0 !-I hub: ... Yes	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
6	259 173	6 926 730	169,8	ENERCON E-150 4200 150.0 !-I hub: ... Yes	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
7	262 702	6 927 373	172,5	ENERCON E-150 4200 150.0 !-I hub: ... Yes	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
8	262 803	6 926 793	172,2	ENERCON E-150 4200 150.0 !-I hub: ... Yes	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
9	262 634	6 926 083	172,5	ENERCON E-150 4200 150.0 !-I hub: ... Yes	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0



Scale 1:100 000  
New WTG Shadow receptor

### Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Lomarakennus (Perämäki)	258 941	6 924 744	171,2	5,0	5,0	2,0	0,0	90,0	"Green house mode"
B	Lomarakennus (Nummikankaantie 218)	257 371	6 924 948	149,3	5,0	5,0	2,0	0,0	90,0	"Green house mode"
C	Lomarakennus (Heikinkatu 25)	259 185	6 929 195	135,0	5,0	5,0	2,0	0,0	90,0	"Green house mode"
D	Lomarakennus (Ruostetuoma)	261 505	6 928 439	146,0	5,0	5,0	2,0	0,0	90,0	"Green house mode"
E	Lomarakennus (Sotkankangas I)	261 168	6 927 279	162,5	5,0	5,0	2,0	0,0	90,0	"Green house mode"
F	Lomarakennus (Sotkankangas II)	261 217	6 927 029	160,0	5,0	5,0	2,0	0,0	90,0	"Green house mode"
G	Lomarakennus (Sotkankangas III)	260 951	6 926 878	160,8	5,0	5,0	2,0	0,0	90,0	"Green house mode"
H	Lomarakennus (Ruostetuoma)	264 587	6 925 975	157,5	5,0	5,0	2,0	0,0	90,0	"Green house mode"
I	Lomarakennus (Heikinkankaantie 135)	265 298	6 925 969	153,1	5,0	5,0	2,0	0,0	90,0	"Green house mode"
J	Lomarakennus (Pukinharju)	264 198	6 924 751	163,2	5,0	5,0	2,0	0,0	90,0	"Green house mode"
K	Lomarakennus (Vähä Nummikangas)	262 649	6 923 216	187,5	5,0	5,0	2,0	0,0	90,0	"Green house mode"

## SHADOW - Main Result

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forest

### Calculation Results

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours	per year [h/year]
A	Lomarakennus (Perämäki)	0:00	0:00
B	Lomarakennus (Nummikankaantie 218)	0:00	0:00
C	Lomarakennus (Heikinkatu 25)	4:53	4:53
D	Lomarakennus (Ressulanmaa)	1:34	1:34
E	Lomarakennus (Sotkakangas I)	6:39	6:39
F	Lomarakennus (Sotkakangas II)	7:45	7:45
G	Lomarakennus (Sotkakangas III)	8:21	8:21
H	Lomarakennus (Ruostetuoma)	4:39	4:39
I	Lomarakennus (Heikinkankaantie 135)	0:00	0:00
J	Lomarakennus (Pukinharju)	0:00	0:00
K	Lomarakennus (Vähä Nummikangas)	0:00	0:00

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

No.	Name		Worst case	Expected
			[h/year]	[h/year]
1	ENERCON E-150 4200 150.0	!-! hub: 155,0 m (TOT: 230,0 m) (30)	28:31	2:56
2	ENERCON E-150 4200 150.0	!-! hub: 155,0 m (TOT: 230,0 m) (31)	40:44	7:31
3	ENERCON E-150 4200 150.0	!-! hub: 155,0 m (TOT: 230,0 m) (32)	16:24	4:39
4	ENERCON E-150 4200 150.0	!-! hub: 155,0 m (TOT: 230,0 m) (33)	0:00	0:00
5	ENERCON E-150 4200 150.0	!-! hub: 155,0 m (TOT: 230,0 m) (34)	0:00	0:00
6	ENERCON E-150 4200 150.0	!-! hub: 155,0 m (TOT: 230,0 m) (35)	6:21	1:20
7	ENERCON E-150 4200 150.0	!-! hub: 155,0 m (TOT: 230,0 m) (36)	35:00	8:12
8	ENERCON E-150 4200 150.0	!-! hub: 155,0 m (TOT: 230,0 m) (37)	21:40	4:45
9	ENERCON E-150 4200 150.0	!-! hub: 155,0 m (TOT: 230,0 m) (38)	20:03	3:33

## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: A - Lomarakenus (Perämäki)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:02	07:38	06:56	05:18	03:55	03:41	04:51	06:17	07:36	08:02	09:26
	15:10	16:29	17:51	20:17	21:40	23:04	23:28	22:22	20:44	19:05	16:27	15:13
2	09:59	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:39	08:05	09:29
	15:12	16:32	17:54	20:19	21:43	23:06	23:27	22:19	20:41	19:02	16:24	15:12
3	09:58	08:56	07:31	06:49	05:12	03:51	03:44	04:57	06:22	07:41	08:08	09:31
	15:13	16:35	17:57	20:22	21:46	23:08	23:26	22:16	20:38	18:58	16:21	15:10
4	09:57	08:53	07:28	06:46	05:09	03:50	03:45	05:00	06:25	07:44	08:11	09:33
	15:15	16:38	18:00	20:25	21:49	23:11	23:24	22:13	20:35	18:55	16:18	15:09
5	09:56	08:51	07:25	06:43	05:06	03:48	03:47	05:02	06:27	07:47	08:14	09:35
	15:17	16:41	18:02	20:27	21:52	23:13	23:23	22:10	20:31	18:52	16:15	15:07
6	09:55	08:48	07:22	06:39	05:03	03:46	03:48	05:05	06:30	07:49	08:16	09:38
	15:19	16:44	18:05	20:30	21:55	23:14	23:22	22:07	20:28	18:49	16:12	15:06
7	09:54	08:45	07:18	06:36	05:00	03:45	03:50	05:08	06:33	07:52	08:19	09:40
	15:21	16:47	18:08	20:33	21:57	23:16	23:20	22:04	20:25	18:45	16:09	15:05
8	09:52	08:42	07:15	06:33	04:57	03:43	03:52	05:11	06:35	07:55	08:22	09:42
	15:23	16:50	18:11	20:36	22:00	23:18	23:19	22:01	20:21	18:42	16:07	15:04
9	09:51	08:39	07:12	06:29	04:54	03:42	03:54	05:14	06:38	07:57	08:25	09:44
	15:26	16:53	18:14	20:38	22:03	23:20	23:17	21:58	20:18	18:39	16:04	15:03
10	09:50	08:36	07:09	06:26	04:51	03:41	03:56	05:16	06:41	08:00	08:28	09:45
	15:28	16:56	18:16	20:41	22:06	23:21	23:15	21:55	20:15	18:35	16:01	15:02
11	09:48	08:33	07:05	06:23	04:48	03:40	03:58	05:19	06:43	08:03	08:31	09:47
	15:30	16:59	18:19	20:44	22:09	23:23	23:13	21:52	20:11	18:32	15:58	15:01
12	09:46	08:30	07:02	06:19	04:45	03:39	04:00	05:22	06:46	08:05	08:34	09:49
	15:33	17:02	18:22	20:47	22:12	23:24	23:11	21:49	20:08	18:29	15:56	15:00
13	09:45	08:27	06:59	06:16	04:43	03:38	04:02	05:25	06:48	08:08	08:37	09:50
	15:35	17:05	18:25	20:50	22:15	23:25	23:10	21:46	20:05	18:26	15:53	14:59
14	09:43	08:24	06:55	06:13	04:40	03:37	04:05	05:27	06:51	08:11	08:40	09:52
	15:38	17:08	18:27	20:52	22:17	23:27	23:07	21:42	20:01	18:23	15:50	14:59
15	09:41	08:21	06:52	06:10	04:37	03:36	04:07	05:30	06:54	08:14	08:43	09:53
	15:40	17:11	18:30	20:55	22:20	23:28	23:05	21:39	19:58	18:19	15:48	14:59
16	09:39	08:18	06:49	06:06	04:34	03:35	04:09	05:33	06:56	08:16	08:46	09:54
	15:43	17:13	18:33	20:58	22:23	23:30	23:03	21:36	19:55	18:16	15:45	14:58
17	09:37	08:15	06:46	06:03	04:31	03:35	04:12	05:36	06:59	08:19	08:48	09:56
	15:46	17:16	18:36	21:01	22:26	23:29	23:01	21:33	19:51	18:13	15:43	14:58
18	09:35	08:12	06:42	06:00	04:29	03:35	04:14	05:39	07:02	08:22	08:51	09:57
	15:48	17:19	18:38	21:03	22:29	23:30	22:59	21:30	19:48	18:10	15:40	14:58
19	09:33	08:09	06:39	05:57	04:26	03:34	04:17	05:41	07:04	08:25	08:54	09:58
	15:51	17:22	18:41	21:06	22:31	23:31	22:56	21:27	19:45	18:07	15:38	14:58
20	09:31	08:06	06:36	05:53	04:23	03:34	04:19	05:44	07:07	08:28	08:57	09:58
	15:54	17:25	18:44	21:09	22:34	23:31	22:54	21:23	19:41	18:03	15:36	14:58
21	09:29	08:03	06:32	05:50	04:21	03:34	04:22	05:47	07:09	08:30	09:00	09:59
	15:57	17:28	18:47	21:12	22:37	23:31	22:51	21:20	19:38	18:00	15:33	14:59
22	09:27	08:00	06:29	05:47	04:18	03:34	04:24	05:50	07:12	08:33	09:03	10:00
	15:59	17:31	18:49	21:15	22:39	23:32	22:49	21:17	19:35	17:57	15:31	14:59
23	09:24	07:57	06:26	05:44	04:16	03:35	04:27	05:52	07:15	08:36	09:05	10:00
	16:02	17:34	18:52	21:18	22:42	23:32	22:46	21:14	19:31	17:54	15:29	15:00
24	09:22	07:54	06:22	05:41	04:13	03:35	04:30	05:55	07:17	08:39	09:08	10:01
	16:05	17:37	18:55	21:20	22:45	23:32	22:44	21:11	19:28	17:51	15:27	15:00
25	09:20	07:50	06:19	05:37	04:11	03:36	04:32	05:58	07:20	07:42	09:11	10:01
	16:08	17:40	18:57	21:23	22:47	23:31	22:41	21:07	19:25	16:48	15:24	15:01
26	09:17	07:47	06:16	05:34	04:08	03:36	04:35	06:00	07:23	07:45	09:13	10:01
	16:11	17:43	19:00	21:26	22:50	23:31	22:38	21:04	19:21	16:45	15:22	15:02
27	09:15	07:44	06:12	05:31	04:06	03:37	04:38	06:03	07:25	07:47	09:16	10:01
	16:14	17:45	19:03	21:29	22:52	23:31	22:36	21:01	19:18	16:42	15:20	15:03
28	09:12	07:41	06:09	05:28	04:04	03:38	04:40	06:06	07:28	07:50	09:19	10:01
	16:17	17:48	19:06	21:32	22:55	23:30	22:33	20:58	19:15	16:39	15:19	15:04
29	09:10	07:06	05:25	04:02	03:39	04:43	06:09	07:31	07:53	09:21	10:01	10:01
	16:20	17:51	19:08	21:35	22:57	23:29	22:30	20:54	19:12	16:36	15:17	15:05
30	09:07	07:02	05:22	03:59	03:40	04:46	06:11	07:33	07:56	09:24	10:00	10:00
	16:23	17:54	19:11	21:37	23:00	23:29	22:27	20:51	19:08	16:33	15:15	15:07
31	09:04	06:59	05:19	03:57	03:02	04:49	06:14	07:35	07:59	09:27	10:00	10:00
	16:26	17:56	19:13	21:39	23:02	23:31	22:25	20:48	16:30	15:14	15:08	15:08
Potential sun hours	190	246	364	444	551	592	584	497	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: B - Lomarakennus (Nummikankaantie 218)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:02	07:38	06:56	05:19	03:55	03:41	04:51	06:17	07:36	08:02	09:26
	15:10	16:29	17:51	20:17	21:40	23:04	23:28	22:22	20:45	19:05	16:27	15:13
2	09:59	08:59	07:35	06:53	05:16	03:53	03:42	04:54	06:19	07:39	08:05	09:29
	15:12	16:32	17:54	20:19	21:43	23:06	23:27	22:19	20:41	19:02	16:24	15:12
3	09:58	08:56	07:31	06:49	05:12	03:52	03:44	04:57	06:22	07:41	08:08	09:31
	15:13	16:35	17:57	20:22	21:46	23:09	23:26	22:16	20:38	18:58	16:21	15:10
4	09:57	08:54	07:28	06:46	05:09	03:50	03:45	05:00	06:25	07:44	08:11	09:33
	15:15	16:38	18:00	20:25	21:49	23:11	23:25	22:13	20:35	18:55	16:18	15:09
5	09:56	08:51	07:25	06:43	05:06	03:48	03:47	05:03	06:27	07:47	08:14	09:36
	15:17	16:41	18:02	20:28	21:52	23:13	23:23	22:10	20:31	18:52	16:15	15:07
6	09:55	08:48	07:22	06:39	05:03	03:46	03:49	05:05	06:30	07:49	08:17	09:38
	15:19	16:44	18:05	20:30	21:55	23:15	23:22	22:07	20:28	18:49	16:12	15:06
7	09:54	08:45	07:18	06:36	05:00	03:45	03:50	05:08	06:33	07:52	08:19	09:40
	15:21	16:47	18:08	20:33	21:58	23:16	23:20	22:04	20:25	18:45	16:10	15:05
8	09:52	08:42	07:15	06:33	04:57	03:43	03:52	05:11	06:35	07:55	08:22	09:42
	15:23	16:50	18:11	20:36	22:00	23:18	23:19	22:01	20:21	18:42	16:07	15:04
9	09:51	08:39	07:12	06:29	04:54	03:42	03:54	05:14	06:38	07:57	08:25	09:44
	15:26	16:53	18:14	20:39	22:03	23:20	23:17	21:58	20:18	18:39	16:04	15:03
10	09:50	08:36	07:09	06:26	04:51	03:41	03:56	05:16	06:41	08:00	08:28	09:45
	15:28	16:56	18:16	20:41	22:06	23:21	23:15	21:55	20:15	18:36	16:01	15:02
11	09:48	08:34	07:05	06:23	04:48	03:40	03:58	05:19	06:43	08:03	08:31	09:47
	15:30	16:59	18:19	20:44	22:09	23:23	23:14	21:52	20:11	18:32	15:58	15:01
12	09:47	08:31	07:02	06:20	04:46	03:39	04:00	05:22	06:46	08:06	08:34	09:49
	15:33	17:02	18:22	20:47	22:12	23:24	23:12	21:49	20:08	18:29	15:56	15:00
13	09:45	08:28	06:59	06:16	04:43	03:38	04:03	05:25	06:49	08:08	08:37	09:50
	15:35	17:05	18:25	20:50	22:15	23:25	23:10	21:46	20:05	18:26	15:53	15:00
14	09:43	08:25	06:56	06:13	04:40	03:37	04:05	05:28	06:51	08:11	08:40	09:52
	15:38	17:08	18:28	20:52	22:18	23:27	23:08	21:43	20:01	18:23	15:51	14:59
15	09:41	08:22	06:52	06:10	04:37	03:36	04:07	05:30	06:54	08:14	08:43	09:53
	15:40	17:11	18:30	20:55	22:20	23:28	23:05	21:39	19:58	18:19	15:48	14:59
16	09:39	08:19	06:49	06:07	04:34	03:36	04:09	05:33	06:56	08:17	08:46	09:55
	15:43	17:14	18:33	20:58	22:23	23:29	23:03	21:36	19:55	18:16	15:45	14:58
17	09:37	08:15	06:46	06:03	04:31	03:35	04:12	05:36	06:59	08:19	08:49	09:56
	15:46	17:17	18:36	21:01	22:26	23:29	23:01	21:33	19:52	18:13	15:43	14:58
18	09:35	08:12	06:42	06:00	04:29	03:35	04:14	05:39	07:02	08:22	08:51	09:57
	15:48	17:19	18:38	21:04	22:29	23:30	22:59	21:30	19:48	18:10	15:40	14:58
19	09:33	08:09	06:39	05:57	04:26	03:34	04:17	05:41	07:04	08:25	08:54	09:58
	15:51	17:22	18:41	21:06	22:31	23:31	22:56	21:27	19:45	18:07	15:38	14:58
20	09:31	08:06	06:36	05:54	04:23	03:34	04:19	05:44	07:07	08:28	08:57	09:59
	15:54	17:25	18:44	21:09	22:34	23:31	22:54	21:24	19:42	18:04	15:36	14:58
21	09:29	08:03	06:32	05:50	04:21	03:34	04:22	05:47	07:10	08:31	09:00	09:59
	15:57	17:28	18:47	21:12	22:37	23:31	22:51	21:20	19:38	18:00	15:33	14:59
22	09:27	08:00	06:29	05:47	04:18	03:34	04:24	05:50	07:12	08:33	09:03	10:00
	15:59	17:31	18:49	21:15	22:39	23:32	22:49	21:17	19:35	17:57	15:31	14:59
23	09:24	07:57	06:26	05:44	04:16	03:35	04:27	05:52	07:15	08:36	09:05	10:00
	16:02	17:34	18:52	21:18	22:42	23:32	22:46	21:14	19:32	17:54	15:29	15:00
24	09:22	07:54	06:22	05:41	04:13	03:35	04:30	05:55	07:17	08:39	09:08	10:01
	16:05	17:37	18:55	21:20	22:45	23:32	22:44	21:11	19:28	17:51	15:27	15:00
25	09:20	07:51	06:19	05:37	04:11	03:36	04:32	05:58	07:20	07:42	09:11	10:01
	16:08	17:40	18:58	21:23	22:47	23:31	22:41	21:07	19:25	16:48	15:25	15:01
26	09:17	07:47	06:16	05:34	04:08	03:36	04:35	06:01	07:23	07:45	09:14	10:01
	16:11	17:43	19:00	21:26	22:50	23:31	22:39	21:04	19:22	16:45	15:23	15:02
27	09:15	07:44	06:13	05:31	04:06	03:37	04:38	06:03	07:25	07:48	09:16	10:01
	16:14	17:45	19:03	21:29	22:52	23:31	22:36	21:01	19:18	16:42	15:21	15:03
28	09:12	07:41	06:09	05:28	04:04	03:38	04:40	06:06	07:28	07:50	09:19	10:01
	16:17	17:48	19:06	21:32	22:55	23:30	22:33	20:58	19:15	16:39	15:19	15:04
29	09:10	07:38	06:06	05:25	04:02	03:39	04:43	06:09	07:31	07:53	09:21	10:01
	16:20	17:51	19:08	21:35	22:57	23:30	22:30	20:54	19:12	16:36	15:17	15:05
30	09:07	07:33	06:03	05:22	03:59	03:40	04:46	06:11	07:33	07:56	09:24	10:00
	16:23	17:54	19:11	21:38	23:00	23:29	22:28	20:51	19:08	16:33	15:15	15:07
31	09:04	07:29	06:01	05:20	03:57	03:40	04:49	06:14	07:36	07:59	09:27	10:00
	16:26	17:57	19:14	21:41	23:02	23:31	22:25	20:48	16:30	15:12	15:08	15:00
Potential sun hours	190	246	364	444	551	592	584	497	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:

Suolakangas

Licensed user:

FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Hans Vadback / hans.vadback@fcg.fi
Calculated:
8.8.2016 14:23/3.0.619

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: C - Lomarakennus (Heikinkatu 25)
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January to December) and rows for time slots (1 to 31). Includes summary rows for Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, and Total, real.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) Minutes with flicker First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: D - Lomarakenus (Ressulanmaa)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time  
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December		
1	09:59 15:09	09:02 16:28	07:38 17:51	06:56 20:16	05:18 21:40	03:55 23:04	03:40 23:28	04:51 22:22	06:16 20:44	07:36 19:05	08:02 16:26	09:26 15:13		
2	09:59 15:11	08:59 16:31	07:34 17:54	06:52 20:19	05:15 21:43	03:53 23:07	03:42 23:27	04:54 22:19	06:19 20:41	07:38 19:01	08:05 16:23	09:29 15:11		
3	09:58 15:13	08:56 16:34	07:31 17:56	06:49 20:22	05:12 21:46	03:51 23:09	03:43 23:26	04:56 22:16	06:22 20:38	07:41 18:58	08:08 16:20	09:31 15:09		
4	09:57 15:15	08:53 16:37	07:28 17:59	06:46 20:25	05:09 21:49	03:49 23:11	03:44 23:25	04:59 22:13	06:24 20:34	07:44 18:55	08:11 16:18	09:33 15:08		
5	09:56 15:17	08:51 16:40	07:25 18:02	06:42 20:27	05:06 21:52	03:47 23:13	03:46 23:24	05:02 22:10	06:27 20:31	07:46 18:52	08:14 16:15	09:36 15:07		
6	09:55 15:19	08:48 16:43	07:21 18:05	06:39 20:30	05:03 21:55	03:46 23:15	03:48 23:22	05:05 22:07	06:30 20:28	07:49 18:48	08:16 16:12	09:38 15:05		
7	09:54 15:21	08:45 16:46	07:18 18:08	06:36 20:33	05:00 21:58	03:44 23:17	03:50 23:21	05:08 22:04	06:32 20:25	07:52 18:45	08:19 16:09	09:40 15:04		
8	09:53 15:23	08:42 16:49	07:15 18:11	06:32 20:36	04:57 22:00	03:43 23:18	03:51 23:19	05:10 22:01	06:35 20:21	07:54 18:42	08:22 16:06	09:42 15:03		
9	09:51 15:25	08:39 16:52	07:12 18:13	06:29 20:38	04:54 22:03	03:41 23:20	03:53 23:17	05:13 21:58	06:38 20:18	07:57 18:39	08:25 16:03	09:44 15:02		
10	09:50 15:27	08:36 16:55	07:08 18:16	06:26 20:41	04:51 22:06	03:40 23:22	03:55 23:16	05:16 21:55	06:40 20:15	08:00 18:35	08:28 16:01	09:46 15:01		
11	09:48 15:30	08:33 16:58	07:05 18:19	06:22 20:44	04:48 22:09	03:39 23:23	03:57 23:14	05:19 21:52	06:43 20:11	08:03 18:32	08:31 15:58	09:47 15:00		
12	09:47 15:32	08:30 17:01	07:02 18:22	06:19 20:47	04:45 22:12	03:38 23:24	04:00 23:12	05:22 21:49	06:46 20:08	08:05 18:29	08:34 15:55	09:49 14:59		
13	09:45 15:35	08:27 17:04	06:59 18:24	06:16 20:49	04:42 22:15	03:37 23:26	04:02 23:10	05:24 21:46	06:48 20:05	08:08 18:26	08:37 15:53	09:51 14:59		
14	09:43 15:37	08:24 17:07	09:06 (7) 09:17 (7)	06:55 18:27	06:13 20:52	04:39 22:18	03:36 23:27	04:04 23:08	05:27 21:43	08:11 20:01	09:37 (7) 09:48 (7)	08:40 15:50	09:52 14:58	
15	09:41 15:40	08:21 17:10	09:04 (7) 09:19 (7)	06:52 18:30	06:09 20:55	04:36 22:20	03:35 23:28	04:06 23:06	05:30 21:39	08:14 19:58	09:35 (7) 09:50 (7)	08:43 15:47	09:53 14:58	
16	09:39 15:42	08:18 17:13	09:02 (7) 09:20 (7)	06:49 18:33	06:06 20:58	04:34 22:23	03:35 23:29	04:09 23:03	05:33 21:36	08:16 19:55	09:34 (7) 09:51 (7)	08:46 15:45	09:55 14:58	
17	09:37 15:45	08:15 17:16	09:01 (7) 09:21 (7)	06:45 18:35	06:03 21:01	04:31 22:26	03:34 23:30	04:11 23:01	05:35 21:33	08:19 18:13	09:32 (7) 09:52 (7)	08:49 15:42	09:56 14:57	
18	09:35 15:48	08:12 17:19	09:01 (7) 09:22 (7)	06:42 18:38	06:00 21:03	04:28 22:29	03:34 23:30	04:14 22:59	05:38 21:30	08:22 19:48	09:32 (7) 09:53 (7)	08:51 15:40	09:57 14:57	
19	09:33 15:50	08:09 17:22	09:00 (7) 09:22 (7)	06:39 18:41	05:56 21:06	04:25 22:31	03:34 23:31	04:16 22:56	05:41 21:27	08:25 19:45	09:31 (7) 09:53 (7)	08:54 15:37	09:58 14:58	
20	09:31 15:53	08:06 17:25	09:00 (7) 09:22 (7)	06:35 18:44	05:53 21:09	04:23 22:34	03:33 23:31	04:19 22:54	05:44 21:23	07:07 19:41	08:28 18:03	09:30 (7) 09:53 (7)	08:57 15:35	09:59 14:58
21	09:29 15:56	08:03 17:28	09:00 (7) 09:23 (7)	06:32 18:46	05:50 21:12	04:20 22:37	03:33 23:32	04:21 22:52	05:46 21:20	07:09 19:38	08:30 18:00	09:30 (7) 09:53 (7)	09:00 15:33	09:59 14:58
22	09:27 15:59	08:00 17:31	08:59 (7) 09:22 (7)	06:29 18:49	05:47 21:15	04:18 22:40	03:34 23:32	04:24 22:49	05:49 21:17	07:12 19:35	08:33 17:57	09:30 (7) 09:52 (7)	09:03 15:30	10:00 14:58
23	09:24 16:02	07:57 17:34	09:00 (7) 09:22 (7)	06:25 18:52	05:43 21:18	04:15 22:42	03:34 23:32	04:26 22:46	05:52 21:14	07:15 19:31	08:36 17:54	09:30 (7) 09:52 (7)	09:05 15:28	10:00 14:59
24	09:22 16:05	07:54 17:36	09:00 (7) 09:21 (7)	06:22 18:55	05:40 21:20	04:13 22:45	03:34 23:32	04:29 22:44	05:55 21:11	07:17 19:28	08:39 17:51	09:31 (7) 09:52 (7)	09:08 15:26	10:01 15:00
25	09:20 16:08	07:50 17:39	09:01 (7) 09:20 (7)	06:19 18:57	05:37 21:23	04:10 22:47	03:35 23:32	04:32 22:41	05:57 21:07	07:20 19:25	08:42 16:48	08:32 (7) 08:51 (7)	09:11 15:24	10:01 15:00
26	09:17 16:10	07:47 17:42	09:02 (7) 09:19 (7)	06:16 19:00	05:34 21:26	04:08 22:50	03:35 23:31	04:34 22:39	06:00 21:04	07:22 19:21	08:45 16:44	08:33 (7) 08:49 (7)	09:14 15:22	10:01 15:01
27	09:15 16:13	07:44 17:45	09:03 (7) 09:16 (7)	06:12 19:03	05:31 21:29	04:05 22:53	03:36 23:31	04:37 22:36	06:03 21:01	07:25 19:18	08:47 16:41	08:34 (7) 08:48 (7)	09:16 15:20	10:01 15:02
28	09:12 16:16	07:41 17:48	09:06 (7) 09:14 (7)	06:09 19:05	05:28 21:32	04:03 22:55	03:37 23:30	04:40 22:33	06:06 20:58	07:28 19:15	08:50 16:38	08:36 (7) 08:45 (7)	09:19 15:18	10:01 15:03
29	09:10 16:19	07:38 17:53	09:06 (7) 09:14 (7)	06:06 19:05	05:24 21:35	04:01 22:57	03:38 23:30	04:43 22:30	06:08 20:54	07:30 19:11	07:53 16:35	09:21 15:16	10:01 15:05	
30	09:07 16:22	07:35 18:08	09:07 (7) 09:15 (7)	06:03 19:02	05:21 21:37	03:59 23:00	03:39 23:29	04:45 22:28	06:11 20:51	07:33 19:08	07:56 16:32	09:24 15:14	10:01 15:06	
31	09:04 16:25	07:32 18:11	09:04 (7) 09:12 (7)	06:01 19:01	05:18 21:40	03:56 23:03	03:38 23:30	04:48 22:25	06:14 20:48	07:59 16:29	09:24 15:07	10:00 15:07		
Potential sun hours	190	246		364	444	552	592	584	498	391	310	212	161	
Total, worst case			275								275			
Sun reduction			0,30								0,25			
Oper. time red.			0,99								0,99			
Wind dir. red.			0,63								0,63			
Total reduction			0,19								0,16			
Total, real			51								43			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: E - Lomarakennus (Sotkankangas I)  
 Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708

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

	January	February	March	April	May	June				
1	09:59 15:10	09:02 16:28	07:38 17:51	06:56 20:16	05:18 21:40	03:55 23:04				
2	09:59 15:11	08:59 16:31	07:34 17:54	06:52 20:19	19:39 (2) 19:45 (2)	05:15 21:43	03:53 23:06			
3	09:58 15:13	08:56 16:34	07:31 17:57	06:49 20:22	19:37 (2) 19:48 (2)	05:12 21:46	03:51 23:09			
4	09:57 15:15	08:53 16:37	07:28 17:59	06:46 20:25	19:36 (2) 19:51 (2)	05:09 21:49	03:49 23:11			
5	09:56 15:17	08:51 16:40	07:25 18:02	06:42 20:27	07:14 (7) 19:54 (2)	05:06 21:52	03:47 23:13			
6	09:55 15:19	08:48 16:43	07:21 18:05	06:39 20:30	07:10 (7) 19:53 (2)	05:03 21:55	03:46 23:15			
7	09:54 15:21	08:45 16:46	07:18 18:08	06:36 20:33	07:08 (7) 19:53 (2)	05:00 21:57	03:44 23:16			
8	09:52 15:23	08:42 16:49	07:15 18:11	06:32 20:36	07:07 (7) 19:53 (2)	04:57 22:00	03:43 23:18			
9	09:51 15:25	08:39 16:52	07:12 18:13	06:29 20:38	07:06 (7) 19:53 (2)	04:54 22:03	03:41 23:20			
10	09:50 15:27	08:36 16:55	07:08 18:16	06:26 20:41	07:05 (7) 19:52 (2)	04:51 22:06	03:40 23:21			
11	09:48 15:30	08:33 16:58	07:05 18:19	06:23 20:44	07:03 (7) 19:50 (2)	04:48 22:09	03:39 23:23			
12	09:47 15:32	08:30 17:01	07:02 18:22	07:32 (8) 07:39 (8)	06:19 20:47	07:03 (7) 19:49 (2)	04:45 22:12	03:38 23:24		
13	09:45 15:35	08:27 17:04	06:59 18:24	07:29 (8) 07:41 (8)	06:16 20:49	07:03 (7) 19:47 (2)	04:42 22:15	03:37 23:26		
14	09:43 15:37	08:24 17:07	09:00 (9) 09:05 (9)	06:55 18:27	07:26 (8) 07:43 (8)	06:13 20:52	07:03 (7) 19:44 (2)	04:39 22:17	03:36 23:27	
15	09:41 15:40	08:21 17:10	08:57 (9) 09:07 (9)	06:52 18:30	07:24 (8) 07:43 (8)	06:09 20:55	07:03 (7) 07:26 (7)	04:37 22:20	03:35 23:28	
16	09:39 15:42	08:18 17:13	08:53 (9) 09:07 (9)	06:49 18:33	07:24 (8) 07:43 (8)	06:06 20:58	07:04 (7) 07:25 (7)	04:34 22:23	03:35 23:29	
17	09:37 15:45	08:15 17:16	08:51 (9) 09:08 (9)	06:45 18:35	07:23 (8) 07:44 (8)	06:03 21:01	07:05 (7) 07:24 (7)	04:31 22:26	03:34 23:30	
18	09:35 15:48	08:12 17:19	08:51 (9) 09:09 (9)	06:42 18:38	07:22 (8) 07:43 (8)	06:00 21:03	07:05 (7) 07:21 (7)	04:28 22:29	03:34 23:30	
19	09:33 15:51	08:09 17:22	08:50 (9) 09:09 (9)	06:39 18:41	07:22 (8) 07:43 (8)	05:56 21:06	07:06 (7) 07:19 (7)	04:26 22:31	03:34 23:31	
20	09:31 15:53	08:06 17:25	08:50 (9) 09:09 (9)	06:35 18:44	07:22 (8) 07:42 (8)	05:53 21:09	07:08 (7) 07:17 (7)	04:23 22:34	03:34 23:31	
21	09:29 15:56	08:03 17:28	08:50 (9) 09:09 (9)	06:32 18:46	07:23 (8) 07:41 (8)	05:50 21:12	04:20 22:37	03:34 23:32	03:34 23:32	
22	09:27 15:59	08:00 17:31	08:50 (9) 09:08 (9)	06:29 18:49	07:23 (8) 07:40 (8)	05:47 21:15	04:18 22:39	03:34 23:32	03:34 23:32	
23	09:24 16:02	07:57 17:34	08:51 (9) 09:08 (9)	06:25 18:52	07:24 (8) 07:38 (8)	05:43 21:17	04:15 22:42	03:34 23:32	03:34 23:32	
24	09:22 16:05	07:54 17:37	08:51 (9) 09:06 (9)	06:22 18:55	07:26 (8) 07:35 (8)	05:40 21:20	04:13 22:45	03:34 23:32	03:34 23:32	
25	09:20 16:08	07:50 17:39	08:53 (9) 09:05 (9)	06:19 18:57	05:37 21:23	04:10 22:47	03:35 23:32	03:35 23:32	03:35 23:32	
26	09:17 16:11	07:47 17:42	08:56 (9) 09:02 (9)	06:16 19:00	05:34 21:26	04:08 22:50	03:36 23:31	03:36 23:31	03:36 23:31	
27	09:15 16:14	07:44 17:45	06:12 19:03	05:31 21:29	04:06 22:52	03:36 23:31	03:36 23:31	03:36 23:31	03:36 23:31	
28	09:12 16:16	07:41 17:48	06:09 19:06	05:28 21:32	04:03 22:55	03:37 23:30	03:37 23:30	03:37 23:30	03:37 23:30	
29	09:10 16:19	07:38 17:45	06:06 19:03	05:25 21:35	04:01 22:57	03:38 23:30	03:38 23:30	03:38 23:30	03:38 23:30	
30	09:07 16:22	07:35 17:42	07:02 19:00	05:21 21:37	03:59 23:00	03:39 23:29	03:39 23:29	03:39 23:29	03:39 23:29	
31	09:04 16:25	07:32 17:39	06:59 19:04	05:18 21:40	03:57 23:02	03:37 23:28	03:37 23:28	03:37 23:28	03:37 23:28	
Potential sun hours	190	246	364	444	551	592				
Total, worst case			189	215	492					
Sun reduction			0,30	0,36	0,45					
Oper. time red.			0,99	0,99	0,99					
Wind dir. red.			0,62	0,59	0,60					
Total reduction			0,19	0,21	0,26					
Total, real			35	45	130					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: E - Lomarakennus (Sotkankangas I)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time  
 N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	July	August	September	October	November	December			
1	03:40	04:51	06:16	07:02 (7)	07:36	08:10 (8)	08:02	09:26	
	23:28	22:22	20:44	41 19:49 (2)	19:05	9 08:19 (8)	16:26	15:13	
2	03:42	04:54	06:19	07:03 (7)	07:38	08:13 (8)	08:05	09:29	
	23:27	22:19	20:41	40 19:50 (2)	19:01	1 08:14 (8)	16:24	15:11	
3	03:43	04:56	06:22	07:04 (7)	07:41		08:08	09:31	
	23:26	22:16	20:38	41 19:51 (2)	18:58		16:21	15:10	
4	03:45	04:59	06:24	07:04 (7)	07:44		08:11	09:33	
	23:25	22:13	20:34	39 19:50 (2)	18:55		16:18	15:08	
5	03:46	05:02	06:27	07:05 (7)	07:46		08:14	09:35	
	23:23	22:10	20:31	37 19:50 (2)	18:52		16:15	15:07	
6	03:48	05:05	06:30	07:06 (7)	07:49		08:16	09:38	
	23:22	22:07	20:28	33 19:49 (2)	18:48		16:12	15:05	
7	03:50	05:08	06:32	07:09 (7)	07:52		08:19	09:40	
	23:20	22:04	20:25	27 19:49 (2)	18:45		16:09	15:04	
8	03:52	05:10	06:35	19:30 (2)	07:54		08:22	09:42	
	23:19	22:01	20:21	15 19:45 (2)	18:42		16:06	15:03	
9	03:54	05:13	06:38	19:31 (2)	07:57		08:25	09:44	
	23:17	21:58	20:18	11 19:42 (2)	18:39		16:03	15:02	
10	03:56	05:16	06:40	19:32 (2)	08:00		08:28	09:45	
	23:15	21:55	20:15	7 19:39 (2)	18:35		16:01	15:01	
11	03:58	05:19	06:43	19:35 (2)	08:03		08:31	09:47	
	23:14	21:52	20:11	1 19:36 (2)	18:32		15:58	15:00	
12	04:00	05:22	06:46		08:05		08:34	09:49	
	23:12	21:49	20:08		18:29		15:55	15:00	
13	04:02	05:24	06:48		08:08		08:37	09:50	
	23:10	21:46	20:05		18:26		15:53	14:59	
14	04:04	05:27	06:51		08:11		08:40	09:52	
	23:08	21:42	20:01		18:22		15:50	14:58	
15	04:07	05:30	06:54		08:14		08:43	09:53	
	23:05	21:39	19:58		18:19		15:47	14:58	
16	04:09	05:33	06:56		08:16	09:27 (9)	08:46	09:55	
	23:03	21:36	19:55		18:16	8 09:35 (9)	15:45	14:58	
17	04:11	05:36	06:59		08:19	09:24 (9)	08:48	09:56	
	23:01	21:33	19:51		18:13	13 09:37 (9)	15:42	14:58	
18	04:14	05:38	07:01		08:22	09:23 (9)	08:51	09:57	
	22:59	21:30	19:48		18:10	15 09:38 (9)	15:40	14:58	
19	04:16	05:41	07:04	08:14 (8)	08:25	09:22 (9)	08:54	09:58	
	22:56	21:27	19:45	7 08:21 (8)	18:06	17 09:39 (9)	15:38	14:58	
20	04:19	05:44	07:07	08:11 (8)	08:28	09:21 (9)	08:57	09:59	
	22:54	21:23	19:41	13 08:24 (8)	18:03	18 09:39 (9)	15:35	14:58	
21	04:21	05:47	07:09	08:10 (8)	08:30	09:20 (9)	09:00	09:59	
	22:51	21:20	19:38	16 08:26 (8)	18:00	19 09:39 (9)	15:33	14:58	
22	04:24	05:49	07:12	08:08 (8)	08:33	09:20 (9)	09:03	10:00	
	22:49	21:17	19:35	18 08:26 (8)	17:57	19 09:39 (9)	15:31	14:59	
23	04:26	05:52	07:15	08:07 (8)	08:36	09:20 (9)	09:05	10:00	
	22:46	21:14	10 07:22 (7)	19:31	19 08:26 (8)	17:54	19 09:39 (9)	15:28	14:59
24	04:29	05:55	07:17	08:05 (8)	08:39	09:21 (9)	09:08	10:01	
	22:44	21:11	14 07:23 (7)	19:28	21 08:26 (8)	17:51	18 09:39 (9)	15:26	15:00
25	04:32	05:57	07:18	07:20	08:05 (8)	07:42	08:21 (9)	09:11	10:01
	22:41	21:07	17 07:25 (7)	19:25	21 08:26 (8)	16:48	17 08:38 (9)	15:24	15:01
26	04:34	06:00	07:19	07:22	08:05 (8)	07:45	08:24 (9)	09:13	10:01
	22:39	21:04	20 07:26 (7)	19:21	21 08:26 (8)	16:45	13 08:37 (9)	15:22	15:01
27	04:37	06:03	07:19	07:25	08:04 (8)	07:47	08:27 (9)	09:16	10:01
	22:36	21:01	21 07:27 (7)	19:18	21 08:25 (8)	16:41	9 08:36 (9)	15:20	15:02
28	04:40	06:06	07:19	07:28	08:05 (8)	07:50	08:30 (9)	09:19	10:01
	22:33	20:57	22 07:26 (7)	19:15	19 08:24 (8)	16:38	3 08:33 (9)	15:18	15:04
29	04:43	06:08	07:19	07:30	08:06 (8)	07:53		09:21	10:01
	22:30	20:54	28 19:45 (2)	19:11	17 08:23 (8)	16:35		15:16	15:05
30	04:45	06:11	07:03 (7)	07:33	08:07 (8)	07:56		09:24	10:00
	22:27	20:51	34 19:47 (2)	19:08	14 08:21 (8)	16:32		15:15	15:06
31	04:48	06:14	07:03 (7)			07:59			10:00
	22:25	20:48	39 19:49 (2)			16:29			15:08
Potential sun hours	584	498	391		310		212	161	
Total, worst case			205	499		198			
Sun reduction			0,42	0,36		0,25			
Oper. time red.			0,99	0,99		0,99			
Wind dir. red.			0,60	0,59		0,62			
Total reduction			0,25	0,21		0,16			
Total, real			52	106		31			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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### SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: F - Lomarakennus (Sotkankangas II)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June		
1	09:59 15:10	09:02 16:28	07:38 17:51	08:29 (9) 21 08:50 (9)	06:56 20:16	07:51 (8) 19 08:10 (8)	05:18 19 06:46 (7)	03:55 23:04
2	09:59 15:11	08:59 16:31	07:34 17:54	08:29 (9) 19 08:48 (9)	06:52 20:19	07:51 (8) 17 08:08 (8)	05:15 17 06:45 (7)	03:53 23:06
3	09:58 15:13	08:56 16:34	07:31 17:57	08:30 (9) 18 08:48 (9)	06:49 20:22	07:53 (8) 14 08:07 (8)	05:12 14 06:44 (7)	03:51 23:09
4	09:57 15:15	08:53 16:37	07:28 17:59	08:30 (9) 16 08:46 (9)	06:46 20:25	07:55 (8) 9 08:04 (8)	05:09 9 06:41 (7)	03:49 23:11
5	09:56 15:17	08:51 16:40	07:25 18:02	08:32 (9) 12 08:44 (9)	06:42 20:27	05:06 21:52	03:47 23:13	
6	09:55 15:19	08:48 16:43	07:21 18:05	08:36 (9) 4 08:40 (9)	06:39 20:30	05:03 21:55	03:46 23:15	
7	09:54 15:21	08:45 16:46	07:18 18:08	06:36 20:33	05:00 21:57	03:44 23:16		
8	09:52 15:23	08:42 16:49	07:15 18:11	06:32 20:36	04:57 22:00	03:43 23:18		
9	09:51 15:25	08:39 16:52	07:12 18:13	06:29 20:38	04:54 22:03	03:41 23:20		
10	09:50 15:27	08:36 16:55	07:08 18:16	06:26 20:41	04:51 1 20:07 (2)	03:40 23:21		
11	09:48 15:30	08:33 16:58	07:05 18:19	06:23 20:44	04:48 6 20:08 (2)	03:39 23:23		
12	09:46 15:32	08:30 17:01	07:02 18:22	06:19 20:47	04:45 11 20:11 (2)	03:38 23:24		
13	09:45 15:35	08:27 17:04	06:59 18:24	06:16 20:49	04:42 15 20:14 (2)	03:37 23:26		
14	09:43 15:37	08:24 17:07	06:55 18:27	06:13 20:52	04:39 18 20:17 (2)	03:36 23:27		
15	09:41 15:40	08:21 17:10	06:52 18:30	06:09 20:55	04:37 19 20:17 (2)	03:36 23:28		
16	09:39 15:42	08:18 17:13	06:49 18:33	06:06 20:58	04:34 19 20:17 (2)	03:35 23:29		
17	09:37 15:45	08:15 17:16	06:45 18:35	06:03 21:01	04:31 24 20:17 (2)	03:34 23:29		
18	09:35 15:48	08:12 17:19	06:42 18:38	06:00 21:03	04:28 30 20:15 (2)	03:34 23:30		
19	09:33 15:51	08:09 17:22	06:39 18:41	05:56 21:06	04:26 33 20:14 (2)	03:34 23:31		
20	09:31 15:53	08:06 17:25	06:35 18:44	05:53 21:09	04:23 34 20:13 (2)	03:34 23:31		
21	09:29 15:56	08:03 17:28	08:37 (9) 8 08:45 (9)	06:32 18:46	05:50 21:12	04:20 34 20:12 (2)	03:34 23:32	
22	09:27 15:59	08:00 17:31	08:33 (9) 14 08:47 (9)	06:29 18:49	05:47 10 07:09 (8)	04:18 31 20:10 (2)	03:34 23:32	
23	09:24 16:02	07:57 17:34	08:32 (9) 16 08:48 (9)	06:25 18:52	05:43 14 07:10 (8)	04:15 24 06:50 (7)	03:34 23:32	
24	09:22 16:05	07:53 17:37	08:30 (9) 19 08:49 (9)	06:22 18:55	05:40 18 07:12 (8)	04:13 24 06:50 (7)	03:34 23:32	
25	09:20 16:08	07:50 17:39	08:29 (9) 20 08:49 (9)	06:19 18:57	05:37 20 07:13 (8)	04:10 25 06:50 (7)	03:35 23:32	
26	09:17 16:11	07:47 17:42	08:29 (9) 21 08:50 (9)	06:16 19:00	05:34 21 07:12 (8)	04:08 24 06:49 (7)	03:36 23:31	
27	09:15 16:14	07:44 17:45	08:28 (9) 22 08:50 (9)	06:12 19:03	05:31 22 07:13 (8)	04:06 24 06:50 (7)	03:36 23:31	
28	09:12 16:16	07:41 17:48	08:29 (9) 21 08:50 (9)	06:09 19:05	05:28 22 07:13 (8)	04:03 23 06:49 (7)	03:37 23:30	
29	09:10 16:19	07:38 17:51	08:26 (9) 20 08:47 (9)	06:06 19:08	05:24 22 08:13 (8)	04:01 22 06:48 (7)	03:38 23:30	
30	09:07 16:22	07:35 17:54	08:23 (9) 19 08:44 (9)	06:03 19:11	05:21 21 08:12 (8)	03:59 21 06:48 (7)	03:39 23:29	
31	09:04 16:25	07:32 17:57	08:20 (9) 18 08:41 (9)	06:00 19:14	05:18 20 08:11 (8)	03:57 23:02	03:39 23:29	
Potential sun hours	190	246	364	444	551	592		
Total, worst case		141	281	521	59			
Sun reduction		0,30	0,36	0,45	0,50			
Oper. time red.		0,99	0,99	0,99	0,99			
Wind dir. red.		0,62	0,60	0,59	0,60			
Total reduction		0,18	0,22	0,26	0,30			
Total, real		26	61	137	17			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: F - Lomarakenus (Sotkankangas II)  
 Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708

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

	July	August	September	October	November	December			
1	03:40	04:51	06:16	20:01 (2)	07:36	08:02	09:26		
	23:28	22:22	20:44	6 20:07 (2)	19:05	16:26	15:13		
2	03:42	04:54	06:19	20:04 (2)	07:38	08:05	09:29		
	23:27	22:19	20:41	1 20:05 (2)	19:01	16:24	15:11		
3	03:43	04:56	06:22		07:41	08:08	09:31		
	23:26	22:16	20:38		18:58	16:21	15:10		
4	03:45	04:59	06:24		07:44	08:11	09:33		
	23:25	22:13	20:34		18:55	16:18	15:08		
5	03:46	05:02	06:27		07:46	08:13	09:35		
	23:23	22:10	20:31		18:52	16:15	15:07		
6	03:48	05:05	06:30		07:49	08:16	09:38		
	23:22	22:07	20:28		18:48	16:12	15:05		
7	03:50	05:08	06:32		07:52	08:19	09:40		
	23:20	22:04	20:24		18:45	16:09	15:04		
8	03:52	05:10	06:35	07:50 (8)	07:54	09:09 (9)	08:22	09:42	
	23:19	22:01	20:21	8 07:58 (8)	18:42	9 09:18 (9)	16:06	15:03	
9	03:54	05:13	06:38	07:47 (8)	07:57	09:06 (9)	08:25	09:44	
	23:17	21:58	20:18	14 08:01 (8)	18:39	13 09:19 (9)	16:04	15:02	
10	03:56	05:16	06:40	07:45 (8)	08:00	09:04 (9)	08:28	09:45	
	23:15	21:55	20:15	16 08:01 (8)	18:35	17 09:21 (9)	16:01	15:01	
11	03:58	05:19	06:43	07:44 (8)	08:03	09:03 (9)	08:31	09:47	
	23:14	21:52	20:11	19 08:03 (8)	18:32	19 09:22 (9)	15:58	15:00	
12	04:00	05:22	06:35 (7)	06:46	07:42 (8)	08:05	09:02 (9)	08:34	09:49
	23:12	21:49	20:08	21 08:03 (8)	18:29	20 09:22 (9)	15:55	15:00	
13	04:02	05:24	06:35 (7)	06:48	07:42 (8)	08:08	09:02 (9)	08:37	09:50
	23:10	21:46	20:05	21 08:03 (8)	18:26	21 09:23 (9)	15:53	14:59	
14	04:04	05:27	06:34 (7)	06:51	07:40 (8)	08:11	09:01 (9)	08:40	09:52
	23:08	21:42	20:01	23 08:03 (8)	18:22	22 09:23 (9)	15:50	14:59	
15	04:07	05:30	06:33 (7)	06:54	07:40 (8)	08:14	09:01 (9)	08:43	09:53
	23:05	21:39	19:58	23 08:03 (8)	18:19	21 09:22 (9)	15:48	14:58	
16	04:09	05:33	06:32 (7)	06:56	07:41 (8)	08:16	09:01 (9)	08:46	09:55
	23:03	21:36	19:55	22 08:03 (8)	18:16	21 09:22 (9)	15:45	14:58	
17	04:11	05:36	06:33 (7)	06:59	07:40 (8)	08:19	09:01 (9)	08:48	09:56
	23:01	21:33	19:51	21 08:01 (8)	18:13	20 09:21 (9)	15:42	14:58	
18	04:14	05:38	06:32 (7)	07:01	07:41 (8)	08:22	09:02 (9)	08:51	09:57
	22:59	21:30	19:48	20 08:01 (8)	18:10	18 09:20 (9)	15:40	14:58	
19	04:16	05:41	06:32 (7)	07:04	07:41 (8)	08:25	09:03 (9)	08:54	09:58
	22:56	21:27	19:45	18 07:59 (8)	18:06	16 09:19 (9)	15:38	14:58	
20	04:19	05:44	06:32 (7)	07:07	07:42 (8)	08:27	09:05 (9)	08:57	09:58
	22:54	21:23	19:41	15 07:57 (8)	18:03	12 09:17 (9)	15:35	14:58	
21	04:21	05:47	06:33 (7)	07:09	07:44 (8)	08:30	09:08 (9)	09:00	09:59
	22:51	21:20	19:38	11 07:55 (8)	18:00	7 09:15 (9)	15:33	14:58	
22	04:24	05:49	06:33 (7)	07:12		08:33		09:03	10:00
	22:49	21:17	19:35			17:57		15:31	14:59
23	04:27	05:52	06:34 (7)	07:15		08:36		09:05	10:00
	22:46	21:14	19:31			17:54		15:28	14:59
24	04:29	05:55	06:35 (7)	07:17		08:39		09:08	10:01
	22:44	21:10	19:28			17:51		15:26	15:00
25	04:32	05:57	06:37 (7)	07:20		07:42		09:11	10:01
	22:41	21:07	19:25			16:48		15:24	15:01
26	04:35	06:00	06:40 (7)	07:22		07:45		09:13	10:01
	22:38	21:04	19:21			16:45		15:22	15:01
27	04:37	06:03	19:59 (2)	07:25		07:47		09:16	10:01
	22:36	21:01	19:18			16:42		15:20	15:02
28	04:40	06:06	19:59 (2)	07:28		07:50		09:19	10:01
	22:33	20:57	19:15			16:38		15:18	15:04
29	04:43	06:08	19:59 (2)	07:30		07:53		09:21	10:01
	22:30	20:54	19:11			16:35		15:16	15:05
30	04:45	06:11	19:59 (2)	07:33		07:56		09:24	10:00
	22:27	20:51	19:08			16:32		15:15	15:06
31	04:48	06:14	20:00 (2)			07:59			10:00
	22:25	20:48	20:11 (2)			16:29			15:08
Potential sun hours	584	498	391		310		212		161
Total, worst case			526		259		236		
Sun reduction			0,42		0,36		0,25		
Oper. time red.			0,99		0,99		0,99		
Wind dir. red.			0,59		0,60		0,62		
Total reduction			0,25		0,21		0,16		
Total, real			132		55		37		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: G - Lomarakenus (Sotkankangas III)  
 Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June
1	09:59	09:02	07:38	06:56	07:29 (8)	05:18
	15:10	16:28	17:51	20:16	19 07:48 (8)	21:40
2	09:59	08:59	07:34	08:06 (9)	06:52	36 07:28 (8)
	15:11	16:31	17:54	6 08:12 (9)	20:19	19 07:47 (8)
3	09:58	08:56	07:31	08:03 (9)	06:49	19 07:28 (8)
	15:13	16:34	17:57	11 08:14 (9)	20:22	19 07:47 (8)
4	09:57	08:53	07:28	07:59 (9)	06:46	19 07:28 (8)
	15:15	16:37	17:59	16 08:15 (9)	20:25	19 07:47 (8)
5	09:56	08:51	07:25	07:58 (9)	06:42	19 07:29 (8)
	15:17	16:40	18:02	18 08:16 (9)	20:27	18 07:47 (8)
6	09:55	08:48	07:21	07:57 (9)	06:39	11 07:29 (8)
	15:19	16:43	18:05	19 08:16 (9)	20:30	16 07:45 (8)
7	09:54	08:45	07:18	07:56 (9)	06:36	13 07:30 (8)
	15:21	16:46	18:08	20 08:16 (9)	20:33	13 07:43 (8)
8	09:52	08:42	07:15	07:57 (9)	06:32	9 07:32 (8)
	15:23	16:49	18:11	19 08:16 (9)	20:36	9 07:41 (8)
9	09:51	08:39	07:12	07:56 (9)	06:29	22:00
	15:25	16:52	18:13	19 08:15 (9)	20:38	22:03
10	09:50	08:36	07:08	07:57 (9)	06:26	22:06
	15:28	16:55	18:16	17 08:14 (9)	20:41	22:06
11	09:48	08:33	07:05	07:58 (9)	06:23	04:48
	15:30	16:58	18:19	15 08:13 (9)	20:44	22:09
12	09:46	08:30	07:02	07:58 (9)	06:19	04:45
	15:32	17:01	18:22	13 08:11 (9)	20:47	22:12
13	09:45	08:27	06:59	08:01 (9)	06:16	04:42
	15:35	17:04	18:24	7 08:08 (9)	20:49	22:15
14	09:43	08:24	06:55	06:13	04:39	22:15
	15:37	17:07	18:27	20:52	22:17	22:27
15	09:41	08:21	06:52	06:09	04:37	22:27
	15:40	17:10	18:30	20:55	22:20	22:28
16	09:39	08:18	06:49	17:54 (6)	06:06	04:34
	15:43	17:13	18:33	5 17:59 (6)	20:58	22:23
17	09:37	08:15	06:45	17:52 (6)	06:03	04:31
	15:45	17:16	18:35	11 18:03 (6)	21:01	22:26
18	09:35	08:12	06:42	17:50 (6)	06:00	04:28
	15:48	17:19	18:38	15 18:05 (6)	21:03	22:29
19	09:33	08:09	06:39	17:49 (6)	05:56	04:26
	15:51	17:22	18:41	18 18:07 (6)	21:06	22:31
20	09:31	08:06	06:35	17:47 (6)	05:53	06:25 (7)
	15:53	17:25	18:44	20 18:07 (6)	21:09	11 20:32 (2)
21	09:29	08:03	06:32	17:47 (6)	05:50	06:22 (7)
	15:56	17:28	18:46	20 18:07 (6)	21:12	21 20:34 (2)
22	09:27	08:00	06:29	17:47 (6)	05:47	06:19 (7)
	15:59	17:31	18:49	20 18:07 (6)	21:15	29 20:37 (2)
23	09:24	07:57	06:26	17:46 (6)	05:44	06:17 (7)
	16:02	17:34	18:52	20 18:06 (6)	21:17	35 20:39 (2)
24	09:22	07:54	06:22	17:47 (6)	05:40	06:16 (7)
	16:05	17:37	18:55	18 18:05 (6)	21:20	39 20:41 (2)
25	09:20	07:50	06:19	17:48 (6)	05:37	06:16 (7)
	16:08	17:39	18:57	16 18:04 (6)	21:23	41 20:41 (2)
26	09:17	07:47	06:16	17:48 (6)	05:34	06:16 (7)
	16:11	17:42	19:00	14 18:02 (6)	21:26	42 20:42 (2)
27	09:15	07:44	06:12	17:50 (6)	05:31	06:16 (7)
	16:14	17:45	19:03	10 18:00 (6)	21:29	42 20:42 (2)
28	09:12	07:41	06:09	06:39 (8)	05:28	06:16 (7)
	16:17	17:48	19:06	6 06:45 (8)	21:32	42 20:42 (2)
29	09:10	07:38	06:06	07:36 (8)	05:24	06:16 (7)
	16:19	17:49	19:08	11 07:47 (8)	21:35	40 20:41 (2)
30	09:07	07:35	06:02	07:32 (8)	05:21	06:16 (7)
	16:22	17:50	19:11	15 07:47 (8)	21:37	38 20:40 (2)
31	09:04	07:32	06:59	07:30 (8)	05:18	03:57
	16:25	17:53	19:14	18 07:48 (8)	21:40	23:02
Potential sun hours	190	246	364	444	551	592
Total, worst case			417	512	132	
Sun reduction			0,36	0,45	0,50	
Oper. time red.			0,99	0,99	0,99	
Wind dir. red.			0,60	0,60	0,60	
Total reduction			0,21	0,27	0,30	
Total, real			89	136	39	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: G - Lomarakenus (Sotkankangas III)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

	July	August	September	October	November	December		
1	03:41 23:28	04:51 22:22	06:16 20:44	07:36 19:05	08:39 (9) 10 08:49 (9)	08:02 16:26	09:26 15:13	
2	03:42 23:27	04:54 22:19	06:19 20:41	07:38 19:01	08:37 (9) 14 08:51 (9)	08:05 16:24	09:29 15:11	
3	03:43 23:26	04:57 22:16	06:22 20:38	07:41 18:58	08:36 (9) 16 08:52 (9)	08:08 16:21	09:31 15:10	
4	03:45 23:25	04:59 22:13	06:24 20:34	07:29 (8) 9 07:38 (8)	07:44 18:55	08:34 (9) 18 08:52 (9)	08:11 16:18	09:33 15:08
5	03:46 23:23	05:02 22:10	06:27 20:31	07:27 (8) 13 07:40 (8)	07:46 18:52	08:33 (9) 19 08:52 (9)	08:13 16:15	09:35 15:07
6	03:48 23:22	05:05 22:07	06:30 20:28	07:25 (8) 16 07:41 (8)	07:49 18:48	08:33 (9) 19 08:52 (9)	08:16 16:12	09:38 15:05
7	03:50 23:20	05:08 22:04	20:36 (2) 06:32	07:24 (8) 18 07:42 (8)	07:52 18:45	08:33 (9) 19 08:52 (9)	08:19 16:09	09:40 15:04
8	03:52 23:19	05:10 22:01	20:33 (2) 06:35	07:23 (8) 18 07:41 (8)	07:55 18:42	08:33 (9) 19 08:52 (9)	08:22 16:06	09:42 15:03
9	03:54 23:17	05:13 21:58	06:30 (7) 22 20:46 (2)	06:38 20 07:42 (8)	07:57 18:39	08:34 (9) 17 08:51 (9)	08:25 16:04	09:44 15:02
10	03:56 23:15	05:16 21:55	06:27 (7) 29 20:47 (2)	06:40 20 07:41 (8)	07:21 (8) 18:35	08:00 14 08:49 (9)	08:28 16:01	09:45 15:01
11	03:58 23:14	05:19 21:52	06:26 (7) 34 20:48 (2)	06:43 19 07:41 (8)	07:22 (8) 18:32	08:03 9 08:47 (9)	08:31 15:58	09:47 15:00
12	04:00 23:12	05:22 21:49	06:25 (7) 37 20:48 (2)	06:46 18 07:39 (8)	08:05 18:29	08:41 (9) 3 08:44 (9)	08:34 15:55	09:49 15:00
13	04:02 23:10	05:24 21:46	06:25 (7) 39 20:49 (2)	06:48 15 07:38 (8)	08:08 18:26	08:37 15:53	09:50 14:59	
14	04:04 23:08	05:27 21:42	06:23 (7) 41 20:48 (2)	06:51 11 07:36 (8)	08:11 18:22	08:40 15:50	09:52 14:59	
15	04:07 23:05	05:30 21:39	06:23 (7) 42 20:49 (2)	06:54 7 07:35 (8)	08:14 18:19	08:43 15:48	09:53 14:58	
16	04:09 23:03	05:33 21:36	06:22 (7) 42 20:48 (2)	06:56 9 18:49 (6)	08:16 18:16	08:46 15:45	09:55 14:58	
17	04:11 23:01	05:36 21:33	06:23 (7) 41 20:48 (2)	06:59 13 18:50 (6)	08:19 18:13	08:48 15:42	09:56 14:58	
18	04:14 22:59	05:38 21:30	06:22 (7) 40 20:47 (2)	07:01 16 18:52 (6)	08:22 18:10	08:51 15:40	09:57 14:58	
19	04:16 22:56	05:41 21:27	06:23 (7) 38 20:47 (2)	07:04 18 18:52 (6)	08:25 18:06	08:54 15:38	09:58 14:58	
20	04:19 22:54	05:44 21:23	06:23 (7) 34 20:45 (2)	07:07 19 18:52 (6)	08:28 18:03	08:57 15:35	09:58 14:58	
21	04:21 22:51	05:47 21:20	06:25 (7) 28 20:42 (2)	07:09 20 18:53 (6)	08:30 18:00	09:00 15:33	09:59 14:58	
22	04:24 22:49	05:49 21:17	06:27 (7) 20 20:39 (2)	07:12 20 18:52 (6)	08:33 17:57	09:03 15:31	10:00 14:59	
23	04:27 22:46	05:52 21:14	06:30 (7) 9 20:36 (2)	07:15 20 18:52 (6)	08:36 17:54	09:05 15:28	10:00 14:59	
24	04:29 22:44	05:55 21:11	07:17 19 18:50 (6)	07:17 19 18:50 (6)	08:39 17:51	09:08 15:26	10:01 15:00	
25	04:32 22:41	05:58 21:07	07:20 17 18:49 (6)	07:20 17 18:49 (6)	07:42 16:48	09:11 15:24	10:01 15:01	
26	04:35 22:38	06:00 21:04	07:22 19:21	13 18:46 (6)	07:45 16:45	09:13 15:22	10:01 15:01	
27	04:37 22:36	06:03 21:01	07:25 19:18	8 18:42 (6)	07:47 16:42	09:16 15:20	10:01 15:02	
28	04:40 22:33	06:06 20:57	07:28 19:15	2 18:39 (6)	07:50 16:38	09:19 15:18	10:01 15:04	
29	04:43 22:30	06:08 20:54	07:30 19:11	07:53 16:35	09:21 15:16	10:01 15:05	10:01 15:00	
30	04:45 22:27	06:11 20:51	07:33 19:08	2 08:43 (9)	07:56 16:32	09:24 15:15	10:00 15:06	
31	04:48 22:25	06:14 20:48	07:59 16:29	07:59 310	10:00 212	10:00 161	15:08	
Potential sun hours	584	498	391	310	212	161		
Total, worst case		515	380	177				
Sun reduction		0,42	0,36	0,25				
Oper. time red.		0,99	0,99	0,99				
Wind dir. red.		0,60	0,60	0,60				
Total reduction		0,25	0,21	0,15				
Total, real		130	81	27				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: H - Lomarakenus (Ruostetluoma)
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months (January to December) and rows for each day of the month, showing sun rise/set times, sun hours, and reduction percentages.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) Minutes with flicker First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)

## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: I - Lomarakennus (Heikinkankaantie 135)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:01	07:37	06:55	05:18	03:55	03:40	04:51	06:16	07:35	08:01	09:26
	15:09	16:28	17:51	20:16	21:40	23:04	23:28	22:21	20:44	19:04	16:26	15:13
2	09:58	08:59	07:34	06:52	05:15	03:53	03:42	04:53	06:19	07:38	08:04	09:28
	15:11	16:31	17:53	20:19	21:43	23:06	23:27	22:18	20:41	19:01	16:23	15:11
3	09:57	08:56	07:31	06:49	05:12	03:51	03:43	04:56	06:21	07:41	08:07	09:31
	15:13	16:34	17:56	20:22	21:46	23:08	23:25	22:16	20:37	18:58	16:20	15:09
4	09:57	08:53	07:28	06:45	05:09	03:49	03:44	04:59	06:24	07:43	08:10	09:33
	15:15	16:37	17:59	20:24	21:49	23:10	23:24	22:13	20:34	18:55	16:17	15:08
5	09:56	08:50	07:24	06:42	05:06	03:47	03:46	05:02	06:27	07:46	08:13	09:35
	15:16	16:40	18:02	20:27	21:51	23:12	23:23	22:10	20:31	18:51	16:15	15:07
6	09:54	08:47	07:21	06:39	05:03	03:46	03:48	05:05	06:29	07:49	08:16	09:37
	15:18	16:43	18:05	20:30	21:54	23:14	23:21	22:07	20:27	18:48	16:12	15:05
7	09:53	08:45	07:18	06:35	05:00	03:44	03:50	05:07	06:32	07:51	08:19	09:39
	15:21	16:46	18:07	20:33	21:57	23:16	23:20	22:04	20:24	18:45	16:09	15:04
8	09:52	08:42	07:15	06:32	04:57	03:43	03:51	05:10	06:35	07:54	08:22	09:41
	15:23	16:49	18:10	20:35	22:00	23:18	23:18	22:01	20:21	18:41	16:06	15:03
9	09:51	08:39	07:11	06:29	04:54	03:41	03:53	05:13	06:37	07:57	08:25	09:43
	15:25	16:52	18:13	20:38	22:03	23:19	23:17	21:58	20:18	18:38	16:03	15:02
10	09:49	08:36	07:08	06:26	04:51	03:40	03:55	05:16	06:40	08:00	08:28	09:45
	15:27	16:55	18:16	20:41	22:06	23:21	23:15	21:55	20:14	18:35	16:00	15:01
11	09:48	08:33	07:05	06:22	04:48	03:39	03:57	05:19	06:43	08:02	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:22	23:13	21:51	20:11	18:32	15:58	15:00
12	09:46	08:30	07:02	06:19	04:45	03:38	04:00	05:21	06:45	08:05	08:34	09:48
	15:32	17:01	18:21	20:46	22:11	23:24	23:11	21:48	20:08	18:28	15:55	14:59
13	09:44	08:27	06:58	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:36	09:50
	15:35	17:04	18:24	20:49	22:14	23:25	23:09	21:45	20:04	18:25	15:52	14:59
14	09:43	08:24	06:55	06:12	04:39	03:36	04:04	05:27	06:51	08:10	08:39	09:51
	15:37	17:07	18:27	20:52	22:17	23:26	23:07	21:42	20:01	18:22	15:50	14:58
15	09:41	08:21	06:52	06:09	04:36	03:35	04:06	05:30	06:53	08:13	08:42	09:53
	15:40	17:10	18:30	20:55	22:20	23:27	23:05	21:39	19:58	18:19	15:47	14:58
16	09:39	08:18	06:48	06:06	04:33	03:35	04:09	05:32	06:56	08:16	08:45	09:54
	15:42	17:13	18:32	20:57	22:23	23:28	23:03	21:36	19:54	18:16	15:45	14:58
17	09:37	08:15	06:45	06:03	04:31	03:34	04:11	05:35	06:58	08:19	08:48	09:55
	15:45	17:16	18:35	21:00	22:25	23:29	23:01	21:33	19:51	18:12	15:42	14:57
18	09:35	08:12	06:42	05:59	04:28	03:34	04:14	05:38	07:01	08:22	08:51	09:56
	15:48	17:19	18:38	21:03	22:28	23:30	22:58	21:29	19:48	18:09	15:40	14:57
19	09:33	08:09	06:38	05:56	04:25	03:34	04:16	05:41	07:04	08:24	08:54	09:57
	15:50	17:22	18:41	21:06	22:31	23:30	22:56	21:26	19:44	18:06	15:37	14:57
20	09:31	08:06	06:35	05:53	04:23	03:33	04:19	05:44	07:06	08:27	08:57	09:58
	15:53	17:25	18:43	21:09	22:34	23:31	22:54	21:23	19:41	18:03	15:35	14:58
21	09:28	08:03	06:32	05:50	04:20	03:33	04:21	05:46	07:09	08:30	08:59	09:59
	15:56	17:28	18:46	21:11	22:36	23:31	22:51	21:20	19:38	18:00	15:33	14:58
22	09:26	07:59	06:28	05:46	04:17	03:34	04:24	05:49	07:12	08:33	09:02	09:59
	15:59	17:30	18:49	21:14	22:39	23:31	22:49	21:17	19:34	17:57	15:30	14:58
23	09:24	07:56	06:25	05:43	04:15	03:34	04:26	05:52	07:14	08:36	09:05	10:00
	16:02	17:33	18:52	21:17	22:42	23:31	22:46	21:13	19:31	17:54	15:28	14:59
24	09:22	07:53	06:22	05:40	04:12	03:34	04:29	05:54	07:17	08:38	09:08	10:00
	16:05	17:36	18:54	21:20	22:44	23:31	22:43	21:10	19:28	17:50	15:26	15:00
25	09:19	07:50	06:19	05:37	04:10	03:35	04:32	05:57	07:19	07:41	09:10	10:00
	16:07	17:39	18:57	21:23	22:47	23:31	22:41	21:07	19:24	16:47	15:24	15:00
26	09:17	07:47	06:15	05:34	04:08	03:35	04:34	06:00	07:22	07:44	09:13	10:01
	16:10	17:42	19:00	21:26	22:49	23:31	22:38	21:04	19:21	16:44	15:22	15:01
27	09:14	07:44	06:12	05:30	04:05	03:36	04:37	06:03	07:25	07:47	09:16	10:01
	16:13	17:45	19:02	21:28	22:52	23:30	22:35	21:00	19:18	16:41	15:20	15:02
28	09:12	07:40	06:09	05:27	04:03	03:37	04:40	06:05	07:27	07:50	09:18	10:01
	16:16	17:48	19:05	21:31	22:54	23:30	22:33	20:57	19:14	16:38	15:18	15:03
29	09:09	07:05	05:24	04:01	03:38	04:42	06:08	07:30	07:53	09:21	10:00	
	16:19	17:51	19:08	21:34	22:57	23:29	22:30	20:54	19:11	16:35	15:16	15:05
30	09:07	07:02	05:21	03:59	03:39	04:45	06:11	07:33	07:56	09:23	10:00	
	16:22	17:54	19:11	21:37	22:59	23:28	22:27	20:51	19:08	16:32	15:14	15:06
31	09:04	06:59	05:19	03:57	03:32	04:48	06:13	07:35	07:59	09:26	10:00	
	16:25	17:56	19:13	21:40	23:02	23:24	22:24	20:47	16:29	15:07	15:07	
Potential sun hours	190	246	364	444	551	592	584	498	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: J - Lomarakenus (Pukinharju)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:01	07:37	06:55	05:18	03:55	03:41	04:51	06:16	07:35	08:01	09:26
	15:10	16:28	17:51	20:16	21:40	23:04	23:27	22:21	20:44	19:05	16:26	15:13
2	09:58	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:38	08:04	09:28
	15:11	16:31	17:53	20:19	21:43	23:06	23:26	22:18	20:41	19:01	16:23	15:11
3	09:57	08:56	07:31	06:49	05:12	03:51	03:43	04:56	06:22	07:41	08:07	09:31
	15:13	16:34	17:56	20:22	21:46	23:08	23:25	22:16	20:37	18:58	16:20	15:10
4	09:56	08:53	07:28	06:45	05:09	03:49	03:45	04:59	06:24	07:43	08:10	09:33
	15:15	16:37	17:59	20:24	21:49	23:10	23:24	22:13	20:34	18:55	16:18	15:08
5	09:55	08:50	07:24	06:42	05:06	03:47	03:46	05:02	06:27	07:46	08:13	09:35
	15:17	16:40	18:02	20:27	21:51	23:12	23:23	22:10	20:31	18:51	16:15	15:07
6	09:54	08:47	07:21	06:39	05:03	03:46	03:48	05:05	06:30	07:49	08:16	09:37
	15:19	16:43	18:05	20:30	21:54	23:14	23:21	22:07	20:28	18:48	16:12	15:05
7	09:53	08:45	07:18	06:36	05:00	03:44	03:50	05:08	06:32	07:52	08:19	09:39
	15:21	16:46	18:08	20:33	21:57	23:16	23:20	22:04	20:24	18:45	16:09	15:04
8	09:52	08:42	07:15	06:32	04:57	03:43	03:52	05:10	06:35	07:54	08:22	09:41
	15:23	16:49	18:10	20:35	22:00	23:18	23:18	22:01	20:21	18:42	16:06	15:03
9	09:51	08:39	07:11	06:29	04:54	03:42	03:54	05:13	06:37	07:57	08:25	09:43
	15:25	16:52	18:13	20:38	22:03	23:19	23:17	21:58	20:18	18:38	16:03	15:02
10	09:49	08:36	07:08	06:26	04:51	03:40	03:56	05:16	06:40	08:00	08:28	09:45
	15:27	16:55	18:16	20:41	22:06	23:21	23:15	21:55	20:14	18:35	16:01	15:01
11	09:48	08:33	07:05	06:22	04:48	03:39	03:58	05:19	06:43	08:02	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:22	23:13	21:51	20:11	18:32	15:58	15:00
12	09:46	08:30	07:02	06:19	04:45	03:38	04:00	05:22	06:45	08:05	08:34	09:48
	15:32	17:01	18:21	20:46	22:11	23:24	23:11	21:48	20:08	18:29	15:55	15:00
13	09:44	08:27	06:58	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:36	09:50
	15:35	17:04	18:24	20:49	22:14	23:25	23:09	21:45	20:04	18:25	15:53	14:59
14	09:43	08:24	06:55	06:13	04:39	03:36	04:04	05:27	06:51	08:11	08:39	09:51
	15:37	17:07	18:27	20:52	22:17	23:26	23:07	21:42	20:01	18:22	15:50	14:58
15	09:41	08:21	06:52	06:09	04:36	03:36	04:07	05:30	06:53	08:13	08:42	09:53
	15:40	17:10	18:30	20:55	22:20	23:27	23:05	21:39	19:58	18:19	15:47	14:58
16	09:39	08:18	06:48	06:06	04:34	03:35	04:09	05:33	06:56	08:16	08:45	09:54
	15:42	17:13	18:32	20:57	22:23	23:28	23:03	21:36	19:54	18:16	15:45	14:58
17	09:37	08:15	06:45	06:03	04:31	03:34	04:11	05:35	06:59	08:19	08:48	09:55
	15:45	17:16	18:35	21:00	22:25	23:29	23:01	21:33	19:51	18:13	15:42	14:58
18	09:35	08:12	06:42	05:59	04:28	03:34	04:14	05:38	07:01	08:22	08:51	09:56
	15:48	17:19	18:38	21:03	22:28	23:30	22:58	21:29	19:48	18:09	15:40	14:58
19	09:33	08:09	06:39	05:56	04:26	03:34	04:16	05:41	07:04	08:24	08:54	09:57
	15:51	17:22	18:41	21:06	22:31	23:30	22:56	21:26	19:44	18:06	15:37	14:58
20	09:31	08:06	06:35	05:53	04:23	03:34	04:19	05:44	07:06	08:27	08:57	09:58
	15:53	17:25	18:43	21:09	22:34	23:31	22:53	21:23	19:41	18:03	15:35	14:58
21	09:28	08:03	06:32	05:50	04:20	03:34	04:21	05:46	07:09	08:30	08:59	09:59
	15:56	17:28	18:46	21:12	22:36	23:31	22:51	21:20	19:38	18:00	15:33	14:58
22	09:26	07:59	06:29	05:47	04:18	03:34	04:24	05:49	07:12	08:33	09:02	09:59
	15:59	17:31	18:49	21:14	22:39	23:31	22:48	21:17	19:34	17:57	15:31	14:59
23	09:24	07:56	06:25	05:43	04:15	03:34	04:26	05:52	07:14	08:36	09:05	10:00
	16:02	17:33	18:52	21:17	22:42	23:31	22:46	21:13	19:31	17:54	15:28	14:59
24	09:22	07:53	06:22	05:40	04:13	03:35	04:29	05:55	07:17	08:38	09:08	10:00
	16:05	17:36	18:54	21:20	22:44	23:31	22:43	21:10	19:28	17:51	15:26	15:00
25	09:19	07:50	06:19	05:37	04:10	03:35	04:32	05:57	07:20	07:41	09:10	10:00
	16:08	17:39	18:57	21:23	22:47	23:31	22:41	21:07	19:24	16:47	15:24	15:01
26	09:17	07:47	06:15	05:34	04:08	03:36	04:34	06:00	07:22	07:44	09:13	10:01
	16:10	17:42	19:00	21:26	22:49	23:31	22:38	21:04	19:21	16:44	15:22	15:01
27	09:14	07:44	06:12	05:31	04:06	03:36	04:37	06:03	07:25	07:47	09:16	10:01
	16:13	17:45	19:03	21:28	22:52	23:30	22:35	21:00	19:18	16:41	15:20	15:02
28	09:12	07:40	06:09	05:27	04:03	03:37	04:40	06:05	07:27	07:50	09:18	10:00
	16:16	17:48	19:05	21:31	22:54	23:30	22:33	20:57	19:14	16:38	15:18	15:04
29	09:09	07:05	05:24	04:01	03:38	04:43	06:08	07:30	07:53	09:21	10:00	
	16:19	17:51	19:08	21:34	22:57	23:29	22:30	20:54	19:11	16:35	15:16	15:05
30	09:07	07:02	05:21	03:59	03:39	03:39	04:45	06:11	07:33	07:56	09:23	10:00
	16:22	17:54	19:11	21:37	22:59	23:28	22:27	20:51	19:08	16:32	15:14	15:06
31	09:04	06:59	05:19	03:57	03:31	03:31	04:48	06:14	07:37	07:59	09:26	09:59
	16:25	17:56	19:13	21:40	23:01	23:24	22:24	20:47	16:29	15:01	13:34	15:08
Potential sun hours	190	246	364	444	551	592	584	497	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forestShadow receptor: K - Lomarakenus (Vähä Nummikangas)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:01	07:37	06:56	05:18	03:55	03:41	04:51	06:16	07:36	08:02	09:26
	15:10	16:28	17:51	20:16	21:40	23:04	23:27	22:21	20:44	19:05	16:26	15:13
2	09:58	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:38	08:04	09:28
	15:11	16:31	17:54	20:19	21:43	23:06	23:26	22:18	20:41	19:01	16:24	15:11
3	09:57	08:56	07:31	06:49	05:12	03:51	03:44	04:57	06:22	07:41	08:07	09:30
	15:13	16:34	17:56	20:22	21:46	23:08	23:25	22:16	20:38	18:58	16:21	15:10
4	09:56	08:53	07:28	06:46	05:09	03:50	03:45	04:59	06:24	07:44	08:10	09:33
	15:15	16:37	17:59	20:24	21:49	23:10	23:24	22:13	20:34	18:55	16:18	15:08
5	09:55	08:50	07:24	06:42	05:06	03:48	03:47	05:02	06:27	07:46	08:13	09:35
	15:17	16:40	18:02	20:27	21:51	23:12	23:23	22:10	20:31	18:52	16:15	15:07
6	09:54	08:47	07:21	06:39	05:03	03:46	03:48	05:05	06:30	07:49	08:16	09:37
	15:19	16:43	18:05	20:30	21:54	23:14	23:21	22:07	20:28	18:48	16:12	15:06
7	09:53	08:45	07:18	06:36	05:00	03:45	03:50	05:08	06:32	07:52	08:19	09:39
	15:21	16:46	18:08	20:33	21:57	23:16	23:20	22:04	20:24	18:45	16:09	15:04
8	09:52	08:42	07:15	06:32	04:57	03:43	03:52	05:11	06:35	07:54	08:22	09:41
	15:23	16:49	18:10	20:35	22:00	23:18	23:18	22:01	20:21	18:42	16:06	15:03
9	09:51	08:39	07:11	06:29	04:54	03:42	03:54	05:13	06:38	07:57	08:25	09:43
	15:25	16:52	18:13	20:38	22:03	23:19	23:17	21:58	20:18	18:38	16:04	15:02
10	09:49	08:36	07:08	06:26	04:51	03:41	03:56	05:16	06:40	08:00	08:28	09:45
	15:28	16:55	18:16	20:41	22:06	23:21	23:15	21:55	20:14	18:35	16:01	15:01
11	09:48	08:33	07:05	06:23	04:48	03:39	03:58	05:19	06:43	08:02	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:22	23:13	21:51	20:11	18:32	15:58	15:01
12	09:46	08:30	07:02	06:19	04:45	03:38	04:00	05:22	06:46	08:05	08:34	09:48
	15:32	17:01	18:22	20:46	22:11	23:24	23:11	21:48	20:08	18:29	15:55	15:00
13	09:44	08:27	06:58	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:37	09:50
	15:35	17:04	18:24	20:49	22:14	23:25	23:09	21:45	20:04	18:26	15:53	14:59
14	09:43	08:24	06:55	06:13	04:40	03:37	04:05	05:27	06:51	08:11	08:39	09:51
	15:37	17:07	18:27	20:52	22:17	23:26	23:07	21:42	20:01	18:22	15:50	14:59
15	09:41	08:21	06:52	06:09	04:37	03:36	04:07	05:30	06:53	08:13	08:42	09:53
	15:40	17:10	18:30	20:55	22:20	23:27	23:05	21:39	19:58	18:19	15:48	14:58
16	09:39	08:18	06:49	06:06	04:34	03:35	04:09	05:33	06:56	08:16	08:45	09:54
	15:43	17:13	18:33	20:58	22:23	23:28	23:03	21:36	19:54	18:16	15:45	14:58
17	09:37	08:15	06:45	06:03	04:31	03:35	04:12	05:36	06:59	08:19	08:48	09:55
	15:45	17:16	18:35	21:00	22:25	23:29	23:00	21:33	19:51	18:13	15:43	14:58
18	09:35	08:12	06:42	06:00	04:28	03:34	04:14	05:38	07:01	08:22	08:51	09:56
	15:48	17:19	18:38	21:03	22:28	23:30	22:58	21:29	19:48	18:10	15:40	14:58
19	09:33	08:09	06:39	05:56	04:26	03:34	04:16	05:41	07:04	08:24	08:54	09:57
	15:51	17:22	18:41	21:06	22:31	23:30	22:56	21:26	19:44	18:06	15:38	14:58
20	09:31	08:06	06:35	05:53	04:23	03:34	04:19	05:44	07:07	08:27	08:57	09:58
	15:54	17:25	18:44	21:09	22:34	23:31	22:53	21:23	19:41	18:03	15:35	14:58
21	09:28	08:03	06:32	05:50	04:21	03:34	04:22	05:47	07:09	08:30	08:59	09:59
	15:56	17:28	18:46	21:12	22:36	23:31	22:51	21:20	19:38	18:00	15:33	14:58
22	09:26	08:00	06:29	05:47	04:18	03:34	04:24	05:49	07:12	08:33	09:02	09:59
	15:59	17:31	18:49	21:14	22:39	23:31	22:48	21:17	19:34	17:57	15:31	14:59
23	09:24	07:56	06:25	05:44	04:15	03:35	04:27	05:52	07:14	08:36	09:05	10:00
	16:02	17:34	18:52	21:17	22:42	23:31	22:46	21:13	19:31	17:54	15:29	14:59
24	09:22	07:53	06:22	05:40	04:13	03:35	04:29	05:55	07:17	08:39	09:08	10:00
	16:05	17:37	18:54	21:20	22:44	23:31	22:43	21:10	19:28	17:51	15:26	15:00
25	09:19	07:50	06:19	05:37	04:11	03:35	04:32	05:57	07:20	07:41	09:10	10:00
	16:08	17:39	18:57	21:23	22:47	23:31	22:41	21:07	19:25	16:48	15:24	15:01
26	09:17	07:47	06:15	05:34	04:08	03:36	04:35	06:00	07:22	07:44	09:13	10:00
	16:11	17:42	19:00	21:26	22:49	23:31	22:38	21:04	19:21	16:45	15:22	15:02
27	09:14	07:44	06:12	05:31	04:06	03:37	04:37	06:03	07:25	07:47	09:16	10:00
	16:14	17:45	19:03	21:29	22:52	23:30	22:35	21:00	19:18	16:42	15:20	15:03
28	09:12	07:41	06:09	05:28	04:04	03:38	04:40	06:06	07:28	07:50	09:18	10:00
	16:17	17:48	19:05	21:31	22:54	23:30	22:33	20:57	19:15	16:38	15:18	15:04
29	09:09	07:05	05:25	04:01	03:39	04:43	06:08	07:30	07:53	09:21	10:00	10:00
	16:20	17:51	19:08	21:34	22:57	23:29	22:30	20:54	19:11	16:35	15:17	15:05
30	09:07	07:02	05:21	03:59	03:40	04:46	06:11	07:33	07:56	09:23	10:00	10:00
	16:23	17:54	19:11	21:37	22:59	23:28	22:27	20:51	19:08	16:32	15:15	15:06
31	09:04	06:59	05:19	03:57	03:01	04:48	06:14	07:35	07:59	09:26	10:00	10:00
	16:25	17:56	19:13	21:40	23:01	23:24	22:24	20:47	16:29	15:12	15:08	15:08
Potential sun hours	190	246	364	444	551	592	583	497	391	310	212	162
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

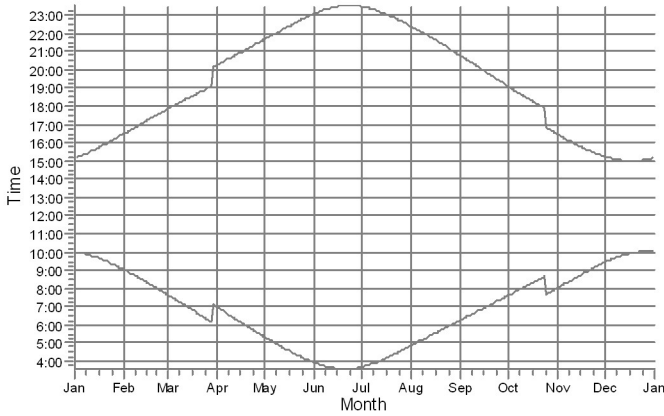
Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

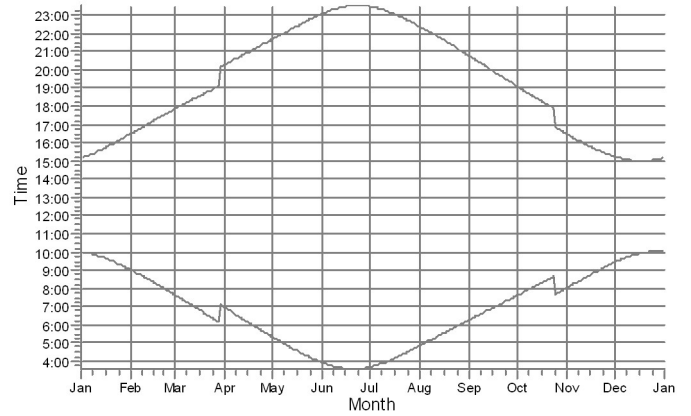
SHADOW - Calendar, graphical

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forest

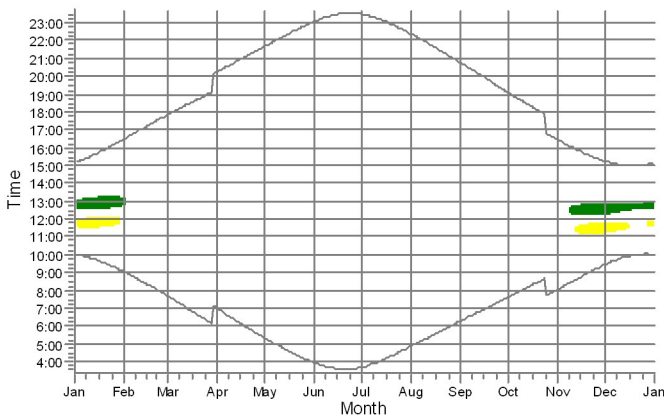
A: Lomarakennus (Perämäki)



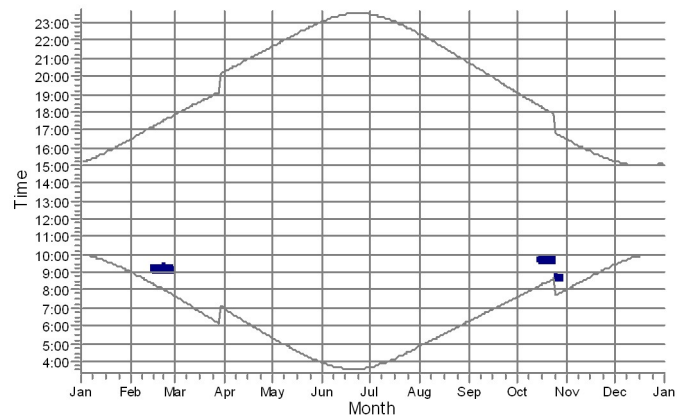
B: Lomarakennus (Nummikankaantie 218)



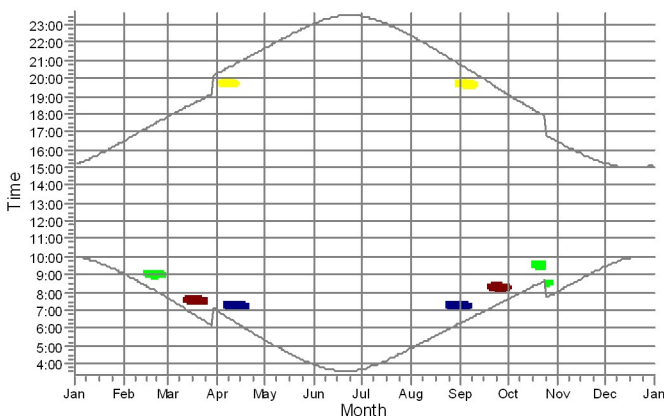
C: Lomarakennus (Heikinkatu 25)



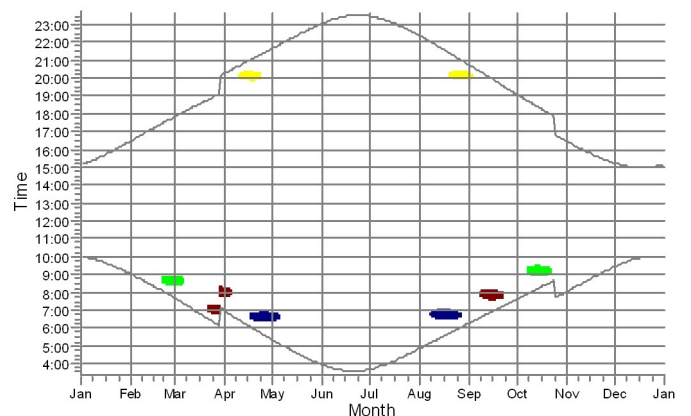
D: Lomarakennus (Ressulanmaa)



E: Lomarakennus (Sotkankangas I)



F: Lomarakennus (Sotkankangas II)



WTGs

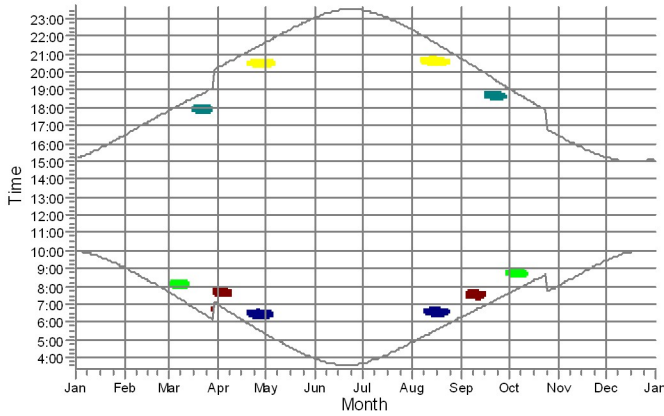
- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: green; margin-right: 5px;"></span> 1: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (30)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; margin-right: 5px;"></span> 2: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (31)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: blue; margin-right: 5px;"></span> 7: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (36)</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: red; margin-right: 5px;"></span> 8: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (37)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: lightgreen; margin-right: 5px;"></span> 9: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (38)</li> </ul> |
|--|---|



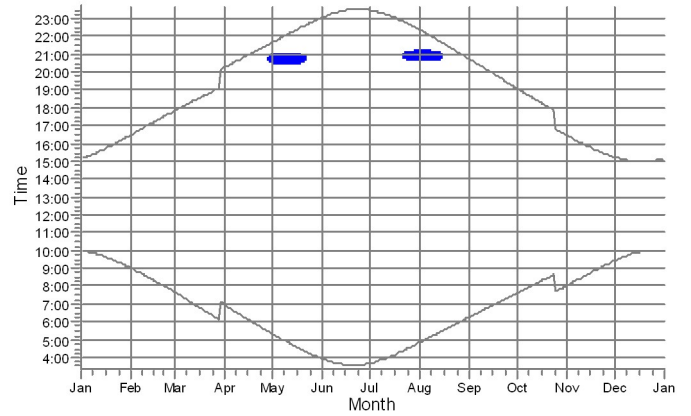
SHADOW - Calendar, graphical

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forest

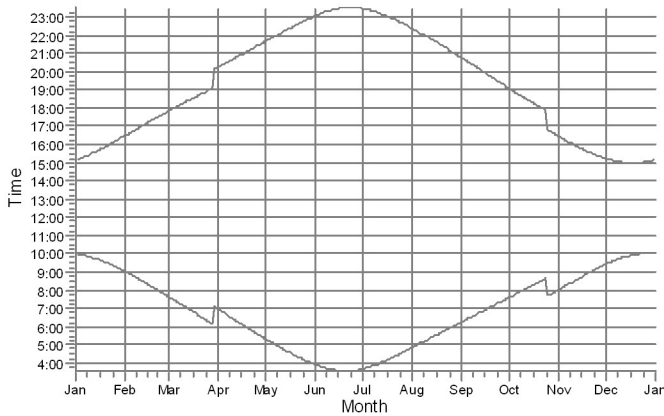
G: Lomarakenus (Sotkankangas III)



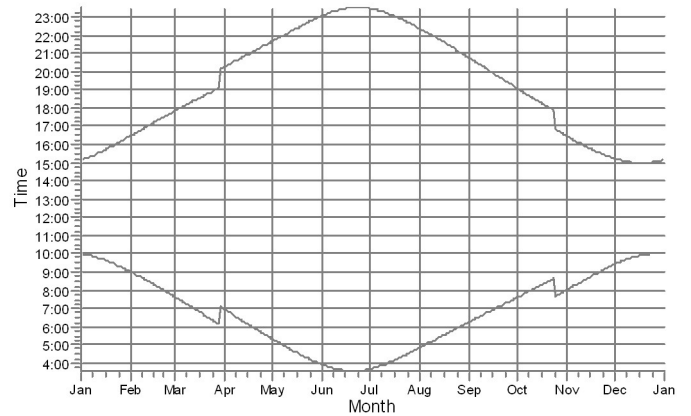
H: Lomarakenus (Ruostetuoma)



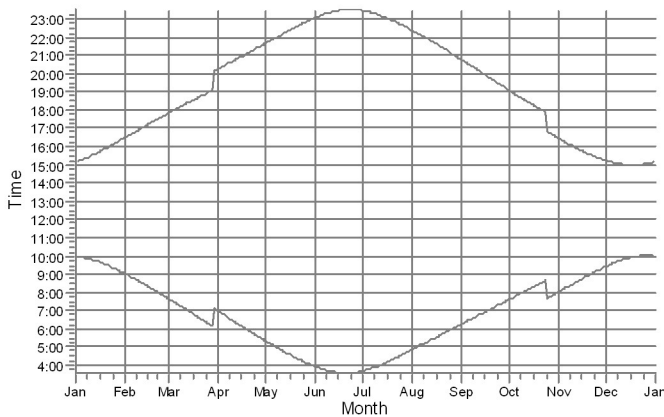
I: Lomarakenus (Heikinkankaantie 135)



J: Lomarakenus (Pukinharju)



K: Lomarakenus (Vähä Nummikangas)



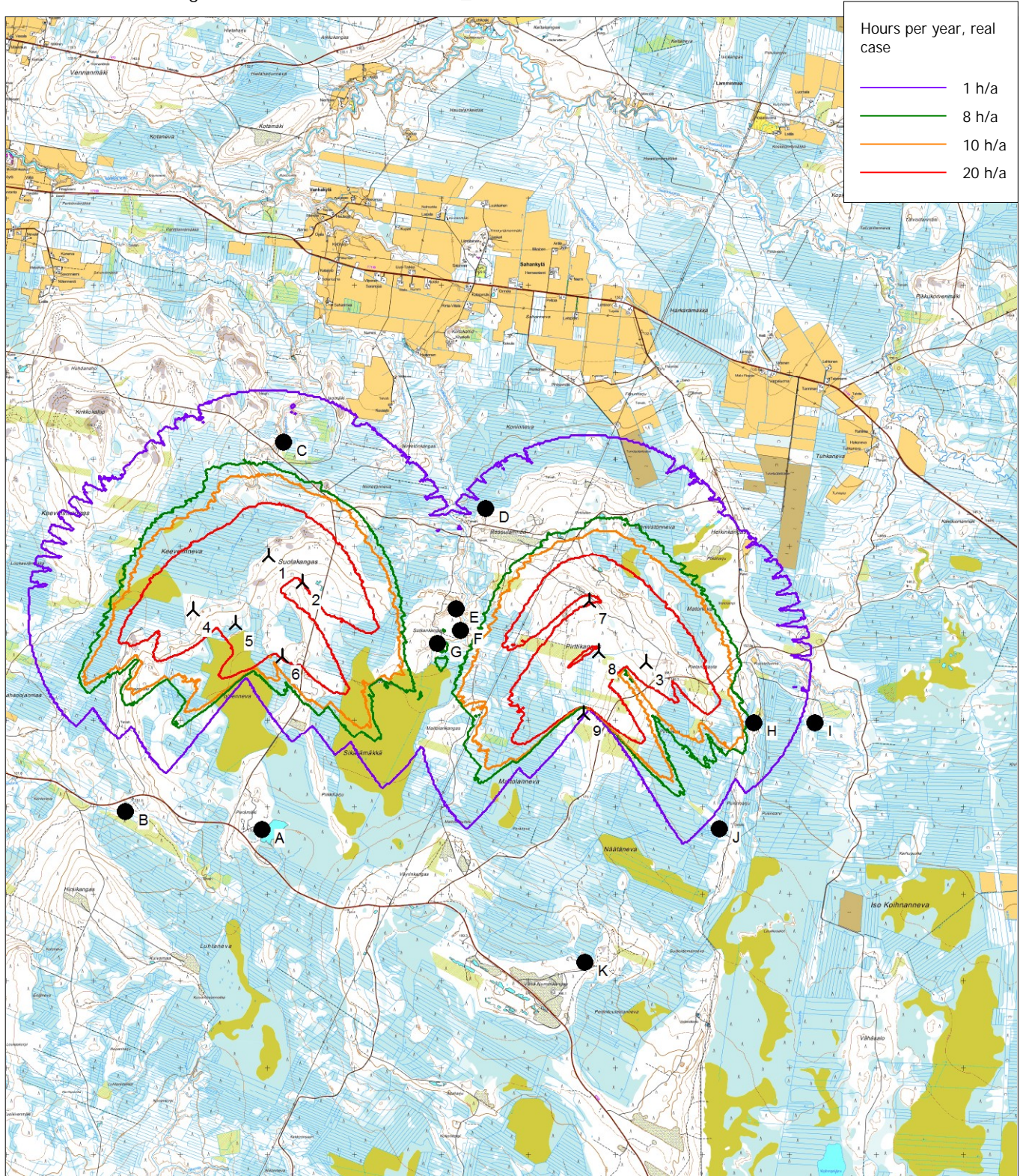
WTGs

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; margin-right: 5px;"></span> 2: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (31)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: blue; margin-right: 5px;"></span> 3: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (32)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: cyan; margin-right: 5px;"></span> 6: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (35)</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: darkblue; margin-right: 5px;"></span> 7: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (36)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: darkred; margin-right: 5px;"></span> 8: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (37)</li> <li><span style="display: inline-block; width: 15px; height: 15px; background-color: green; margin-right: 5px;"></span> 9: ENERCON E-150 4200 150.0 !-! hub: 155,0 m (TOT: 230,0 m) (38)</li> </ul> |
|---|---|



## SHADOW - Map

Calculation: Suolakangas E-150 x 9 x HH155 real case\_no forest

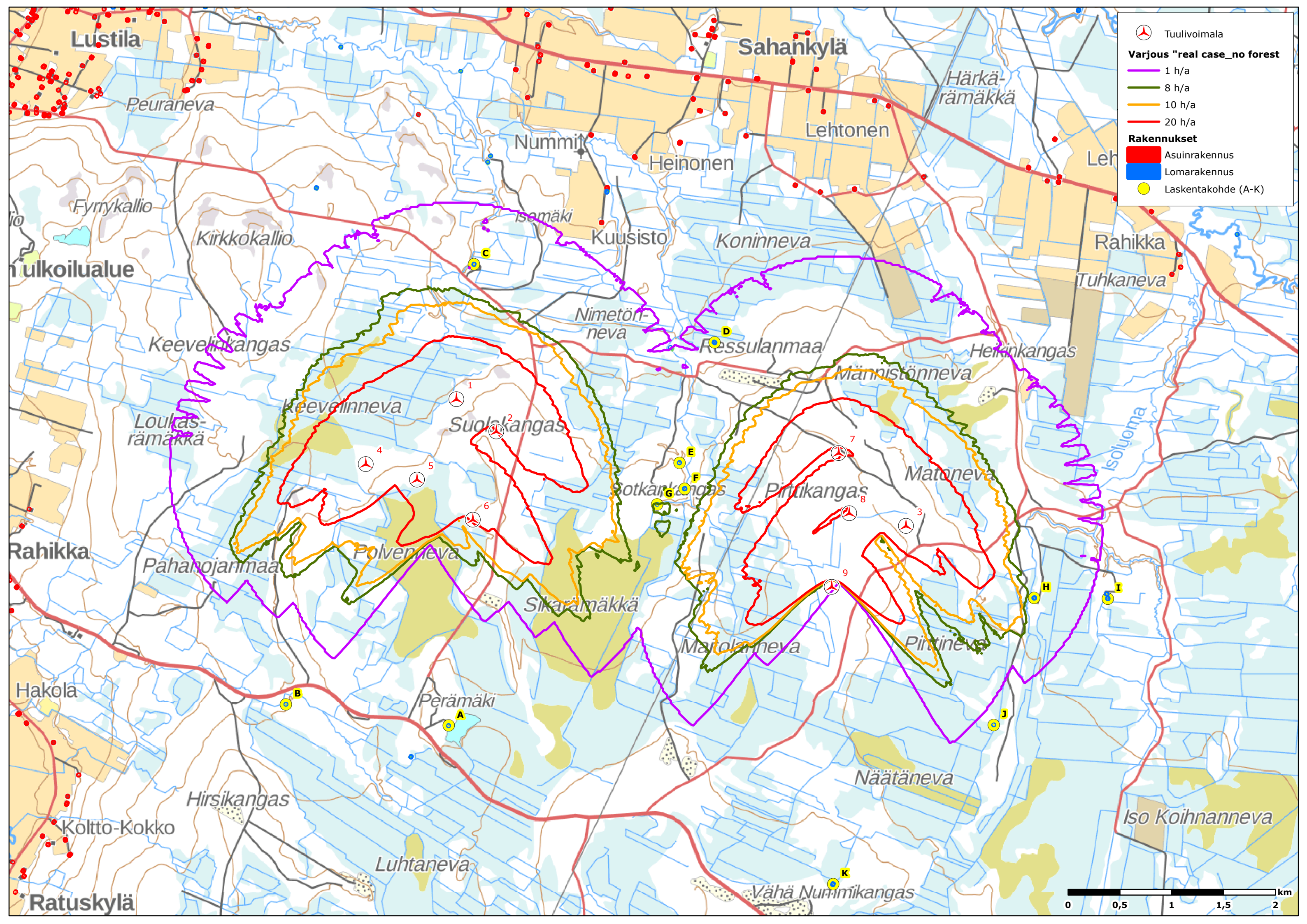


Map: Peruskartta , Print scale 1:65 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 261 160 North: 6 926 900

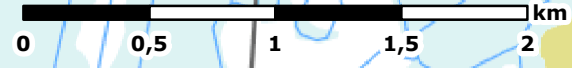
👤 New WTG      📍 Shadow receptor

Flicker map level: Height Contours: Korkeuskäyrät\_Kauhajoki.wpo (1)



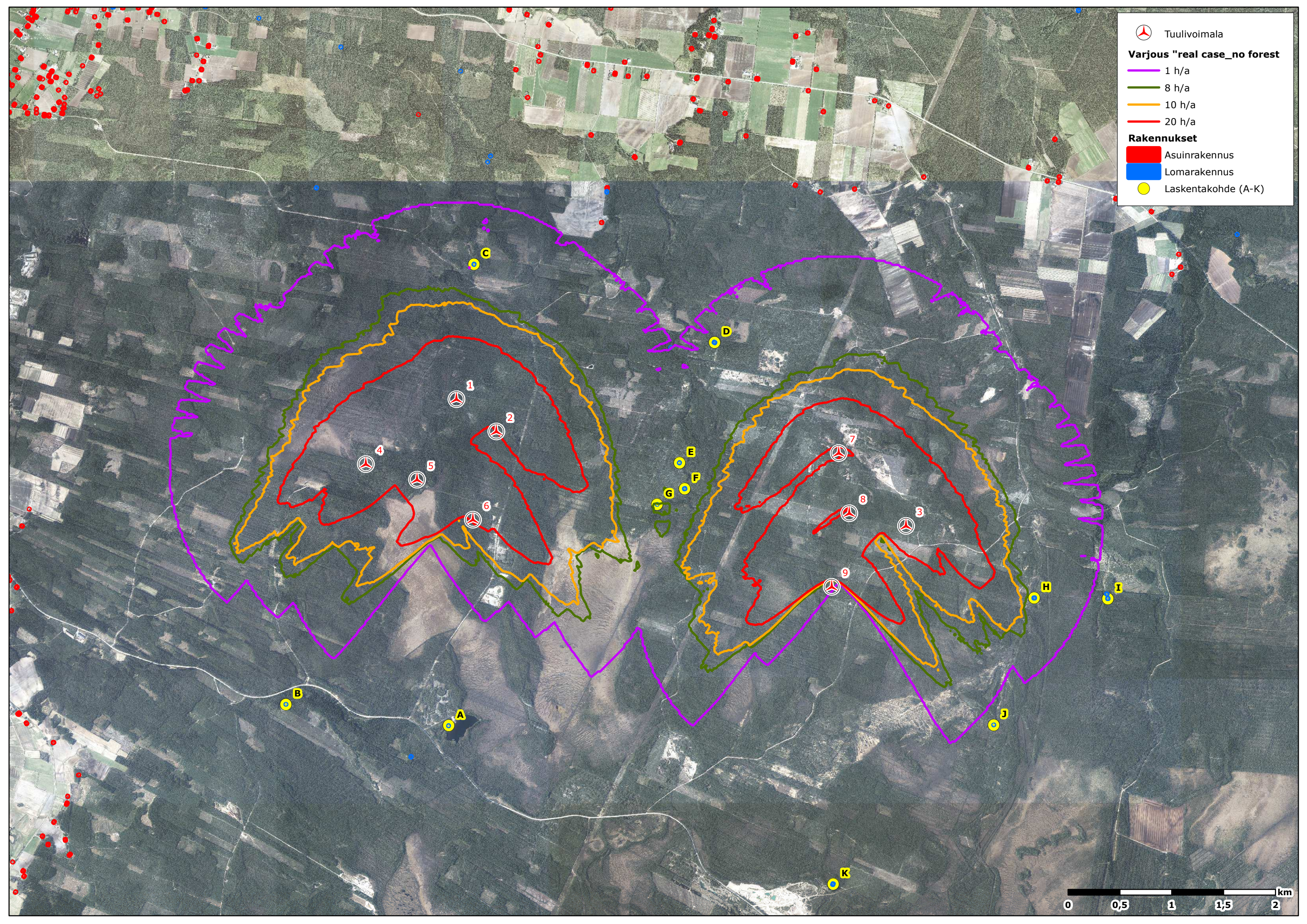


 Tuulivoimala  
**Varjous "real case\_no forest"**  
 1 h/a  
 8 h/a  
 10 h/a  
 20 h/a  
**Rakennukset**  
 Asuinrakennus  
 Lomarakennus  
 Laskentakohta (A-K)





 Tuulivoimala  
**Varjous "real case\_no forest"**  
 1 h/a  
 8 h/a  
 10 h/a  
 20 h/a  
**Rakennukset**  
 Asuinrakennus  
 Lomarakennus  
 Laskentakohde (A-K)





**Liite 2: Varjostusmallinnusten tulokset "real case, forest luke"**

## SHADOW - Main Result

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest luke

### 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) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational hours are calculated from WTGs in calculation and wind distribution:  
MERRA\_basic\_E22.668\_N62.500

Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
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: Korkeuskäyrät\_Kauhajoki.wpo (1)  
Area object(s) used in calculation:  
Luke 8 km  
Obstacles used in calculation  
Eye height: 1,5 m  
Grid resolution: 10,0 m

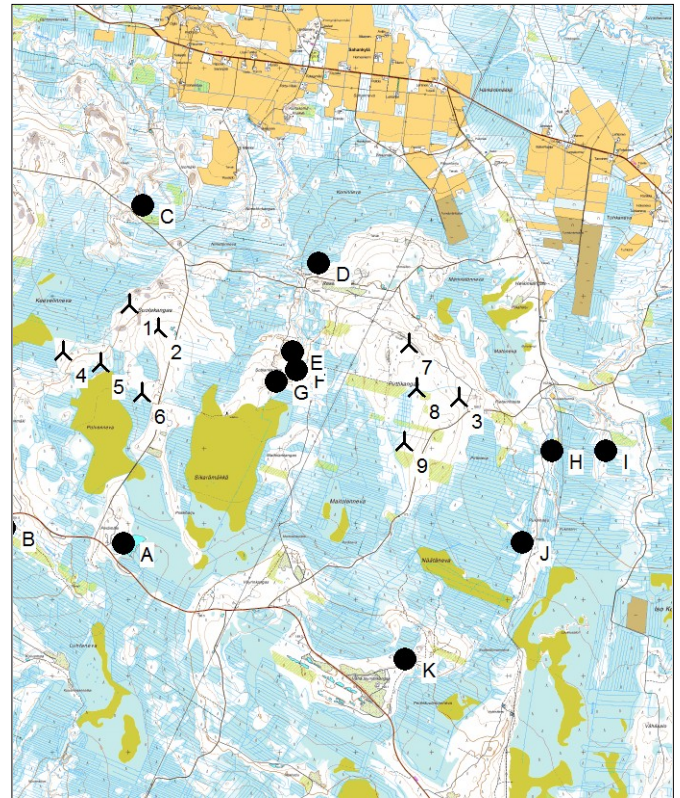
All coordinates are in  
Finish TM ETRS-TM35FIN-ETRS89

### WTGs

	East	North	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]
1	259 015	6 927 893	155,0	ENERCON E-150 4200 150.0 !-! hub: ...	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
2	259 400	6 927 582	167,5	ENERCON E-150 4200 150.0 !-! hub: ...	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
3	263 350	6 926 671	167,4	ENERCON E-150 4200 150.0 !-! hub: ...	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
4	258 141	6 927 267	153,8	ENERCON E-150 4200 150.0 !-! hub: ...	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
5	258 635	6 927 116	162,2	ENERCON E-150 4200 150.0 !-! hub: ...	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
6	259 173	6 926 730	169,8	ENERCON E-150 4200 150.0 !-! hub: ...	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
7	262 702	6 927 373	172,5	ENERCON E-150 4200 150.0 !-! hub: ...	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
8	262 803	6 926 793	172,2	ENERCON E-150 4200 150.0 !-! hub: ...	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0
9	262 634	6 926 083	172,5	ENERCON E-150 4200 150.0 !-! hub: ...	Yes	ENERCON	E-150-4 200	4 200	150,0	155,0	1 902	0,0

### Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Lomarakennus (Perämäki)	258 941	6 924 744	171,2	5,0	5,0	2,0	0,0	90,0	"Green house mode"
B	Lomarakennus (Nummikankaantie 218)	257 371	6 924 948	149,3	5,0	5,0	2,0	0,0	90,0	"Green house mode"
C	Lomarakennus (Heikinkatu 25)	259 185	6 929 195	135,0	5,0	5,0	2,0	0,0	90,0	"Green house mode"
D	Lomarakennus (Ressulanmaa)	261 505	6 928 439	146,0	5,0	5,0	2,0	0,0	90,0	"Green house mode"
E	Lomarakennus (Sotkankangas I)	261 168	6 927 279	162,5	5,0	5,0	2,0	0,0	90,0	"Green house mode"
F	Lomarakennus (Sotkankangas II)	261 217	6 927 029	160,0	5,0	5,0	2,0	0,0	90,0	"Green house mode"
G	Lomarakennus (Sotkankangas III)	260 951	6 926 878	160,8	5,0	5,0	2,0	0,0	90,0	"Green house mode"
H	Lomarakennus (Ruostetuoma)	264 587	6 925 975	157,5	5,0	5,0	2,0	0,0	90,0	"Green house mode"
I	Lomarakennus (Heikinkankaantie 135)	265 298	6 925 969	153,1	5,0	5,0	2,0	0,0	90,0	"Green house mode"
J	Lomarakennus (Pukiharju)	264 198	6 924 751	163,2	5,0	5,0	2,0	0,0	90,0	"Green house mode"
K	Lomarakennus (Vähä Nummikangas)	262 649	6 923 216	187,5	5,0	5,0	2,0	0,0	90,0	"Green house mode"



## SHADOW - Main Result

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest luke

### Calculation Results

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours	per year [h/year]
A	Lomarakennus (Perämäki)		0:00
B	Lomarakennus (Nummikankaantie 218)		0:00
C	Lomarakennus (Heikinkatu 25)		0:00
D	Lomarakennus (Ressulanmaa)		0:00
E	Lomarakennus (Sotkakangas I)		0:00
F	Lomarakennus (Sotkakangas II)		0:00
G	Lomarakennus (Sotkakangas III)		0:00
H	Lomarakennus (Ruostetuoma)		0:00
I	Lomarakennus (Heikinkankaantie 135)		0:00
J	Lomarakennus (Pukinharju)		0:00
K	Lomarakennus (Vähä Nummikangas)		0:00

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

No.	Name		Worst case	Expected
			[h/year]	[h/year]
1	ENERCON E-150 4200 150.0 !-!	hub: 155,0 m (TOT: 230,0 m) (30)	0:00	0:00
2	ENERCON E-150 4200 150.0 !-!	hub: 155,0 m (TOT: 230,0 m) (31)	0:00	0:00
3	ENERCON E-150 4200 150.0 !-!	hub: 155,0 m (TOT: 230,0 m) (32)	0:00	0:00
4	ENERCON E-150 4200 150.0 !-!	hub: 155,0 m (TOT: 230,0 m) (33)	0:00	0:00
5	ENERCON E-150 4200 150.0 !-!	hub: 155,0 m (TOT: 230,0 m) (34)	0:00	0:00
6	ENERCON E-150 4200 150.0 !-!	hub: 155,0 m (TOT: 230,0 m) (35)	0:00	0:00
7	ENERCON E-150 4200 150.0 !-!	hub: 155,0 m (TOT: 230,0 m) (36)	0:00	0:00
8	ENERCON E-150 4200 150.0 !-!	hub: 155,0 m (TOT: 230,0 m) (37)	0:00	0:00
9	ENERCON E-150 4200 150.0 !-!	hub: 155,0 m (TOT: 230,0 m) (38)	0:00	0:00

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: A - Lomarakenus (Perämäki)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:02	07:38	06:56	05:18	03:55	03:41	04:51	06:17	07:36	08:02	09:26
	15:10	16:29	17:51	20:17	21:40	23:04	23:28	22:22	20:44	19:05	16:27	15:13
2	09:59	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:39	08:05	09:29
	15:12	16:32	17:54	20:19	21:43	23:06	23:27	22:19	20:41	19:02	16:24	15:12
3	09:58	08:56	07:31	06:49	05:12	03:51	03:44	04:57	06:22	07:41	08:08	09:31
	15:13	16:35	17:57	20:22	21:46	23:08	23:26	22:16	20:38	18:58	16:21	15:10
4	09:57	08:53	07:28	06:46	05:09	03:50	03:45	05:00	06:25	07:44	08:11	09:33
	15:15	16:38	18:00	20:25	21:49	23:11	23:24	22:13	20:35	18:55	16:18	15:09
5	09:56	08:51	07:25	06:43	05:06	03:48	03:47	05:02	06:27	07:47	08:14	09:35
	15:17	16:41	18:02	20:27	21:52	23:13	23:23	22:10	20:31	18:52	16:15	15:07
6	09:55	08:48	07:22	06:39	05:03	03:46	03:48	05:05	06:30	07:49	08:16	09:38
	15:19	16:44	18:05	20:30	21:55	23:14	23:22	22:07	20:28	18:49	16:12	15:06
7	09:54	08:45	07:18	06:36	05:00	03:45	03:50	05:08	06:33	07:52	08:19	09:40
	15:21	16:47	18:08	20:33	21:57	23:16	23:20	22:04	20:25	18:45	16:09	15:05
8	09:52	08:42	07:15	06:33	04:57	03:43	03:52	05:11	06:35	07:55	08:22	09:42
	15:23	16:50	18:11	20:36	22:00	23:18	23:19	22:01	20:21	18:42	16:07	15:04
9	09:51	08:39	07:12	06:29	04:54	03:42	03:54	05:14	06:38	07:57	08:25	09:44
	15:26	16:53	18:14	20:38	22:03	23:20	23:17	21:58	20:18	18:39	16:04	15:03
10	09:50	08:36	07:09	06:26	04:51	03:41	03:56	05:16	06:41	08:00	08:28	09:45
	15:28	16:56	18:16	20:41	22:06	23:21	23:15	21:55	20:15	18:35	16:01	15:02
11	09:48	08:33	07:05	06:23	04:48	03:40	03:58	05:19	06:43	08:03	08:31	09:47
	15:30	16:59	18:19	20:44	22:09	23:23	23:13	21:52	20:11	18:32	15:58	15:01
12	09:46	08:30	07:02	06:19	04:45	03:39	04:00	05:22	06:46	08:05	08:34	09:49
	15:33	17:02	18:22	20:47	22:12	23:24	23:11	21:49	20:08	18:29	15:56	15:00
13	09:45	08:27	06:59	06:16	04:43	03:38	04:02	05:25	06:48	08:08	08:37	09:50
	15:35	17:05	18:25	20:50	22:15	23:25	23:10	21:46	20:05	18:26	15:53	14:59
14	09:43	08:24	06:55	06:13	04:40	03:37	04:05	05:27	06:51	08:11	08:40	09:52
	15:38	17:08	18:27	20:52	22:17	23:27	23:07	21:42	20:01	18:23	15:50	14:59
15	09:41	08:21	06:52	06:10	04:37	03:36	04:07	05:30	06:54	08:14	08:43	09:53
	15:40	17:11	18:30	20:55	22:20	23:28	23:05	21:39	19:58	18:19	15:48	14:59
16	09:39	08:18	06:49	06:06	04:34	03:35	04:09	05:33	06:56	08:16	08:46	09:54
	15:43	17:13	18:33	20:58	22:23	23:30	23:03	21:36	19:55	18:16	15:45	14:58
17	09:37	08:15	06:46	06:03	04:31	03:35	04:12	05:36	06:59	08:19	08:48	09:56
	15:46	17:16	18:36	21:01	22:26	23:29	23:01	21:33	19:51	18:13	15:43	14:58
18	09:35	08:12	06:42	06:00	04:29	03:35	04:14	05:39	07:02	08:22	08:51	09:57
	15:48	17:19	18:38	21:03	22:29	23:30	22:59	21:30	19:48	18:10	15:40	14:58
19	09:33	08:09	06:39	05:57	04:26	03:34	04:17	05:41	07:04	08:25	08:54	09:58
	15:51	17:22	18:41	21:06	22:31	23:31	22:56	21:27	19:45	18:07	15:38	14:58
20	09:31	08:06	06:36	05:53	04:23	03:34	04:19	05:44	07:07	08:28	08:57	09:58
	15:54	17:25	18:44	21:09	22:34	23:31	22:54	21:23	19:41	18:03	15:36	14:58
21	09:29	08:03	06:32	05:50	04:21	03:34	04:22	05:47	07:09	08:30	09:00	09:59
	15:57	17:28	18:47	21:12	22:37	23:31	22:51	21:20	19:38	18:00	15:33	14:59
22	09:27	08:00	06:29	05:47	04:18	03:34	04:24	05:50	07:12	08:33	09:03	10:00
	15:59	17:31	18:49	21:15	22:39	23:32	22:49	21:17	19:35	17:57	15:31	14:59
23	09:24	07:57	06:26	05:44	04:16	03:35	04:27	05:52	07:15	08:36	09:05	10:00
	16:02	17:34	18:52	21:18	22:42	23:32	22:46	21:14	19:31	17:54	15:29	15:00
24	09:22	07:54	06:22	05:41	04:13	03:35	04:30	05:55	07:17	08:39	09:08	10:01
	16:05	17:37	18:55	21:20	22:45	23:32	22:44	21:11	19:28	17:51	15:27	15:00
25	09:20	07:50	06:19	05:37	04:11	03:36	04:32	05:58	07:20	07:42	09:11	10:01
	16:08	17:40	18:57	21:23	22:47	23:31	22:41	21:07	19:25	16:48	15:24	15:01
26	09:17	07:47	06:16	05:34	04:08	03:36	04:35	06:00	07:23	07:45	09:13	10:01
	16:11	17:43	19:00	21:26	22:50	23:31	22:38	21:04	19:21	16:45	15:22	15:02
27	09:15	07:44	06:12	05:31	04:06	03:37	04:38	06:03	07:25	07:47	09:16	10:01
	16:14	17:45	19:03	21:29	22:52	23:31	22:36	21:01	19:18	16:42	15:20	15:03
28	09:12	07:41	06:09	05:28	04:04	03:38	04:40	06:06	07:28	07:50	09:19	10:01
	16:17	17:48	19:06	21:32	22:55	23:30	22:33	20:58	19:15	16:39	15:19	15:04
29	09:10	07:06	05:25	04:02	03:39	04:43	06:09	07:31	07:53	09:21	10:01	10:01
	16:20	07:06	05:25	04:02	03:39	04:43	06:09	07:31	07:53	09:21	10:01	10:01
30	09:07	07:02	05:22	03:59	03:40	04:46	06:11	07:33	07:56	09:24	10:00	10:00
	16:23	07:02	05:22	03:59	03:40	04:46	06:11	07:33	07:56	09:24	10:00	10:00
31	09:04	06:59	05:19	03:57	03:30	04:49	06:14	07:36	07:59	09:27	10:00	10:00
	16:26	06:59	05:19	03:57	03:30	04:49	06:14	07:36	07:59	09:27	10:00	10:00
Potential sun hours	190	246	364	444	551	592	584	497	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: B - Lomarakennus (Nummikankaantie 218)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
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	15:10	16:29	17:51	20:17	21:40	23:04	23:28	22:22	20:45	19:05	16:27	15:13
2	09:59	08:59	07:35	06:53	05:16	03:53	03:42	04:54	06:19	07:39	08:05	09:29
	15:12	16:32	17:54	20:19	21:43	23:06	23:27	22:19	20:41	19:02	16:24	15:12
3	09:58	08:56	07:31	06:49	05:12	03:52	03:44	04:57	06:22	07:41	08:08	09:31
	15:13	16:35	17:57	20:22	21:46	23:09	23:26	22:16	20:38	18:58	16:21	15:10
4	09:57	08:54	07:28	06:46	05:09	03:50	03:45	05:00	06:25	07:44	08:11	09:33
	15:15	16:38	18:00	20:25	21:49	23:11	23:25	22:13	20:35	18:55	16:18	15:09
5	09:56	08:51	07:25	06:43	05:06	03:48	03:47	05:03	06:27	07:47	08:14	09:36
	15:17	16:41	18:02	20:28	21:52	23:13	23:23	22:10	20:31	18:52	16:15	15:07
6	09:55	08:48	07:22	06:39	05:03	03:46	03:49	05:05	06:30	07:49	08:17	09:38
	15:19	16:44	18:05	20:30	21:55	23:15	23:22	22:07	20:28	18:49	16:12	15:06
7	09:54	08:45	07:18	06:36	05:00	03:45	03:50	05:08	06:33	07:52	08:19	09:40
	15:21	16:47	18:08	20:33	21:58	23:16	23:20	22:04	20:25	18:45	16:10	15:05
8	09:52	08:42	07:15	06:33	04:57	03:43	03:52	05:11	06:35	07:55	08:22	09:42
	15:23	16:50	18:11	20:36	22:00	23:18	23:19	22:01	20:21	18:42	16:07	15:04
9	09:51	08:39	07:12	06:29	04:54	03:42	03:54	05:14	06:38	07:57	08:25	09:44
	15:26	16:53	18:14	20:39	22:03	23:20	23:17	21:58	20:18	18:39	16:04	15:03
10	09:50	08:36	07:09	06:26	04:51	03:41	03:56	05:16	06:41	08:00	08:28	09:45
	15:28	16:56	18:16	20:41	22:06	23:21	23:15	21:55	20:15	18:36	16:01	15:02
11	09:48	08:34	07:05	06:23	04:48	03:40	03:58	05:19	06:43	08:03	08:31	09:47
	15:30	16:59	18:19	20:44	22:09	23:23	23:14	21:52	20:11	18:32	15:58	15:01
12	09:47	08:31	07:02	06:20	04:46	03:39	04:00	05:22	06:46	08:06	08:34	09:49
	15:33	17:02	18:22	20:47	22:12	23:24	23:12	21:49	20:08	18:29	15:56	15:00
13	09:45	08:28	06:59	06:16	04:43	03:38	04:03	05:25	06:49	08:08	08:37	09:50
	15:35	17:05	18:25	20:50	22:15	23:25	23:10	21:46	20:05	18:26	15:53	15:00
14	09:43	08:25	06:56	06:13	04:40	03:37	04:05	05:28	06:51	08:11	08:40	09:52
	15:38	17:08	18:28	20:52	22:18	23:27	23:08	21:43	20:01	18:23	15:51	14:59
15	09:41	08:22	06:52	06:10	04:37	03:36	04:07	05:30	06:54	08:14	08:43	09:53
	15:40	17:11	18:30	20:55	22:20	23:28	23:05	21:39	19:58	18:19	15:48	14:59
16	09:39	08:19	06:49	06:07	04:34	03:36	04:09	05:33	06:56	08:17	08:46	09:55
	15:43	17:14	18:33	20:58	22:23	23:29	23:03	21:36	19:55	18:16	15:45	14:58
17	09:37	08:15	06:46	06:03	04:31	03:35	04:12	05:36	06:59	08:19	08:49	09:56
	15:46	17:17	18:36	21:01	22:26	23:29	23:01	21:33	19:52	18:13	15:43	14:58
18	09:35	08:12	06:42	06:00	04:29	03:35	04:14	05:39	07:02	08:22	08:51	09:57
	15:48	17:19	18:38	21:04	22:29	23:30	22:59	21:30	19:48	18:10	15:40	14:58
19	09:33	08:09	06:39	05:57	04:26	03:34	04:17	05:41	07:04	08:25	08:54	09:58
	15:51	17:22	18:41	21:06	22:31	23:31	22:56	21:27	19:45	18:07	15:38	14:58
20	09:31	08:06	06:36	05:54	04:23	03:34	04:19	05:44	07:07	08:28	08:57	09:59
	15:54	17:25	18:44	21:09	22:34	23:31	22:54	21:24	19:42	18:04	15:36	14:58
21	09:29	08:03	06:32	05:50	04:21	03:34	04:22	05:47	07:10	08:31	09:00	09:59
	15:57	17:28	18:47	21:12	22:37	23:31	22:51	21:20	19:38	18:00	15:33	14:59
22	09:27	08:00	06:29	05:47	04:18	03:34	04:24	05:50	07:12	08:33	09:03	10:00
	15:59	17:31	18:49	21:15	22:39	23:32	22:49	21:17	19:35	17:57	15:31	14:59
23	09:24	07:57	06:26	05:44	04:16	03:35	04:27	05:52	07:15	08:36	09:05	10:00
	16:02	17:34	18:52	21:18	22:42	23:32	22:46	21:14	19:32	17:54	15:29	15:00
24	09:22	07:54	06:22	05:41	04:13	03:35	04:30	05:55	07:17	08:39	09:08	10:01
	16:05	17:37	18:55	21:20	22:45	23:32	22:44	21:11	19:28	17:51	15:27	15:00
25	09:20	07:51	06:19	05:37	04:11	03:36	04:32	05:58	07:20	07:42	09:11	10:01
	16:08	17:40	18:58	21:23	22:47	23:31	22:41	21:07	19:25	16:48	15:25	15:01
26	09:17	07:47	06:16	05:34	04:08	03:36	04:35	06:01	07:23	07:45	09:14	10:01
	16:11	17:43	19:00	21:26	22:50	23:31	22:39	21:04	19:22	16:45	15:23	15:02
27	09:15	07:44	06:13	05:31	04:06	03:37	04:38	06:03	07:25	07:48	09:16	10:01
	16:14	17:45	19:03	21:29	22:52	23:31	22:36	21:01	19:18	16:42	15:21	15:03
28	09:12	07:41	06:09	05:28	04:04	03:38	04:40	06:06	07:28	07:50	09:19	10:01
	16:17	17:48	19:06	21:32	22:55	23:30	22:33	20:58	19:15	16:39	15:19	15:04
29	09:10	07:06	05:25	04:02	03:39	04:43	06:09	07:31	07:53	09:21	10:01	10:01
	16:20	17:51	19:08	21:35	22:57	23:30	22:30	20:54	19:12	16:36	15:17	15:05
30	09:07	07:03	05:22	03:59	03:40	04:46	06:11	07:33	07:56	09:24	10:00	10:00
	16:23	17:54	19:11	21:38	23:00	23:29	22:28	20:51	19:08	16:33	15:15	15:07
31	09:04	06:59	05:19	03:57	03:02	04:49	06:14	07:35	07:59	09:27	10:00	10:00
	16:26	17:56	19:13	21:41	23:02	23:25	22:25	20:48	16:30	15:15	15:08	15:08
Potential sun hours	190	246	364	444	551	592	584	497	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: C - Lomarakennus (Heikinkatu 25)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:00	09:02	07:38	06:56	05:18	03:55	03:40	04:51	06:17	07:36	08:02	09:27
	15:09	16:28	17:51	20:17	21:41	23:05	23:28	22:22	20:45	19:05	16:27	15:13
2	09:59	08:59	07:35	06:52	05:15	03:53	03:42	04:54	06:19	07:39	08:05	09:29
	15:11	16:31	17:54	20:19	21:43	23:07	23:27	22:19	20:41	19:02	16:24	15:11
3	09:58	08:56	07:31	06:49	05:12	03:51	03:43	04:57	06:22	07:41	08:08	09:31
	15:13	16:34	17:57	20:22	21:46	23:09	23:26	22:16	20:38	18:58	16:21	15:10
4	09:57	08:54	07:28	06:46	05:09	03:49	03:45	04:59	06:25	07:44	08:11	09:34
	15:15	16:37	17:59	20:25	21:49	23:11	23:25	22:13	20:35	18:55	16:18	15:08
5	09:56	08:51	07:25	06:42	05:06	03:47	03:46	05:02	06:27	07:47	08:14	09:36
	15:17	16:40	18:02	20:28	21:52	23:13	23:24	22:10	20:31	18:52	16:15	15:07
6	09:55	08:48	07:22	06:39	05:03	03:46	03:48	05:05	06:30	07:49	08:17	09:38
	15:19	16:43	18:05	20:30	21:55	23:15	23:22	22:07	20:28	18:48	16:12	15:05
7	09:54	08:45	07:18	06:36	05:00	03:44	03:50	05:08	06:33	07:52	08:20	09:40
	15:21	16:46	18:08	20:33	21:58	23:17	23:21	22:04	20:25	18:45	16:09	15:04
8	09:53	08:42	07:15	06:33	04:57	03:43	03:52	05:11	06:35	07:55	08:23	09:42
	15:23	16:49	18:11	20:36	22:01	23:19	23:19	22:01	20:21	18:42	16:06	15:03
9	09:51	08:39	07:12	06:29	04:54	03:41	03:53	05:13	06:38	07:57	08:25	09:44
	15:25	16:52	18:14	20:39	22:04	23:20	23:18	21:58	20:18	18:39	16:04	15:02
10	09:50	08:37	07:09	06:26	04:51	03:40	03:55	05:16	06:40	08:00	08:28	09:46
	15:27	16:55	18:16	20:41	22:06	23:22	23:16	21:55	20:15	18:35	16:01	15:01
11	09:48	08:34	07:05	06:23	04:48	03:39	03:58	05:19	06:43	08:03	08:31	09:48
	15:30	16:58	18:19	20:44	22:09	23:23	23:14	21:52	20:11	18:32	15:58	15:00
12	09:47	08:31	07:02	06:19	04:45	03:38	04:00	05:22	06:46	08:06	08:34	09:49
	15:32	17:01	18:22	20:47	22:12	23:25	23:12	21:49	20:08	18:29	15:55	15:00
13	09:45	08:28	06:59	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:37	09:51
	15:35	17:04	18:25	20:50	22:15	23:26	23:10	21:46	20:05	18:26	15:53	14:59
14	09:43	08:25	06:55	06:13	04:39	03:36	04:04	05:27	06:51	08:11	08:40	09:52
	15:37	17:07	18:27	20:52	22:18	23:27	23:08	21:43	20:01	18:22	15:50	14:58
15	09:42	08:22	06:52	06:10	04:37	03:35	04:06	05:30	06:54	08:14	08:43	09:54
	15:40	17:10	18:30	20:55	22:21	23:28	23:06	21:40	19:58	18:19	15:48	14:58
16	09:40	08:19	06:49	06:06	04:34	03:35	04:09	05:33	06:56	08:17	08:46	09:55
	15:42	17:13	18:33	20:58	22:23	23:29	23:04	21:36	19:55	18:16	15:45	14:58
17	09:38	08:16	06:46	06:03	04:31	03:34	04:11	05:36	06:59	08:19	08:49	09:56
	15:45	17:16	18:36	21:01	22:26	23:30	23:01	21:33	19:51	18:13	15:42	14:58
18	09:36	08:12	06:42	06:00	04:28	03:34	04:14	05:38	07:02	08:22	08:52	09:57
	15:48	17:19	18:38	21:04	22:29	23:31	22:59	21:30	19:48	18:10	15:40	14:58
19	09:34	08:09	06:39	05:56	04:26	03:34	04:16	05:41	07:04	08:25	08:54	09:58
	15:51	17:22	18:41	21:06	22:32	23:31	22:57	21:27	19:45	18:07	15:38	14:58
20	09:31	08:06	06:36	05:53	04:23	03:34	04:19	05:44	07:07	08:28	08:57	09:59
	15:53	17:25	18:44	21:09	22:34	23:32	22:54	21:24	19:41	18:03	15:35	14:58
21	09:29	08:03	06:32	05:50	04:20	03:34	04:21	05:47	07:09	08:31	09:00	10:00
	15:56	17:28	18:47	21:12	22:37	23:32	22:52	21:20	19:38	18:00	15:33	14:58
22	09:27	08:00	06:29	05:47	04:18	03:34	04:24	05:49	07:12	08:33	09:03	10:00
	15:59	17:31	18:49	21:15	22:40	23:32	22:49	21:17	19:35	17:57	15:31	14:59
23	09:25	07:57	06:26	05:44	04:15	03:34	04:26	05:52	07:15	08:36	09:06	10:01
	16:02	17:34	18:52	21:18	22:42	23:32	22:47	21:14	19:31	17:54	15:28	14:59
24	09:22	07:54	06:22	05:40	04:13	03:34	04:29	05:55	07:17	08:39	09:08	10:01
	16:05	17:37	18:55	21:21	22:45	23:32	22:44	21:11	19:28	17:51	15:26	15:00
25	09:20	07:51	06:19	05:37	04:10	03:35	04:32	05:58	07:20	07:42	09:11	10:01
	16:08	17:40	18:58	21:23	22:48	23:32	22:41	21:07	19:25	16:48	15:24	15:00
26	09:17	07:47	06:16	05:34	04:08	03:35	04:34	06:00	07:23	07:45	09:14	10:01
	16:11	17:42	19:00	21:26	22:50	23:32	22:39	21:04	19:21	16:45	15:22	15:01
27	09:15	07:44	06:12	05:31	04:06	03:36	04:37	06:03	07:25	07:48	09:16	10:01
	16:14	17:45	19:03	21:29	22:53	23:31	22:36	21:01	19:18	16:42	15:20	15:02
28	09:12	07:41	06:09	05:28	04:03	03:37	04:40	06:06	07:28	07:50	09:19	10:01
	16:17	17:48	19:06	21:32	22:55	23:31	22:33	20:58	19:15	16:39	15:18	15:04
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30	09:07	07:35	06:02	05:21	03:59	03:39	04:45	06:11	07:33	07:56	09:24	10:01
	16:22	17:53	19:11	21:38	23:00	23:29	22:28	20:51	19:08	16:33	15:15	15:06
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	16:25	17:56	19:14	21:41	23:02	23:30	22:25	20:48	16:30	15:12	15:07	15:07
Potential sun hours	190	246	364	444	552	593	584	498	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: D - Lomarakenus (Ressulanmaa)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:02	07:38	06:56	05:18	03:55	03:40	04:51	06:16	07:36	08:02	09:26
	15:09	16:28	17:51	20:16	21:40	23:04	23:28	22:22	20:44	19:05	16:26	15:13
2	09:59	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:38	08:05	09:29
	15:11	16:31	17:54	20:19	21:43	23:07	23:27	22:19	20:41	19:01	16:23	15:11
3	09:58	08:56	07:31	06:49	05:12	03:51	03:43	04:56	06:22	07:41	08:08	09:31
	15:13	16:34	17:56	20:22	21:46	23:09	23:26	22:16	20:38	18:58	16:20	15:09
4	09:57	08:53	07:28	06:46	05:09	03:49	03:44	04:59	06:24	07:44	08:11	09:33
	15:15	16:37	17:59	20:25	21:49	23:11	23:25	22:13	20:34	18:55	16:18	15:08
5	09:56	08:51	07:25	06:42	05:06	03:47	03:46	05:02	06:27	07:46	08:14	09:36
	15:17	16:40	18:02	20:27	21:52	23:13	23:24	22:10	20:31	18:52	16:15	15:07
6	09:55	08:48	07:21	06:39	05:03	03:46	03:48	05:05	06:30	07:49	08:16	09:38
	15:19	16:43	18:05	20:30	21:55	23:15	23:22	22:07	20:28	18:48	16:12	15:05
7	09:54	08:45	07:18	06:36	05:00	03:44	03:50	05:08	06:32	07:52	08:19	09:40
	15:21	16:46	18:08	20:33	21:58	23:17	23:21	22:04	20:25	18:45	16:09	15:04
8	09:53	08:42	07:15	06:32	04:57	03:43	03:51	05:10	06:35	07:54	08:22	09:42
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9	09:51	08:39	07:12	06:29	04:54	03:41	03:53	05:13	06:38	07:57	08:25	09:44
	15:25	16:52	18:13	20:38	22:03	23:20	23:17	21:58	20:18	18:39	16:03	15:02
10	09:50	08:36	07:08	06:26	04:51	03:40	03:55	05:16	06:40	08:00	08:28	09:46
	15:27	16:55	18:16	20:41	22:06	23:22	23:16	21:55	20:15	18:35	16:01	15:01
11	09:48	08:33	07:05	06:22	04:48	03:39	03:57	05:19	06:43	08:03	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:23	23:14	21:52	20:11	18:32	15:58	15:00
12	09:47	08:30	07:02	06:19	04:45	03:38	04:00	05:22	06:46	08:05	08:34	09:49
	15:32	17:01	18:22	20:47	22:12	23:24	23:12	21:49	20:08	18:29	15:55	14:59
13	09:45	08:27	06:59	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:37	09:51
	15:35	17:04	18:24	20:49	22:15	23:26	23:10	21:46	20:05	18:26	15:53	14:59
14	09:43	08:24	06:55	06:13	04:39	03:36	04:04	05:27	06:51	08:11	08:40	09:52
	15:37	17:07	18:27	20:52	22:18	23:27	23:08	21:43	20:01	18:22	15:50	14:58
15	09:41	08:21	06:52	06:09	04:36	03:35	04:06	05:30	06:53	08:14	08:43	09:53
	15:40	17:10	18:30	20:55	22:20	23:28	23:06	21:39	19:58	18:19	15:47	14:58
16	09:39	08:18	06:49	06:06	04:34	03:35	04:09	05:33	06:56	08:16	08:46	09:55
	15:42	17:13	18:33	20:58	22:23	23:29	23:03	21:36	19:55	18:16	15:45	14:58
17	09:37	08:15	06:45	06:03	04:31	03:34	04:11	05:35	06:59	08:19	08:49	09:56
	15:45	17:16	18:35	21:01	22:26	23:30	23:01	21:33	19:51	18:13	15:42	14:57
18	09:35	08:12	06:42	06:00	04:28	03:34	04:14	05:38	07:01	08:22	08:51	09:57
	15:48	17:19	18:38	21:03	22:29	23:30	22:59	21:30	19:48	18:10	15:40	14:57
19	09:33	08:09	06:39	05:56	04:25	03:34	04:16	05:41	07:04	08:25	08:54	09:58
	15:50	17:22	18:41	21:06	22:31	23:31	22:56	21:27	19:45	18:06	15:37	14:58
20	09:31	08:06	06:35	05:53	04:23	03:33	04:19	05:44	07:07	08:28	08:57	09:59
	15:53	17:25	18:44	21:09	22:34	23:31	22:54	21:23	19:41	18:03	15:35	14:58
21	09:29	08:03	06:32	05:50	04:20	03:33	04:21	05:46	07:09	08:30	09:00	09:59
	15:56	17:28	18:46	21:12	22:37	23:32	22:52	21:20	19:38	18:00	15:33	14:58
22	09:27	08:00	06:29	05:47	04:18	03:34	04:24	05:49	07:12	08:33	09:03	10:00
	15:59	17:31	18:49	21:15	22:40	23:32	22:49	21:17	19:35	17:57	15:30	14:58
23	09:24	07:57	06:25	05:43	04:15	03:34	04:26	05:52	07:15	08:36	09:05	10:00
	16:02	17:34	18:52	21:18	22:42	23:32	22:46	21:14	19:31	17:54	15:28	14:59
24	09:22	07:54	06:22	05:40	04:13	03:34	04:29	05:55	07:17	08:39	09:08	10:01
	16:05	17:36	18:55	21:20	22:45	23:32	22:44	21:11	19:28	17:51	15:26	15:00
25	09:20	07:50	06:19	05:37	04:10	03:35	04:32	05:57	07:20	07:42	09:11	10:01
	16:08	17:39	18:57	21:23	22:47	23:32	22:41	21:07	19:25	16:48	15:24	15:00
26	09:17	07:47	06:16	05:34	04:08	03:35	04:34	06:00	07:22	07:45	09:14	10:01
	16:10	17:42	19:00	21:26	22:50	23:31	22:39	21:04	19:21	16:44	15:22	15:01
27	09:15	07:44	06:12	05:31	04:05	03:36	04:37	06:03	07:25	07:47	09:16	10:01
	16:13	17:45	19:03	21:29	22:53	23:31	22:36	21:01	19:18	16:41	15:20	15:02
28	09:12	07:41	06:09	05:28	04:03	03:37	04:40	06:06	07:28	07:50	09:19	10:01
	16:16	17:48	19:05	21:32	22:55	23:30	22:33	20:58	19:15	16:38	15:18	15:03
29	09:10	07:06	05:24	04:01	03:38	04:43	06:08	07:30	07:53	09:21	10:01	10:01
	16:19	17:51	19:08	21:35	22:57	23:30	22:30	20:54	19:11	16:35	15:16	15:05
30	09:07	07:02	05:21	03:59	03:39	03:39	04:45	06:11	07:33	07:56	09:24	10:01
	16:22	17:54	19:11	21:37	23:00	23:29	22:28	20:51	19:08	16:32	15:14	15:06
31	09:04	06:59	05:19	03:57	03:02	03:02	04:48	06:14	07:59	08:22	09:50	10:00
	16:25	17:56	19:13	21:40	23:03	23:32	22:25	20:48	16:29	15:11	15:07	15:07
Potential sun hours	190	246	364	444	552	592	584	498	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: E - Lomarakenus (Sotkankangas I)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:02	07:38	06:56	05:18	03:55	03:40	04:51	06:16	07:36	08:02	09:26
	15:10	16:28	17:51	20:16	21:40	23:04	23:28	22:22	20:44	19:05	16:26	15:13
2	09:59	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:38	08:05	09:29
	15:11	16:31	17:54	20:19	21:43	23:06	23:27	22:19	20:41	19:01	16:24	15:11
3	09:58	08:56	07:31	06:49	05:12	03:51	03:43	04:56	06:22	07:41	08:08	09:31
	15:13	16:34	17:57	20:22	21:46	23:09	23:26	22:16	20:38	18:58	16:21	15:10
4	09:57	08:53	07:28	06:46	05:09	03:49	03:45	04:59	06:24	07:44	08:11	09:33
	15:15	16:37	17:59	20:25	21:49	23:11	23:25	22:13	20:34	18:55	16:18	15:08
5	09:56	08:51	07:25	06:42	05:06	03:47	03:46	05:02	06:27	07:46	08:14	09:35
	15:17	16:40	18:02	20:27	21:52	23:13	23:23	22:10	20:31	18:52	16:15	15:07
6	09:55	08:48	07:21	06:39	05:03	03:46	03:48	05:05	06:30	07:49	08:16	09:38
	15:19	16:43	18:05	20:30	21:55	23:15	23:22	22:07	20:28	18:48	16:12	15:05
7	09:54	08:45	07:18	06:36	05:00	03:44	03:50	05:08	06:32	07:52	08:19	09:40
	15:21	16:46	18:08	20:33	21:57	23:16	23:20	22:04	20:25	18:45	16:09	15:04
8	09:52	08:42	07:15	06:32	04:57	03:43	03:52	05:10	06:35	07:54	08:22	09:42
	15:23	16:49	18:11	20:36	22:00	23:18	23:19	22:01	20:21	18:42	16:06	15:03
9	09:51	08:39	07:12	06:29	04:54	03:41	03:54	05:13	06:38	07:57	08:25	09:44
	15:25	16:52	18:13	20:38	22:03	23:20	23:17	21:58	20:18	18:39	16:03	15:02
10	09:50	08:36	07:08	06:26	04:51	03:40	03:56	05:16	06:40	08:00	08:28	09:45
	15:27	16:55	18:16	20:41	22:06	23:21	23:15	21:55	20:15	18:35	16:01	15:01
11	09:48	08:33	07:05	06:23	04:48	03:39	03:58	05:19	06:43	08:03	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:23	23:14	21:52	20:11	18:32	15:58	15:00
12	09:47	08:30	07:02	06:19	04:45	03:38	04:00	05:22	06:46	08:05	08:34	09:49
	15:32	17:01	18:22	20:47	22:12	23:24	23:12	21:49	20:08	18:29	15:55	15:00
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14	09:43	08:24	06:55	06:13	04:39	03:36	04:04	05:27	06:51	08:11	08:40	09:52
	15:37	17:07	18:27	20:52	22:17	23:27	23:08	21:42	20:01	18:22	15:50	14:58
15	09:41	08:21	06:52	06:09	04:37	03:35	04:07	05:30	06:54	08:14	08:43	09:53
	15:40	17:10	18:30	20:55	22:20	23:28	23:05	21:39	19:58	18:19	15:47	14:58
16	09:39	08:18	06:49	06:06	04:34	03:35	04:09	05:33	06:56	08:16	08:46	09:55
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18	09:35	08:12	06:42	06:00	04:28	03:34	04:14	05:38	07:01	08:22	08:51	09:57
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	15:56	17:28	18:46	21:12	22:37	23:32	22:51	21:20	19:38	18:00	15:33	14:58
22	09:27	08:00	06:29	05:47	04:18	03:34	04:24	05:49	07:12	08:33	09:03	10:00
	15:59	17:31	18:49	21:15	22:39	23:32	22:49	21:17	19:35	17:57	15:31	14:59
23	09:24	07:57	06:25	05:43	04:15	03:34	04:26	05:52	07:15	08:36	09:05	10:00
	16:02	17:34	18:52	21:17	22:42	23:32	22:46	21:14	19:31	17:54	15:28	14:59
24	09:22	07:54	06:22	05:40	04:13	03:34	04:29	05:55	07:17	08:39	09:08	10:01
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26	09:17	07:47	06:16	05:34	04:08	03:36	04:34	06:00	07:22	07:45	09:13	10:01
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	16:25	17:54	19:12	21:40	23:02	23:28	22:25	20:48	16:29	15:14	15:08	15:08
Potential sun hours	190	246	364	444	551	592	584	498	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: F - Lomarakenus (Sotkankangas II)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:02	07:38	06:56	05:18	03:55	03:40	04:51	06:16	07:36	08:02	09:26
	15:10	16:28	17:51	20:16	21:40	23:04	23:28	22:22	20:44	19:05	16:26	15:13
2	09:59	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:38	08:05	09:29
	15:11	16:31	17:54	20:19	21:43	23:06	23:27	22:19	20:41	19:01	16:24	15:11
3	09:58	08:56	07:31	06:49	05:12	03:51	03:43	04:56	06:22	07:41	08:08	09:31
	15:13	16:34	17:57	20:22	21:46	23:09	23:26	22:16	20:38	18:58	16:21	15:10
4	09:57	08:53	07:28	06:46	05:09	03:49	03:45	04:59	06:24	07:44	08:11	09:33
	15:15	16:37	17:59	20:25	21:49	23:11	23:25	22:13	20:34	18:55	16:18	15:08
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7	09:54	08:45	07:18	06:36	05:00	03:44	03:50	05:08	06:32	07:52	08:19	09:40
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8	09:52	08:42	07:15	06:32	04:57	03:43	03:52	05:10	06:35	07:54	08:22	09:42
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11	09:48	08:33	07:05	06:23	04:48	03:39	03:58	05:19	06:43	08:03	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:23	23:14	21:52	20:11	18:32	15:58	15:00
12	09:46	08:30	07:02	06:19	04:45	03:38	04:00	05:22	06:46	08:05	08:34	09:49
	15:32	17:01	18:22	20:47	22:12	23:24	23:12	21:49	20:08	18:29	15:55	15:00
13	09:45	08:27	06:59	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:37	09:50
	15:35	17:04	18:24	20:49	22:15	23:26	23:10	21:46	20:05	18:26	15:53	14:59
14	09:43	08:24	06:55	06:13	04:39	03:36	04:04	05:27	06:51	08:11	08:40	09:52
	15:37	17:07	18:27	20:52	22:17	23:27	23:08	21:42	20:01	18:22	15:50	14:59
15	09:41	08:21	06:52	06:09	04:37	03:36	04:07	05:30	06:54	08:14	08:43	09:53
	15:40	17:10	18:30	20:55	22:20	23:28	23:05	21:39	19:58	18:19	15:48	14:58
16	09:39	08:18	06:49	06:06	04:34	03:35	04:09	05:33	06:56	08:16	08:46	09:55
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	15:56	17:28	18:46	21:12	22:37	23:32	22:51	21:20	19:38	18:00	15:33	14:58
22	09:27	08:00	06:29	05:47	04:18	03:34	04:24	05:49	07:12	08:33	09:03	10:00
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23	09:24	07:57	06:25	05:43	04:15	03:34	04:27	05:52	07:15	08:36	09:05	10:00
	16:02	17:34	18:52	21:17	22:42	23:32	22:46	21:14	19:31	17:54	15:28	14:59
24	09:22	07:53	06:22	05:40	04:13	03:34	04:29	05:55	07:17	08:39	09:08	10:01
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25	09:20	07:50	06:19	05:37	04:10	03:35	04:32	05:57	07:20	07:42	09:11	10:01
	16:08	17:39	18:57	21:23	22:47	23:32	22:41	21:07	19:25	16:48	15:24	15:01
26	09:17	07:47	06:16	05:34	04:08	03:36	04:35	06:00	07:22	07:45	09:13	10:01
	16:11	17:42	19:00	21:26	22:50	23:31	22:38	21:04	19:21	16:45	15:22	15:01
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	16:19	17:49	19:06	21:35	22:57	23:30	22:30	20:54	19:11	16:35	15:16	15:05
30	09:07	07:02	05:21	03:59	03:39	03:39	04:45	06:11	07:33	07:56	09:24	10:00
	16:22	17:49	19:06	21:37	23:00	23:29	22:27	20:51	19:08	16:32	15:15	15:06
31	09:04	06:59	05:19	03:57	03:32	03:32	04:48	06:14	07:35	07:59	09:27	10:00
	16:25	17:49	19:06	21:37	23:00	23:29	22:25	20:48	16:29	15:15	15:08	15:08
Potential sun hours	190	246	364	444	551	592	584	498	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: G - Lomarakennus (Sotkankangas III)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:02	07:38	06:56	05:18	03:55	03:41	04:51	06:16	07:36	08:02	09:26
	15:10	16:28	17:51	20:16	21:40	23:04	23:28	22:22	20:44	19:05	16:26	15:13
2	09:59	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:38	08:05	09:29
	15:11	16:31	17:54	20:19	21:43	23:06	23:27	22:19	20:41	19:01	16:24	15:11
3	09:58	08:56	07:31	06:49	05:12	03:51	03:43	04:57	06:22	07:41	08:08	09:31
	15:13	16:34	17:57	20:22	21:46	23:09	23:26	22:16	20:38	18:58	16:21	15:10
4	09:57	08:53	07:28	06:46	05:09	03:49	03:45	04:59	06:24	07:44	08:11	09:33
	15:15	16:37	17:59	20:25	21:49	23:11	23:25	22:13	20:34	18:55	16:18	15:08
5	09:56	08:51	07:25	06:42	05:06	03:48	03:46	05:02	06:27	07:46	08:13	09:35
	15:17	16:40	18:02	20:27	21:52	23:13	23:23	22:10	20:31	18:52	16:15	15:07
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	15:19	16:43	18:05	20:30	21:55	23:15	23:22	22:07	20:28	18:48	16:12	15:05
7	09:54	08:45	07:18	06:36	05:00	03:44	03:50	05:08	06:32	07:52	08:19	09:40
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9	09:51	08:39	07:12	06:29	04:54	03:42	03:54	05:13	06:38	07:57	08:25	09:44
	15:25	16:52	18:13	20:38	22:03	23:20	23:17	21:58	20:18	18:39	16:04	15:02
10	09:50	08:36	07:08	06:26	04:51	03:40	03:56	05:16	06:40	08:00	08:28	09:45
	15:28	16:55	18:16	20:41	22:06	23:21	23:15	21:55	20:15	18:35	16:01	15:01
11	09:48	08:33	07:05	06:23	04:48	03:39	03:58	05:19	06:43	08:03	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:23	23:14	21:52	20:11	18:32	15:58	15:00
12	09:46	08:30	07:02	06:19	04:45	03:38	04:00	05:22	06:46	08:05	08:34	09:49
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13	09:45	08:27	06:59	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:37	09:50
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14	09:43	08:24	06:55	06:13	04:39	03:36	04:04	05:27	06:51	08:11	08:40	09:52
	15:37	17:07	18:27	20:52	22:17	23:27	23:08	21:42	20:01	18:22	15:50	14:59
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20	09:31	08:06	06:35	05:53	04:23	03:34	04:19	05:44	07:07	08:28	08:57	09:58
	15:53	17:25	18:44	21:09	22:34	23:31	22:54	21:23	19:41	18:03	15:35	14:58
21	09:29	08:03	06:32	05:50	04:20	03:34	04:21	05:47	07:09	08:30	09:00	09:59
	15:56	17:28	18:46	21:12	22:37	23:32	22:51	21:20	19:38	18:00	15:33	14:58
22	09:27	08:00	06:29	05:47	04:18	03:34	04:24	05:49	07:12	08:33	09:03	10:00
	15:59	17:31	18:49	21:15	22:39	23:32	22:49	21:17	19:35	17:57	15:31	14:59
23	09:24	07:57	06:26	05:44	04:15	03:34	04:27	05:52	07:15	08:36	09:05	10:00
	16:02	17:34	18:52	21:17	22:42	23:32	22:46	21:14	19:31	17:54	15:28	14:59
24	09:22	07:54	06:22	05:40	04:13	03:35	04:29	05:55	07:17	08:39	09:08	10:01
	16:05	17:37	18:55	21:20	22:45	23:32	22:44	21:11	19:28	17:51	15:26	15:00
25	09:20	07:50	06:19	05:37	04:10	03:35	04:32	05:58	07:20	07:42	09:11	10:01
	16:08	17:39	18:57	21:23	22:47	23:32	22:41	21:07	19:25	16:48	15:24	15:01
26	09:17	07:47	06:16	05:34	04:08	03:36	04:35	06:00	07:22	07:45	09:13	10:01
	16:11	17:42	19:00	21:26	22:50	23:31	22:38	21:04	19:21	16:45	15:22	15:01
27	09:15	07:44	06:12	05:31	04:06	03:36	04:37	06:03	07:25	07:47	09:16	10:01
	16:14	17:45	19:03	21:29	22:52	23:31	22:36	21:01	19:18	16:42	15:20	15:02
28	09:12	07:41	06:09	05:28	04:03	03:37	04:40	06:06	07:28	07:50	09:19	10:01
	16:17	17:48	19:06	21:32	22:55	23:30	22:33	20:57	19:15	16:38	15:18	15:04
29	09:10	07:06	05:24	04:01	03:38	04:43	06:08	07:30	07:53	09:21	10:01	10:01
	16:19	17:49	19:07	21:35	22:57	23:30	22:30	20:54	19:11	16:35	15:16	15:05
30	09:07	07:02	05:21	03:59	03:39	03:39	04:45	06:11	07:33	07:56	09:24	10:00
	16:22	17:51	19:09	21:37	23:00	23:29	22:27	20:51	19:08	16:32	15:15	15:06
31	09:04	06:59	05:19	03:57	03:32	03:32	04:48	06:14	07:36	07:59	09:27	10:00
	16:25	17:54	19:12	21:40	23:02	23:31	22:25	20:48	16:29	15:14	15:08	15:08
Potential sun hours	190	246	364	444	551	592	584	498	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: H - Lomarakenus (Ruostetuoma)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

### Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:01	07:37	06:55	05:18	03:55	03:40	04:51	06:16	07:35	08:02	09:26
	15:09	16:28	17:51	20:16	21:40	23:04	23:28	22:21	20:44	19:05	16:26	15:13
2	09:58	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:38	08:04	09:28
	15:11	16:31	17:53	20:19	21:43	23:06	23:27	22:19	20:41	19:01	16:23	15:11
3	09:57	08:56	07:31	06:49	05:12	03:51	03:43	04:56	06:22	07:41	08:07	09:31
	15:13	16:34	17:56	20:22	21:46	23:08	23:25	22:16	20:37	18:58	16:20	15:09
4	09:57	08:53	07:28	06:45	05:09	03:49	03:45	04:59	06:24	07:43	08:10	09:33
	15:15	16:37	17:59	20:24	21:49	23:10	23:24	22:13	20:34	18:55	16:17	15:08
5	09:56	08:50	07:24	06:42	05:06	03:47	03:46	05:02	06:27	07:46	08:13	09:35
	15:17	16:40	18:02	20:27	21:51	23:12	23:23	22:10	20:31	18:51	16:15	15:07
6	09:55	08:47	07:21	06:39	05:03	03:46	03:48	05:05	06:29	07:49	08:16	09:37
	15:19	16:43	18:05	20:30	21:54	23:14	23:22	22:07	20:28	18:48	16:12	15:05
7	09:53	08:45	07:18	06:35	05:00	03:44	03:50	05:07	06:32	07:52	08:19	09:39
	15:21	16:46	18:08	20:33	21:57	23:16	23:20	22:04	20:24	18:45	16:09	15:04
8	09:52	08:42	07:15	06:32	04:57	03:43	03:51	05:10	06:35	07:54	08:22	09:41
	15:23	16:49	18:10	20:35	22:00	23:18	23:18	22:01	20:21	18:42	16:06	15:03
9	09:51	08:39	07:11	06:29	04:54	03:41	03:53	05:13	06:37	07:57	08:25	09:43
	15:25	16:52	18:13	20:38	22:03	23:19	23:17	21:58	20:18	18:38	16:03	15:02
10	09:49	08:36	07:08	06:26	04:51	03:40	03:55	05:16	06:40	08:00	08:28	09:45
	15:27	16:55	18:16	20:41	22:06	23:21	23:15	21:55	20:14	18:35	16:01	15:01
11	09:48	08:33	07:05	06:22	04:48	03:39	03:57	05:19	06:43	08:02	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:23	23:13	21:51	20:11	18:32	15:58	15:00
12	09:46	08:30	07:02	06:19	04:45	03:38	04:00	05:21	06:45	08:05	08:34	09:49
	15:32	17:01	18:21	20:46	22:11	23:24	23:11	21:48	20:08	18:29	15:55	14:59
13	09:44	08:27	06:58	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:37	09:50
	15:35	17:04	18:24	20:49	22:14	23:25	23:09	21:45	20:04	18:25	15:52	14:59
14	09:43	08:24	06:55	06:12	04:39	03:36	04:04	05:27	06:51	08:11	08:39	09:52
	15:37	17:07	18:27	20:52	22:17	23:26	23:07	21:42	20:01	18:22	15:50	14:58
15	09:41	08:21	06:52	06:09	04:36	03:35	04:06	05:30	06:53	08:13	08:42	09:53
	15:40	17:10	18:30	20:55	22:20	23:27	23:05	21:39	19:58	18:19	15:47	14:58
16	09:39	08:18	06:48	06:06	04:34	03:35	04:09	05:33	06:56	08:16	08:45	09:54
	15:42	17:13	18:32	20:58	22:23	23:28	23:03	21:36	19:54	18:16	15:45	14:58
17	09:37	08:15	06:45	06:03	04:31	03:34	04:11	05:35	06:59	08:19	08:48	09:55
	15:45	17:16	18:35	21:00	22:25	23:29	23:01	21:33	19:51	18:13	15:42	14:57
18	09:35	08:12	06:42	05:59	04:28	03:34	04:14	05:38	07:01	08:22	08:51	09:56
	15:48	17:19	18:38	21:03	22:28	23:30	22:58	21:29	19:48	18:09	15:40	14:57
19	09:33	08:09	06:38	05:56	04:25	03:34	04:16	05:41	07:04	08:24	08:54	09:57
	15:50	17:22	18:41	21:06	22:31	23:30	22:56	21:26	19:44	18:06	15:37	14:58
20	09:31	08:06	06:35	05:53	04:23	03:34	04:19	05:44	07:06	08:27	08:57	09:58
	15:53	17:25	18:43	21:09	22:34	23:31	22:54	21:23	19:41	18:03	15:35	14:58
21	09:29	08:03	06:32	05:50	04:20	03:34	04:21	05:46	07:09	08:30	08:59	09:59
	15:56	17:28	18:46	21:12	22:36	23:31	22:51	21:20	19:38	18:00	15:33	14:58
22	09:26	07:59	06:29	05:46	04:18	03:34	04:24	05:49	07:12	08:33	09:02	09:59
	15:59	17:31	18:49	21:14	22:39	23:31	22:49	21:17	19:34	17:57	15:30	14:58
23	09:24	07:56	06:25	05:43	04:15	03:34	04:26	05:52	07:14	08:36	09:05	10:00
	16:02	17:33	18:52	21:17	22:42	23:31	22:46	21:13	19:31	17:54	15:28	14:59
24	09:22	07:53	06:22	05:40	04:13	03:34	04:29	05:55	07:17	08:39	09:08	10:00
	16:05	17:36	18:54	21:20	22:44	23:31	22:43	21:10	19:28	17:50	15:26	15:00
25	09:19	07:50	06:19	05:37	04:10	03:35	04:32	05:57	07:20	07:41	09:10	10:01
	16:07	17:39	18:57	21:23	22:47	23:31	22:41	21:07	19:24	16:47	15:24	15:00
26	09:17	07:47	06:15	05:34	04:08	03:35	04:34	06:00	07:22	07:44	09:13	10:01
	16:10	17:42	19:00	21:26	22:50	23:31	22:38	21:04	19:21	16:44	15:22	15:01
27	09:14	07:44	06:12	05:31	04:05	03:36	04:37	06:03	07:25	07:47	09:16	10:01
	16:13	17:45	19:02	21:29	22:52	23:30	22:35	21:00	19:18	16:41	15:20	15:02
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	16:16	17:48	19:05	21:31	22:54	23:30	22:33	20:57	19:14	16:38	15:18	15:03
29	09:09	07:05	05:24	04:01	03:38	04:42	06:08	07:30	07:53	09:21	10:00	
	16:19	17:48	19:05	21:34	22:57	23:29	22:30	20:54	19:11	16:35	15:16	15:05
30	09:07	07:02	05:21	03:59	03:39	03:39	04:45	06:11	07:33	07:56	09:23	10:00
	16:22	17:48	19:05	21:37	22:59	23:28	22:27	20:51	19:08	16:32	15:14	15:06
31	09:04	06:59	05:19	03:57	03:32	03:32	04:48	06:13	07:35	07:59	09:26	10:00
	16:25	17:48	19:05	21:37	22:59	23:28	22:24	20:47	16:29	15:14	15:06	15:07
Potential sun hours	190	246	364	444	551	592	584	498	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: I - Lomarakennus (Heikinkankaantie 135)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:01	07:37	06:55	05:18	03:55	03:40	04:51	06:16	07:35	08:01	09:26
	15:09	16:28	17:51	20:16	21:40	23:04	23:28	22:21	20:44	19:04	16:26	15:13
2	09:58	08:59	07:34	06:52	05:15	03:53	03:42	04:53	06:19	07:38	08:04	09:28
	15:11	16:31	17:53	20:19	21:43	23:06	23:27	22:18	20:41	19:01	16:23	15:11
3	09:57	08:56	07:31	06:49	05:12	03:51	03:43	04:56	06:21	07:41	08:07	09:31
	15:13	16:34	17:56	20:22	21:46	23:08	23:25	22:16	20:37	18:58	16:20	15:09
4	09:57	08:53	07:28	06:45	05:09	03:49	03:44	04:59	06:24	07:43	08:10	09:33
	15:15	16:37	17:59	20:24	21:49	23:10	23:24	22:13	20:34	18:55	16:17	15:08
5	09:56	08:50	07:24	06:42	05:06	03:47	03:46	05:02	06:27	07:46	08:13	09:35
	15:16	16:40	18:02	20:27	21:51	23:12	23:23	22:10	20:31	18:51	16:15	15:07
6	09:54	08:47	07:21	06:39	05:03	03:46	03:48	05:05	06:29	07:49	08:16	09:37
	15:18	16:43	18:05	20:30	21:54	23:14	23:21	22:07	20:27	18:48	16:12	15:05
7	09:53	08:45	07:18	06:35	05:00	03:44	03:50	05:07	06:32	07:51	08:19	09:39
	15:21	16:46	18:07	20:33	21:57	23:16	23:20	22:04	20:24	18:45	16:09	15:04
8	09:52	08:42	07:15	06:32	04:57	03:43	03:51	05:10	06:35	07:54	08:22	09:41
	15:23	16:49	18:10	20:35	22:00	23:18	23:18	22:01	20:21	18:41	16:06	15:03
9	09:51	08:39	07:11	06:29	04:54	03:41	03:53	05:13	06:37	07:57	08:25	09:43
	15:25	16:52	18:13	20:38	22:03	23:19	23:17	21:58	20:18	18:38	16:03	15:02
10	09:49	08:36	07:08	06:26	04:51	03:40	03:55	05:16	06:40	08:00	08:28	09:45
	15:27	16:55	18:16	20:41	22:06	23:21	23:15	21:55	20:14	18:35	16:00	15:01
11	09:48	08:33	07:05	06:22	04:48	03:39	03:57	05:19	06:43	08:02	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:22	23:13	21:51	20:11	18:32	15:58	15:00
12	09:46	08:30	07:02	06:19	04:45	03:38	04:00	05:21	06:45	08:05	08:34	09:48
	15:32	17:01	18:21	20:46	22:11	23:24	23:11	21:48	20:08	18:28	15:55	14:59
13	09:44	08:27	06:58	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:36	09:50
	15:35	17:04	18:24	20:49	22:14	23:25	23:09	21:45	20:04	18:25	15:52	14:59
14	09:43	08:24	06:55	06:12	04:39	03:36	04:04	05:27	06:51	08:10	08:39	09:51
	15:37	17:07	18:27	20:52	22:17	23:26	23:07	21:42	20:01	18:22	15:50	14:58
15	09:41	08:21	06:52	06:09	04:36	03:35	04:06	05:30	06:53	08:13	08:42	09:53
	15:40	17:10	18:30	20:55	22:20	23:27	23:05	21:39	19:58	18:19	15:47	14:58
16	09:39	08:18	06:48	06:06	04:33	03:35	04:09	05:32	06:56	08:16	08:45	09:54
	15:42	17:13	18:32	20:57	22:23	23:28	23:03	21:36	19:54	18:16	15:45	14:58
17	09:37	08:15	06:45	06:03	04:31	03:34	04:11	05:35	06:58	08:19	08:48	09:55
	15:45	17:16	18:35	21:00	22:25	23:29	23:01	21:33	19:51	18:12	15:42	14:57
18	09:35	08:12	06:42	05:59	04:28	03:34	04:14	05:38	07:01	08:22	08:51	09:56
	15:48	17:19	18:38	21:03	22:28	23:30	22:58	21:29	19:48	18:09	15:40	14:57
19	09:33	08:09	06:38	05:56	04:25	03:34	04:16	05:41	07:04	08:24	08:54	09:57
	15:50	17:22	18:41	21:06	22:31	23:30	22:56	21:26	19:44	18:06	15:37	14:57
20	09:31	08:06	06:35	05:53	04:23	03:33	04:19	05:44	07:06	08:27	08:57	09:58
	15:53	17:25	18:43	21:09	22:34	23:31	22:54	21:23	19:41	18:03	15:35	14:58
21	09:28	08:03	06:32	05:50	04:20	03:33	04:21	05:46	07:09	08:30	08:59	09:59
	15:56	17:28	18:46	21:11	22:36	23:31	22:51	21:20	19:38	18:00	15:33	14:58
22	09:26	07:59	06:28	05:46	04:17	03:34	04:24	05:49	07:12	08:33	09:02	09:59
	15:59	17:30	18:49	21:14	22:39	23:31	22:49	21:17	19:34	17:57	15:30	14:58
23	09:24	07:56	06:25	05:43	04:15	03:34	04:26	05:52	07:14	08:36	09:05	10:00
	16:02	17:33	18:52	21:17	22:42	23:31	22:46	21:13	19:31	17:54	15:28	14:59
24	09:22	07:53	06:22	05:40	04:12	03:34	04:29	05:54	07:17	08:38	09:08	10:00
	16:05	17:36	18:54	21:20	22:44	23:31	22:43	21:10	19:28	17:50	15:26	15:00
25	09:19	07:50	06:19	05:37	04:10	03:35	04:32	05:57	07:19	07:41	09:10	10:00
	16:07	17:39	18:57	21:23	22:47	23:31	22:41	21:07	19:24	16:47	15:24	15:00
26	09:17	07:47	06:15	05:34	04:08	03:35	04:34	06:00	07:22	07:44	09:13	10:01
	16:10	17:42	19:00	21:26	22:49	23:31	22:38	21:04	19:21	16:44	15:22	15:01
27	09:14	07:44	06:12	05:30	04:05	03:36	04:37	06:03	07:25	07:47	09:16	10:01
	16:13	17:45	19:02	21:28	22:52	23:30	22:35	21:00	19:18	16:41	15:20	15:02
28	09:12	07:40	06:09	05:27	04:03	03:37	04:40	06:05	07:27	07:50	09:18	10:01
	16:16	17:48	19:05	21:31	22:54	23:30	22:33	20:57	19:14	16:38	15:18	15:03
29	09:09	07:05	05:24	04:01	03:38	04:42	06:08	07:30	07:53	09:21	10:00	
	16:19	17:51	19:08	21:34	22:57	23:29	22:30	20:54	19:11	16:35	15:16	15:05
30	09:07	07:02	05:21	03:59	03:39	03:39	04:45	06:11	07:33	07:56	09:23	10:00
	16:22	17:54	19:11	21:37	22:59	23:28	22:27	20:51	19:08	16:32	15:14	15:06
31	09:04	06:59	05:19	03:57	03:32	03:32	04:48	06:13	07:35	07:59	09:26	10:00
	16:25	17:56	19:13	21:40	23:02	23:24	22:24	20:47	16:29	15:07	15:07	
Potential sun hours	190	246	364	444	551	592	584	498	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: J - Lomarakennus (Pukinharju)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:01	07:37	06:55	05:18	03:55	03:41	04:51	06:16	07:35	08:01	09:26
	15:10	16:28	17:51	20:16	21:40	23:04	23:27	22:21	20:44	19:05	16:26	15:13
2	09:58	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:38	08:04	09:28
	15:11	16:31	17:53	20:19	21:43	23:06	23:26	22:18	20:41	19:01	16:23	15:11
3	09:57	08:56	07:31	06:49	05:12	03:51	03:43	04:56	06:22	07:41	08:07	09:31
	15:13	16:34	17:56	20:22	21:46	23:08	23:25	22:16	20:37	18:58	16:20	15:10
4	09:56	08:53	07:28	06:45	05:09	03:49	03:45	04:59	06:24	07:43	08:10	09:33
	15:15	16:37	17:59	20:24	21:49	23:10	23:24	22:13	20:34	18:55	16:18	15:08
5	09:55	08:50	07:24	06:42	05:06	03:47	03:46	05:02	06:27	07:46	08:13	09:35
	15:17	16:40	18:02	20:27	21:51	23:12	23:23	22:10	20:31	18:51	16:15	15:07
6	09:54	08:47	07:21	06:39	05:03	03:46	03:48	05:05	06:30	07:49	08:16	09:37
	15:19	16:43	18:05	20:30	21:54	23:14	23:21	22:07	20:28	18:48	16:12	15:05
7	09:53	08:45	07:18	06:36	05:00	03:44	03:50	05:08	06:32	07:52	08:19	09:39
	15:21	16:46	18:08	20:33	21:57	23:16	23:20	22:04	20:24	18:45	16:09	15:04
8	09:52	08:42	07:15	06:32	04:57	03:43	03:52	05:10	06:35	07:54	08:22	09:41
	15:23	16:49	18:10	20:35	22:00	23:18	23:18	22:01	20:21	18:42	16:06	15:03
9	09:51	08:39	07:11	06:29	04:54	03:42	03:54	05:13	06:37	07:57	08:25	09:43
	15:25	16:52	18:13	20:38	22:03	23:19	23:17	21:58	20:18	18:38	16:03	15:02
10	09:49	08:36	07:08	06:26	04:51	03:40	03:56	05:16	06:40	08:00	08:28	09:45
	15:27	16:55	18:16	20:41	22:06	23:21	23:15	21:55	20:14	18:35	16:01	15:01
11	09:48	08:33	07:05	06:22	04:48	03:39	03:58	05:19	06:43	08:02	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:22	23:13	21:51	20:11	18:32	15:58	15:00
12	09:46	08:30	07:02	06:19	04:45	03:38	04:00	05:22	06:45	08:05	08:34	09:48
	15:32	17:01	18:21	20:46	22:11	23:24	23:11	21:48	20:08	18:29	15:55	15:00
13	09:44	08:27	06:58	06:16	04:42	03:37	04:02	05:24	06:48	08:08	08:36	09:50
	15:35	17:04	18:24	20:49	22:14	23:25	23:09	21:45	20:04	18:25	15:53	14:59
14	09:43	08:24	06:55	06:13	04:39	03:36	04:04	05:27	06:51	08:11	08:39	09:51
	15:37	17:07	18:27	20:52	22:17	23:26	23:07	21:42	20:01	18:22	15:50	14:58
15	09:41	08:21	06:52	06:09	04:36	03:36	04:07	05:30	06:53	08:13	08:42	09:53
	15:40	17:10	18:30	20:55	22:20	23:27	23:05	21:39	19:58	18:19	15:47	14:58
16	09:39	08:18	06:48	06:06	04:34	03:35	04:09	05:33	06:56	08:16	08:45	09:54
	15:42	17:13	18:32	20:57	22:23	23:28	23:03	21:36	19:54	18:16	15:45	14:58
17	09:37	08:15	06:45	06:03	04:31	03:34	04:11	05:35	06:59	08:19	08:48	09:55
	15:45	17:16	18:35	21:00	22:25	23:29	23:01	21:33	19:51	18:13	15:42	14:58
18	09:35	08:12	06:42	05:59	04:28	03:34	04:14	05:38	07:01	08:22	08:51	09:56
	15:48	17:19	18:38	21:03	22:28	23:30	22:58	21:29	19:48	18:09	15:40	14:58
19	09:33	08:09	06:39	05:56	04:26	03:34	04:16	05:41	07:04	08:24	08:54	09:57
	15:51	17:22	18:41	21:06	22:31	23:30	22:56	21:26	19:44	18:06	15:37	14:58
20	09:31	08:06	06:35	05:53	04:23	03:34	04:19	05:44	07:06	08:27	08:57	09:58
	15:53	17:25	18:43	21:09	22:34	23:31	22:53	21:23	19:41	18:03	15:35	14:58
21	09:28	08:03	06:32	05:50	04:20	03:34	04:21	05:46	07:09	08:30	08:59	09:59
	15:56	17:28	18:46	21:12	22:36	23:31	22:51	21:20	19:38	18:00	15:33	14:58
22	09:26	07:59	06:29	05:47	04:18	03:34	04:24	05:49	07:12	08:33	09:02	09:59
	15:59	17:31	18:49	21:14	22:39	23:31	22:48	21:17	19:34	17:57	15:31	14:59
23	09:24	07:56	06:25	05:43	04:15	03:34	04:26	05:52	07:14	08:36	09:05	10:00
	16:02	17:33	18:52	21:17	22:42	23:31	22:46	21:13	19:31	17:54	15:28	14:59
24	09:22	07:53	06:22	05:40	04:13	03:35	04:29	05:55	07:17	08:38	09:08	10:00
	16:05	17:36	18:54	21:20	22:44	23:31	22:43	21:10	19:28	17:51	15:26	15:00
25	09:19	07:50	06:19	05:37	04:10	03:35	04:32	05:57	07:20	07:41	09:10	10:00
	16:08	17:39	18:57	21:23	22:47	23:31	22:41	21:07	19:24	16:47	15:24	15:01
26	09:17	07:47	06:15	05:34	04:08	03:36	04:34	06:00	07:22	07:44	09:13	10:01
	16:10	17:42	19:00	21:26	22:49	23:31	22:38	21:04	19:21	16:44	15:22	15:01
27	09:14	07:44	06:12	05:31	04:06	03:36	04:37	06:03	07:25	07:47	09:16	10:01
	16:13	17:45	19:03	21:28	22:52	23:30	22:35	21:00	19:18	16:41	15:20	15:02
28	09:12	07:40	06:09	05:27	04:03	03:37	04:40	06:05	07:27	07:50	09:18	10:00
	16:16	17:48	19:05	21:31	22:54	23:30	22:33	20:57	19:14	16:38	15:18	15:04
29	09:09	07:05	05:24	04:01	03:38	04:43	06:08	07:30	07:53	09:21	10:00	
	16:19	17:51	19:08	21:34	22:57	23:29	22:30	20:54	19:11	16:35	15:16	15:05
30	09:07	07:02	05:21	03:59	03:39	03:39	04:45	06:11	07:33	07:56	09:23	10:00
	16:22	17:54	19:11	21:37	22:59	23:28	22:27	20:51	19:08	16:32	15:14	15:06
31	09:04	06:59	05:19	03:57	03:31	03:31	04:48	06:14	07:37	07:59	09:26	10:00
	16:25	17:56	19:13	21:40	23:01	23:24	22:24	20:47	16:29	15:01	13:44	15:08
Potential sun hours	190	246	364	444	551	592	584	497	391	310	212	161
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



## SHADOW - Calendar

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest lukeShadow receptor: K - Lomarakennus (Vähä Nummikangas)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,00 2,63 4,23 6,60 8,87 9,10 8,97 6,81 4,67 2,54 1,17 0,59

### Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
694 512 422 424 541 795 981 1 274 986 806 638 634 8 708  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	09:59	09:01	07:37	06:56	05:18	03:55	03:41	04:51	06:16	07:36	08:02	09:26
	15:10	16:28	17:51	20:16	21:40	23:04	23:27	22:21	20:44	19:05	16:26	15:13
2	09:58	08:59	07:34	06:52	05:15	03:53	03:42	04:54	06:19	07:38	08:04	09:28
	15:11	16:31	17:54	20:19	21:43	23:06	23:26	22:18	20:41	19:01	16:24	15:11
3	09:57	08:56	07:31	06:49	05:12	03:51	03:44	04:57	06:22	07:41	08:07	09:30
	15:13	16:34	17:56	20:22	21:46	23:08	23:25	22:16	20:38	18:58	16:21	15:10
4	09:56	08:53	07:28	06:46	05:09	03:50	03:45	04:59	06:24	07:44	08:10	09:33
	15:15	16:37	17:59	20:24	21:49	23:10	23:24	22:13	20:34	18:55	16:18	15:08
5	09:55	08:50	07:24	06:42	05:06	03:48	03:47	05:02	06:27	07:46	08:13	09:35
	15:17	16:40	18:02	20:27	21:51	23:12	23:23	22:10	20:31	18:52	16:15	15:07
6	09:54	08:47	07:21	06:39	05:03	03:46	03:48	05:05	06:30	07:49	08:16	09:37
	15:19	16:43	18:05	20:30	21:54	23:14	23:21	22:07	20:28	18:48	16:12	15:06
7	09:53	08:45	07:18	06:36	05:00	03:45	03:50	05:08	06:32	07:52	08:19	09:39
	15:21	16:46	18:08	20:33	21:57	23:16	23:20	22:04	20:24	18:45	16:09	15:04
8	09:52	08:42	07:15	06:32	04:57	03:43	03:52	05:11	06:35	07:54	08:22	09:41
	15:23	16:49	18:10	20:35	22:00	23:18	23:18	22:01	20:21	18:42	16:06	15:03
9	09:51	08:39	07:11	06:29	04:54	03:42	03:54	05:13	06:38	07:57	08:25	09:43
	15:25	16:52	18:13	20:38	22:03	23:19	23:17	21:58	20:18	18:38	16:04	15:02
10	09:49	08:36	07:08	06:26	04:51	03:41	03:56	05:16	06:40	08:00	08:28	09:45
	15:28	16:55	18:16	20:41	22:06	23:21	23:15	21:55	20:14	18:35	16:01	15:01
11	09:48	08:33	07:05	06:23	04:48	03:39	03:58	05:19	06:43	08:02	08:31	09:47
	15:30	16:58	18:19	20:44	22:09	23:22	23:13	21:51	20:11	18:32	15:58	15:01
12	09:46	08:30	07:02	06:19	04:45	03:38	04:00	05:22	06:46	08:05	08:34	09:48
	15:32	17:01	18:22	20:46	22:11	23:24	23:11	21:48	20:08	18:29	15:55	15:00
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14	09:43	08:24	06:55	06:13	04:40	03:37	04:05	05:27	06:51	08:11	08:39	09:51
	15:37	17:07	18:27	20:52	22:17	23:26	23:07	21:42	20:01	18:22	15:50	14:59
15	09:41	08:21	06:52	06:09	04:37	03:36	04:07	05:30	06:53	08:13	08:42	09:53
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18	09:35	08:12	06:42	06:00	04:28	03:34	04:14	05:38	07:01	08:22	08:51	09:56
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19	09:33	08:09	06:39	05:56	04:26	03:34	04:16	05:41	07:04	08:24	08:54	09:57
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20	09:31	08:06	06:35	05:53	04:23	03:34	04:19	05:44	07:07	08:27	08:57	09:58
	15:54	17:25	18:44	21:09	22:34	23:31	22:53	21:23	19:41	18:03	15:35	14:58
21	09:28	08:03	06:32	05:50	04:21	03:34	04:22	05:47	07:09	08:30	08:59	09:59
	15:56	17:28	18:46	21:12	22:36	23:31	22:51	21:20	19:38	18:00	15:33	14:58
22	09:26	08:00	06:29	05:47	04:18	03:34	04:24	05:49	07:12	08:33	09:02	09:59
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	16:11	17:42	19:00	21:26	22:49	23:31	22:38	21:04	19:21	16:45	15:22	15:02
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	16:23	17:54	19:11	21:37	22:59	23:28	22:27	20:51	19:08	16:32	15:15	15:06
31	09:04	06:59	05:19	03:57	03:01	04:48	06:14	07:35	07:59	09:26	10:00	
	16:25	17:56	19:13	21:40	23:01	23:24	22:24	20:47	16:29	15:12	15:08	
Potential sun hours	190	246	364	444	551	592	583	497	391	310	212	162
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

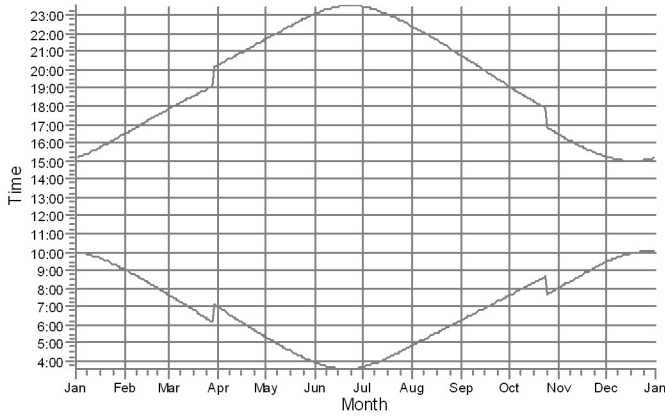
Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

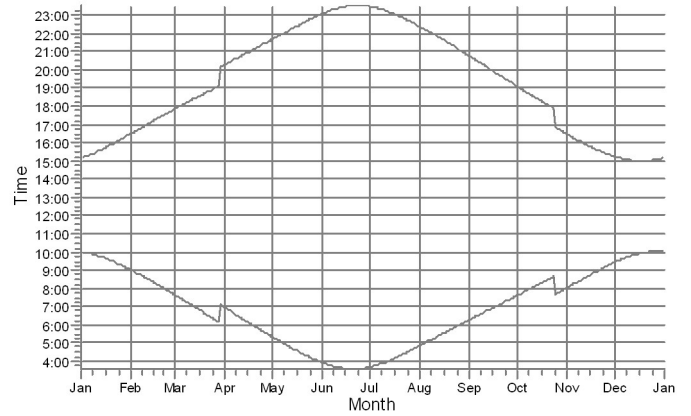
SHADOW - Calendar, graphical

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest luke

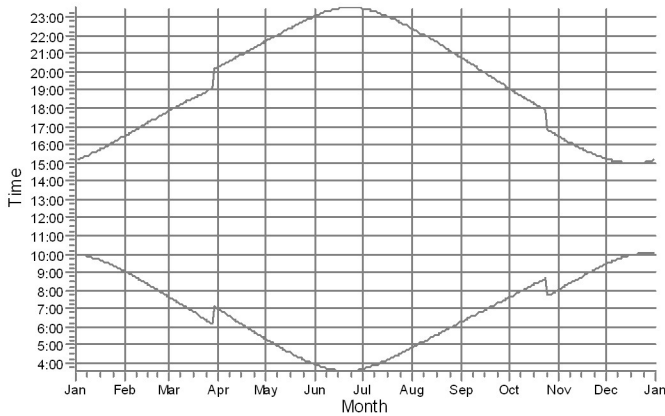
A: Lomarakenus (Perämäki)



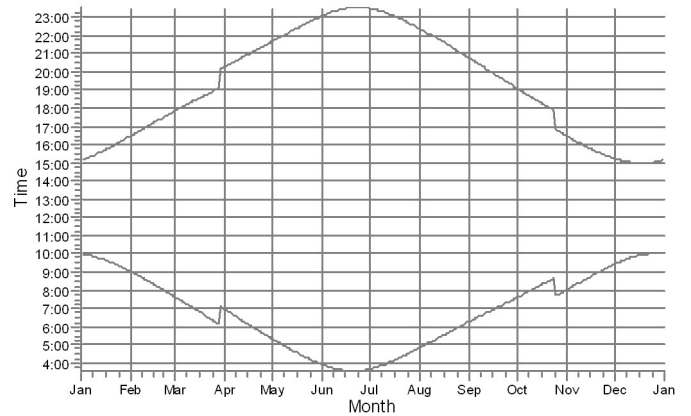
B: Lomarakenus (Nummikankaantie 218)



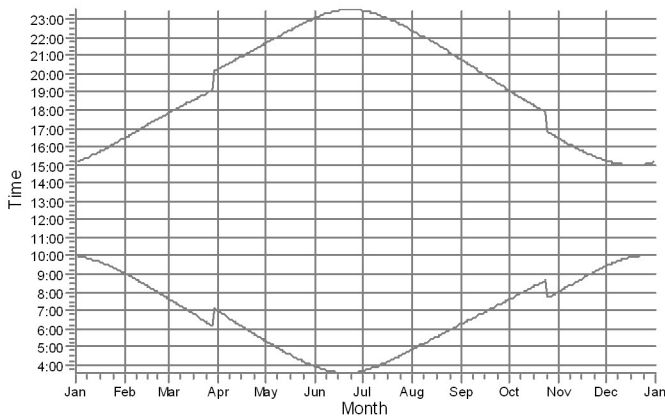
C: Lomarakenus (Heikinkatu 25)



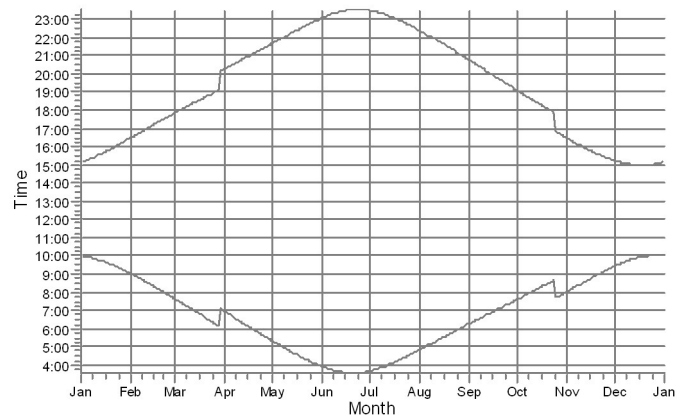
D: Lomarakenus (Ressulanmaa)



E: Lomarakenus (Sotkankangas I)



F: Lomarakenus (Sotkankangas II)

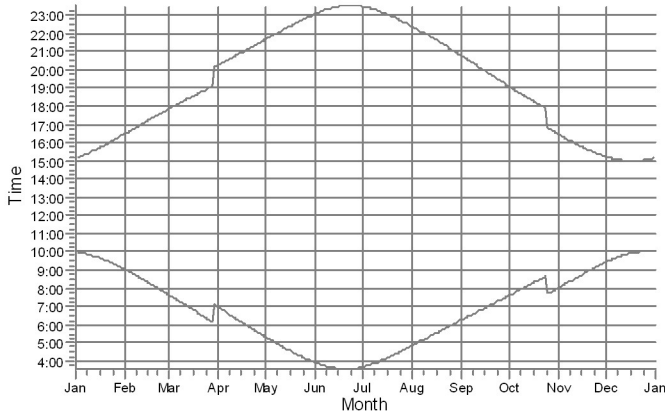


WTGs

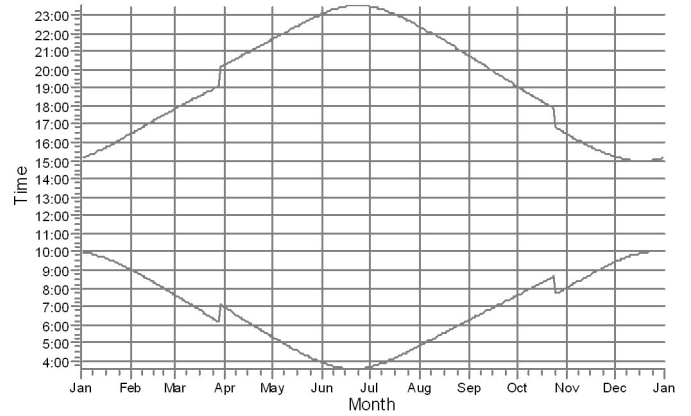
### SHADOW - Calendar, graphical

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest luke

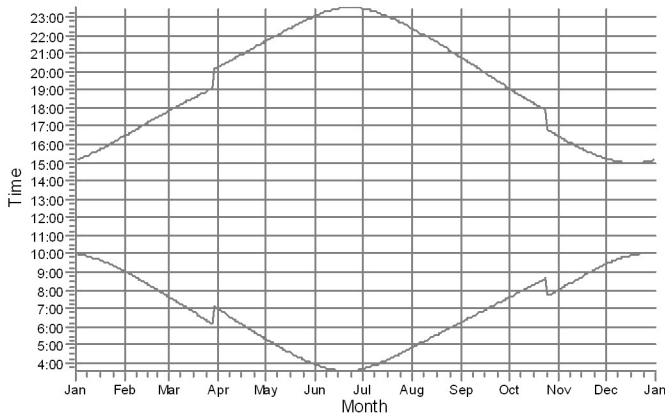
G: Lomarakennus (Sotkankangas III)



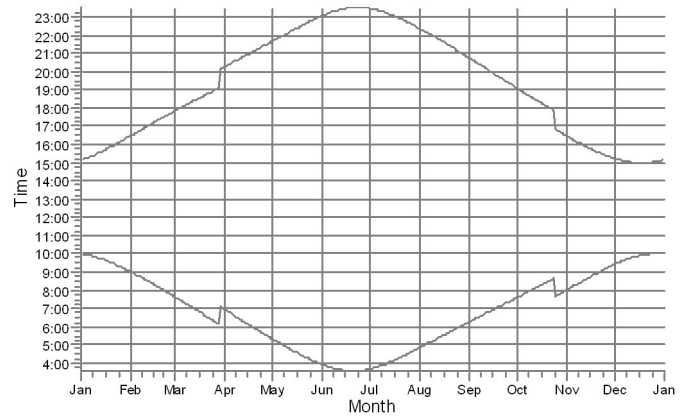
H: Lomarakennus (Ruostetuoma)



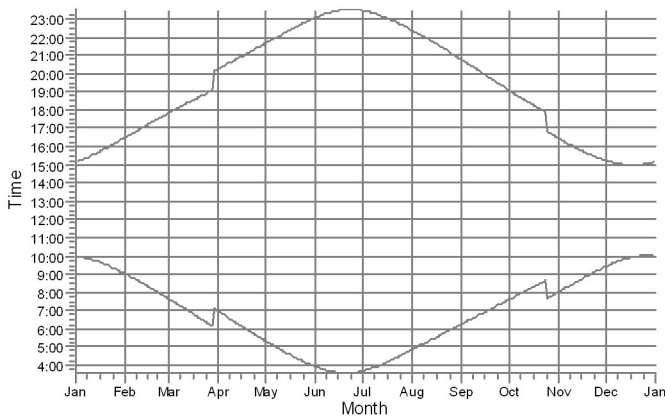
I: Lomarakennus (Heikinkankaantie 135)



J: Lomarakennus (Pukinharju)



K: Lomarakennus (Vähä Nummikangas)

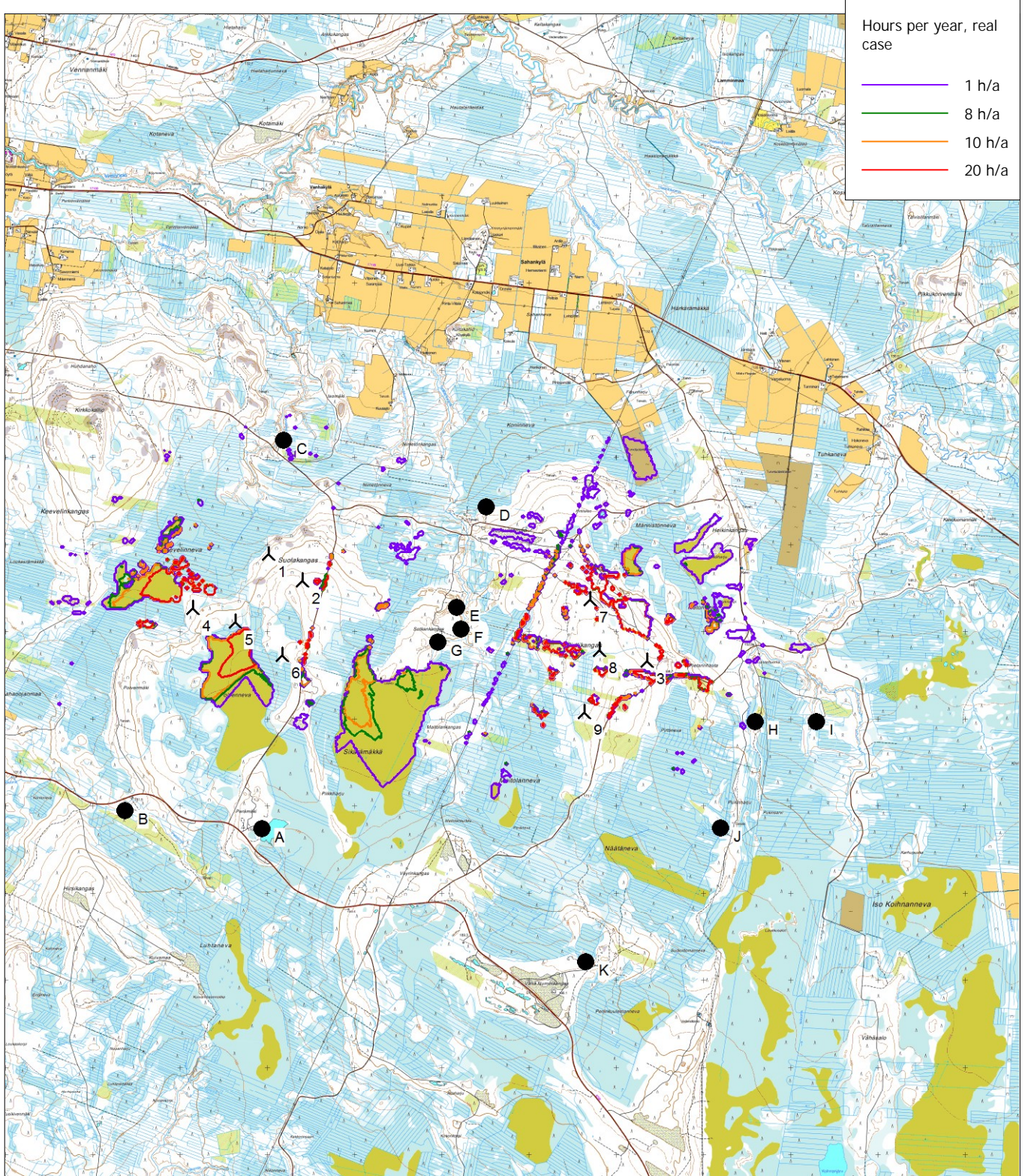


WTGs



## SHADOW - Map

Calculation: Suolakangas E-150 x 9 x HH155 real case\_forest luke



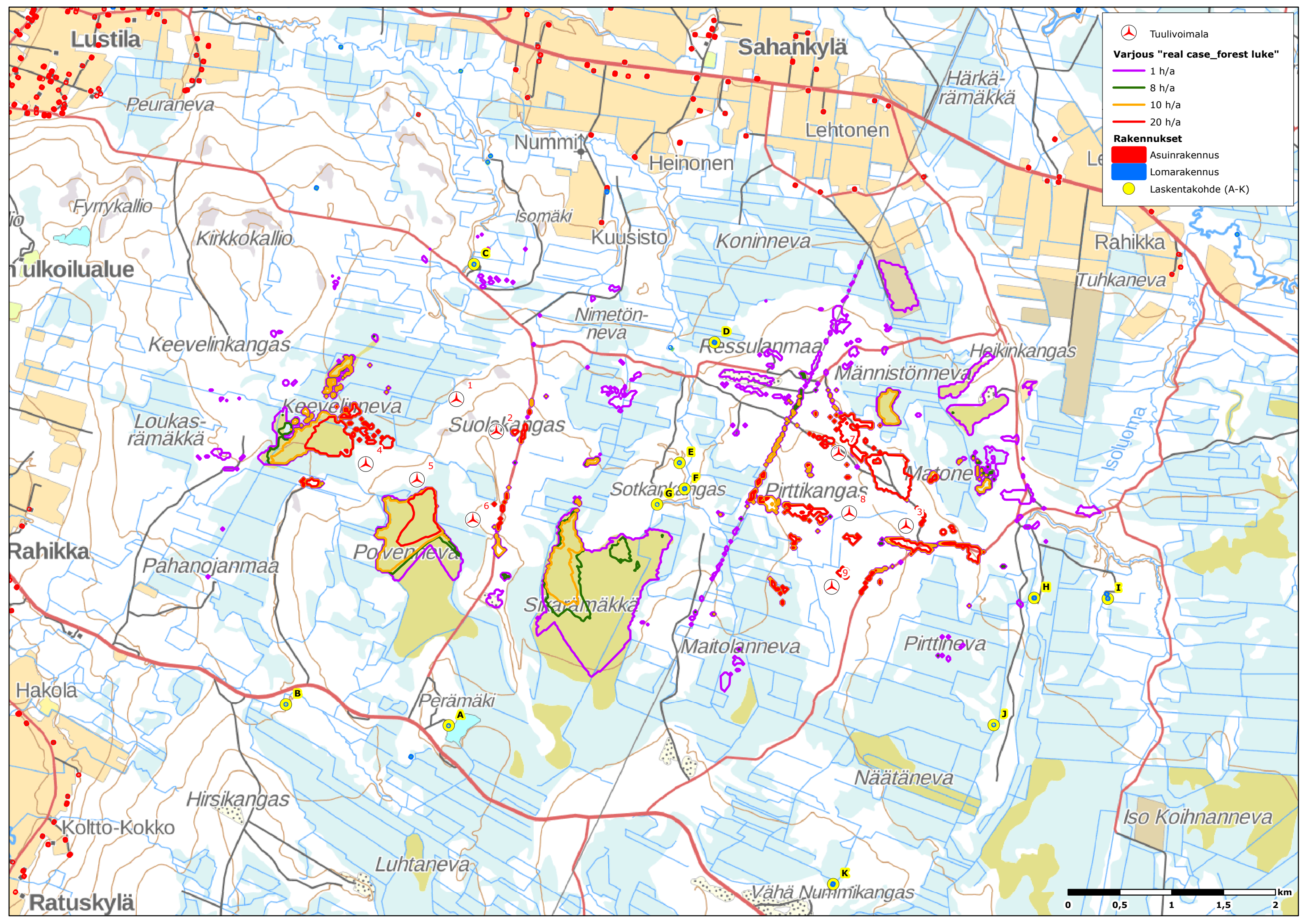
0 1000 2000 3000 4000 m

Map: Peruskartta , Print scale 1:65 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 261 160 North: 6 926 900

👤 New WTG    📍 Shadow receptor

Flicker map level: Height Contours: Korkeuskäyrät\_Kauhajoki.wpo (1)





Lustila

Sahankylä

Härkä-  
rämäkkä

Peuraneva

Nummi

Heinonen

Lehtonen

Fyrrykallio

Kirkkokallio

Isomäki

Kuusisto

Koninneva

Rahikka

Ulkooiluvualue

Keevelinkangas

Nimetön-  
neva

Ressulanmaa

Heikinkangas

Tuhkaneva

Loukas-  
rämäkkä

Keevölinneva

Suolankangas

Männistönneva

Isoluoma

Rahikka

Pahanojanmaa

Povenneva

Sotkan-  
kangas

Pirttikangas

Matone

Sikarämäkkä

Maitolanneva

Pirttineva

Hakola

Perämäki

Näätäneva

Iso Koihnanneva

Koltto-Kokko









Hirsikangas

Luhtaneva

Vähä Nummikangas

Ratuskylä



 Tuulivoimala  
**Varjous "real case\_forest luke"**  
 1 h/a  
 8 h/a  
 10 h/a  
 20 h/a  
**Rakennukset**  
 Asuinrakennus  
 Lomarakennus  
 Laskentakohde (A-K)

