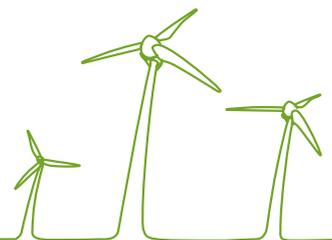


OX2

# **Merkkikallion tuulivoimapuisto**

Melu- ja varjostusmallinnukset V136 x 15 x HH172



Salmeskari Elina

13.6.2016

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## 1 MELU- JA VARJOSTUSMALLINNUKSEN TAVOITTEET

Mustasaaren kunnan ja Vaasan kaupungin alueille suunnitteilla olevan tuulivoimahankkeen aiheuttamia melu- ja varjostusvaikutuksia on arvioitu laatimalla mallinnukset tuulivoimaloiden aiheuttamista äänenpainetasoista ja varjostuksista. Mallinnusten tavoitteena on osoittaa, kuinka laajalle alueelle kyseiset vaikutukset ulottuvat ja arvioida vaikutukset läheiselle asutukselle tai loma-asutukselle.

Tuulivoimaloiden aiheuttamia meluvaikutuksia on arvioitu melun laskentamallin avulla, joiden mukaan on tehty melumallinnus WindPRO-ohjelmalla tuulivoimapuistosta. Hanksuunnitelman mukaisen tuulivoimamelun leviämisyöhykkeet mallinnettiin noudattaen uusimpia tuulivoimamelun ohjeita (Ohje 2/2014 Tuulivoimaloiden melun mallintaminen, Ympäristöministeriö 2014).

Tuulivoimaloiden aiheuttamat varjostusvaikutukset on mallinnettu WindPro-ohjelman SHADOW-moduulilla alustavien voimalanpaikkojen sijoitusten mukaisesti.

Melu- ja varjostusmallinnukset on laatinut FCG Suunnittelu ja Tekniikka Oy Ins. Hans Vadbäck ja laaduntarkistuksesta vastaa aluepäällikkö Jakob Kjellman.

## 2 LÄHTÖTIEDOT JA MENETELMÄT

### 2.1 Melu

#### 2.1.1 Melumallinnus YM 2/2014

Tuulivoimaloiden aiheuttamat äänenpainetasot on mallinnettu WindPRO-laskentaohjelmalla ISO 9613-2 standardin mukaisesti, jossa tuulen nopeutena käytettiin 8 m/s 10 m korkeudella mitattuna, ilman lämpötilana 15°C, ilmanpaineena 101,325 kPa sekä ilman suhteellisenä kosteutena 70 %.

Lähtötietoina eli referenssivoimalana on käytetty tuulivoimalaitosvalmistaja Vestas V136-3.45 MW:n voimalaa. Tuulivoimalan napakorkeutena on käytetty 172 m ja näin ollen voimalan kokonaiskorkeus on 240 m.

Lähtömelutaso on arvioitu valmistajan antamien tietojen pohjalta, laskemalla ensin napakorkeudessa vallitseva tuulen nopeus ympäristöministeriön ohjeen 4/2014 kaavan 5.3.1 mukaisesti. Maan karheutena on käytetty arvoa 0,3. Tuulivoimalan lähtömelutasona ( $L_{WA}$ ) on käytetty 108,2 dB(A). Käytetty lähtömelutaso vastaa laitetoimittajan tietojen mukaan ylempi 95% CL.

Laskenta on tehty 4,0 m maapinta-tasosta. Maanpinnan kovuutena käytettiin arvoa 0,4 Ympäristöhallinnon ohjeen 2/2014 "Tuulivoimaloiden melun mallintaminen" mukaisesti.

Melumallinnuksen laskentatuloksia on havainnollistettu keskiäänitasokarttojen avulla. Keskiäänitasokartassa on melun keskiäänitaso- eli ekvivalenttiäänitasokäyrät ( $L_{Aeq}$ ) 5 dB välein.

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**Taulukko 1. Mallinnusohjelma ja tuulivoimaloiden äänitehotasot sekä melun erityispiirteet**

<b>MALLINNUSOHJELMAN TIEDOT</b>							
Mallinnusohjelma ja versio: WindPRO version 3.0.619				Mallinnusmenetelmä: ISO 9613-2			
<b>TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)</b>							
Tuulivoimalan valmistaja: Vestas				Tyyppi: V136-3.45 MW		Sarjanumero/t:-	
Nimellisteho: 3,45 MW		Napakorkeus:172		Roottorin halkaisija:136		Tornin tyyppi: hybridi	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä; NO STE			
Kyllä	- dB	Kyllä	- dB	Noise mode säätötasot:		-	
Ei		Ei		Noise mode, lähtömelutaso:		-	
<b>AKUSTISET TIEDOT /LASKENNAN LÄHTÖTIEDOT</b>							
Melupäästötiedot perustuvat valmistajan dokumenttiin " DMS no.: DMS 0055-9919_V00, V136-mk3--3.45MW- Third octave noise emission, Date 2015-11-23 ).							
Oktaaveittain [Hz], dB(A)		1/3-oktaaveittain, LWA dB [Hz]					
		20	73,8	200	89,7	2000	96,4
63	86,7	25	74,4	250	91,5	2500	92,8
125	95,0	31,5	73,9	315	93,5	3150	88,3
250	96,9	40	77,3	400	95,4	4000	85,9
500	101,0	50	81,3	500	95,6	5000	75,1
1000	104,3	63	81,2	630	97,0	6300	66,2
2000	102,2	80	83,3	800	98,5	8000	56,9
4000	90,8	100	86,4	1000	99,5	10000	57,2
8000	68,6	125	91,8	1250	100,1		
<b>108,2 dB(A)</b>		160	91,0	1600	100,5		
Melun erityispiirteiden mittaus ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudimodulaatio)		Muu, Mikä: +2 dB lisäys (maapinnan korkeus >60m)	
kyllä	ei	kyllä	ei	kyllä	ei	kyllä	ei

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**Taulukko 2. Käytetyt mallinnusparametrit ISO 9613-2 laskelmissa sekä melulle altistuvat kohteet**

AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT			
Laskenta korkeus		Laskentaruudun koko [m·m]	
ISO 9613-2: 4,0 m		25x25 m	
Suhteellinen kosteus		Lämpötila	
70 %	Muu, mikä ja miksi:	ISO 9613-2: 15 C°	
Maastomallin lähde ja tarkkuus			
Maastomallin lähde: MML maastotietokanta		Vaakaresoluutio:1,0 m	Pystyresoluutio:0,5 m
Maan- ja vedenpinnan absorptioon ja heijastuksen huomioiminen, käytetyt kertoimet			
ISO 9613-2		0,4	HUOM
Ilmakehän stabiilius laskennassa/meteorologinen korjaus			
Neutraali, (0): Neutraali		Muu, mikä ja miksi:	
Sääolosuhteiden huomiointi; laskennassa käytetty tuulen suunnat ja nopeus			
Tuulen suunta: 0-360°		Tuulennopeus: 8 m/s (ref. 10 m)	
Voimalan äänen suuntaavuus ja vaimentuminen			
Vapaa avaruus: kyllä		Muu, mikä, miksi:	
Melulle altistuvat asukkaat ja kohteet > 40 dB(A), lkm (ilman meluntorjuntaa/voimalan ohjausta)			
Asukkaat:	0 kpl	Vapaa-ajan rakennukset:	0 kpl
		Hoito- ja oppilaitokset:	0 kpl
Melun leviäminen virkistys- tai luonnonsuojelualueille			
Virkistysalueet: 0 kpl		Luonnonsuojelualueet: 0 kpl	

**2.1.2 Matalataajuisen melun mallinnus**

Matalataajuinen melu laskettiin Ympäristöministeriön ohjeen 2/2014 mukaisin menetelmin käyttäen voimalavalmistajalta saatuja arvioita voimalan äänitehotasoista (Taulukko 1).

Sosiaali- ja terveysministeriön asetuksessa (545/2015) on annettu matalataajuiselle melulle toimenpiderajat. Asetus tuli voimaan 15.5.2015. Toimenpiderajat koskevat asuinhuoneita ja ne on annettu taajuuspainottamattomina yhden tunnin keskiäänitasoina tersseittäin. Toimenpiderajat koskevat yöaikaa ja päivällä sallitaan 5 dB suuremmat arvot.

Rakennusten sisälle kantautuva äänitaso arvioitiin tanskalaisen DSO1284 laskentaohjeen mukaisin ääneneristävyysarvoin ja tuloksia verrattiin toimenpiderajoihin.

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### Taulukko 3. Matalataajuisen sisämelun tunnin keskiäänitason toimenpiderajat nukkumiseen tarkoitetuissa tiloissa.

Terssikaista Hz	20	25	31,5	40	50	63	80	100	125	160	200
Keskiäänitaso L <sub>Zeq,1h</sub> , dB	74	64	56	49	44	42	40	38	36	34	32
Edellisestä laskettu keskiäänitaso A-painotettuna L <sub>Aeq,1h</sub> , dB	24	19	17	14	14	16	18	19	20	21	21

Lisäksi yöaikainen mahdollisesti unihäiriötä aiheuttava melu, joka erottuu selvästi taustamelusta, ei saa ylittää 25 dB yhden tunnin keskiäänitasona L<sub>Aeq,1h</sub> mitattuna niissä tiloissa, jotka on tarkoitettu nukkumiseen. Matalataajuisen tai pienitaajuisen melun osalta asuntojen sisätiloissa käytetään lisäksi seuraavia terssikaistoittain määritettyjä taajuuspainottamattomia tunnin keskiäänitasoon L<sub>eq,1h</sub> perustuvia suunnitteluohjeita.

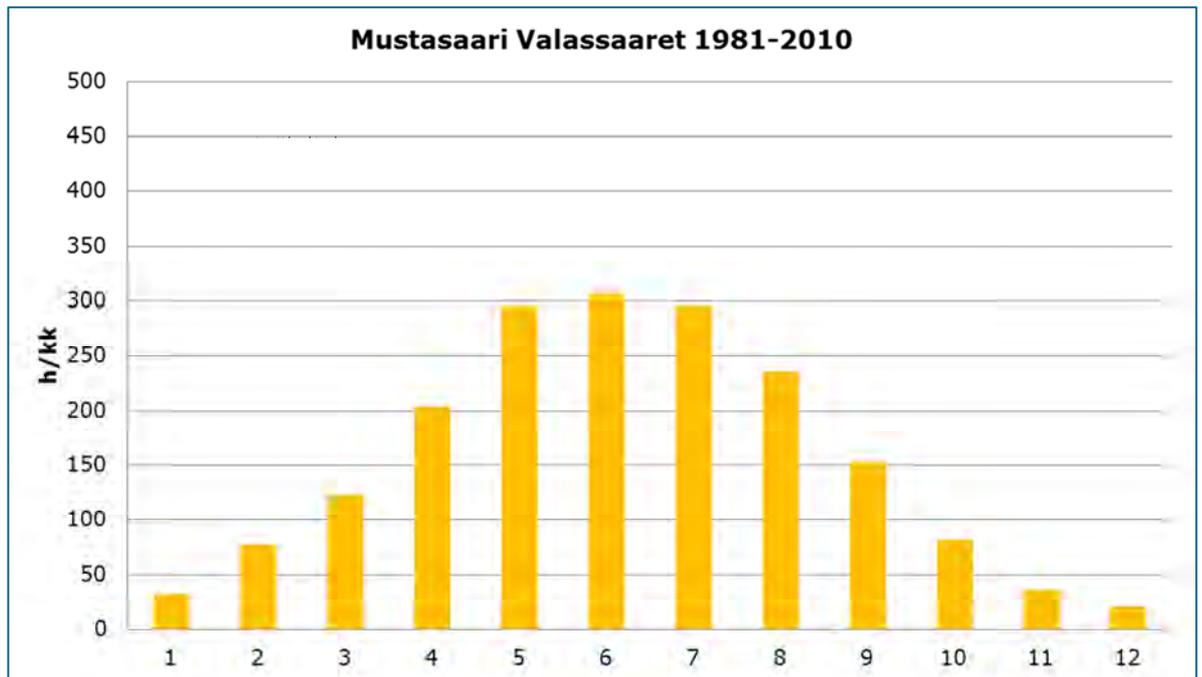
## 2.2 Varjostusmallinnus

Tuulivoimaloiden varjostusvaikutuksia mallinnettiin WindPRO-ohjelman Shadow-moduulilla. Varjostulaskennassa käytettiin Vestas V136-3.45 MW voimalaa, jonka roottorin halkaisija on 136 metriä ja napakorkeus 172 metriä. Mallinnus tehtiin niin sanotulle todelliselle tilanteelle (real case). Mallinuksissa tehtiin kaksi eri laskentatilannetta:

- 1) Todellinen tilanne, jossa puuston suojaavaa vaikutusta ei huomioitu (real case, no forest) voimaloiden napakorkeus = 172 m (HH172)
- 2) Todellinen tilanne, jossa puuston suojaavaa vaikutusta on huomioitu (real case, forest luke) voimaloiden napakorkeus = 172 m (HH172). 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 × 16 metriä.

Auringon keskimääräiset paistetunnit perustuvat Mustasaaren Valassaarten sääaseman pitkäaikaisiin mitattuihin säätietoihin 1981-2010 (Kuva 1). Laskentojen tuulen suunta ja nopeusjakamana käytettiin Suomen tuulitatlaksen tietoja hankealueelta (lib 30051).

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**Kuva 1. Mustasaari Valasaarten 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 1,0 metriä ja laskenta-alueen kokoa 5,0 x 5,0 metriä.

### 2.3 Raja- ja ohjearvot

Valtioneuvoston asetuksessa (1107/2015) tuulivoimaloille on määritelty melun suunnitteluarvot päivä- ja yöajan keskiäänitasojen maksimiarvolle. Asetus tuli voimaan 1.9.2015. Jos tuulivoimalan melu sisältää tonaalisia, kapeakaistaisia tai impulssimaisia komponentteja, tai se on selvästi amplitudimoduloitunutta, mallinnustuloksiin tulee ohjeen mukaan lisätä viisi desibeliä ennen suunnitteluarvoon vertaamista. Koska ohjearvo sisältää jo tyypillisen tuulivoimamelun piirteet, edellä mainitut äänenpiirteiden tulee olla tuulivoimalalle epätyypillisen voimakkaita, jotta mallinnustuloksissa täytyy huomioida viiden desibelin lisä äänenvoimakkuuteen.

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**Taulukko 4. Valtioneuvoston asetuksen mukaiset tuulivoimaloiden melutason ohjearvot (Valtioneuvoston asetus 27.8.2015).**

Vaikutuskohde	Päivä (7-22)	Yö (22-7)
Pysyvä asutus	45 dB	40 dB
Loma-asutus	45 dB	40 dB
Hoitolaitokset	45 dB	40 dB
Oppilaitokset	45 dB	—
Virkistysalueet	45 dB	—
Leirintäalueet	45 dB	40 dB
Kansallispuistot	40 dB	40 dB

Sosiaali- ja terveysministeriön asetuksessa (545/2015) on annettu matalataajuiselle melulle toimenpiderajat. Asetus tuli voimaan 15.5.2015. Toimenpiderajat koskevat asuinhuoneita ja ne on annettu taajuuspainottamattomina yhden tunnin keskiäänitasoina tersseittäin. Toimenpiderajat koskevat yöaikaa ja päivällä sallitaan 5 dB suuremmat arvot.

**Taulukko 5. Matalataajuisen sisämelun tunnin keskiäänitason toimenpiderajat nukkumiseen tarkoitetuissa tiloissa.**

Terssikaista Hz	20	25	31,5	40	50	63	80	100	125	160	200
Keskiäänitaso (LZeq,1h, dB)	74	64	56	49	44	42	40	38	36	34	32
Edellisestä laskettu keskiäänitaso A-painotettuna (LAeq,1h, dB)	24	19	17	14	14	16	18	19	20	21	21

Lisäksi yöaikainen mahdollisesti unihäiriötä aiheuttava melu, joka erottuu selvästi taustamelusta, ei saa ylittää 25 dB yhden tunnin keskiäänitasona LAeq,1h mitattuna niissä tiloissa, jotka on tarkoitettu nukkumiseen.

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

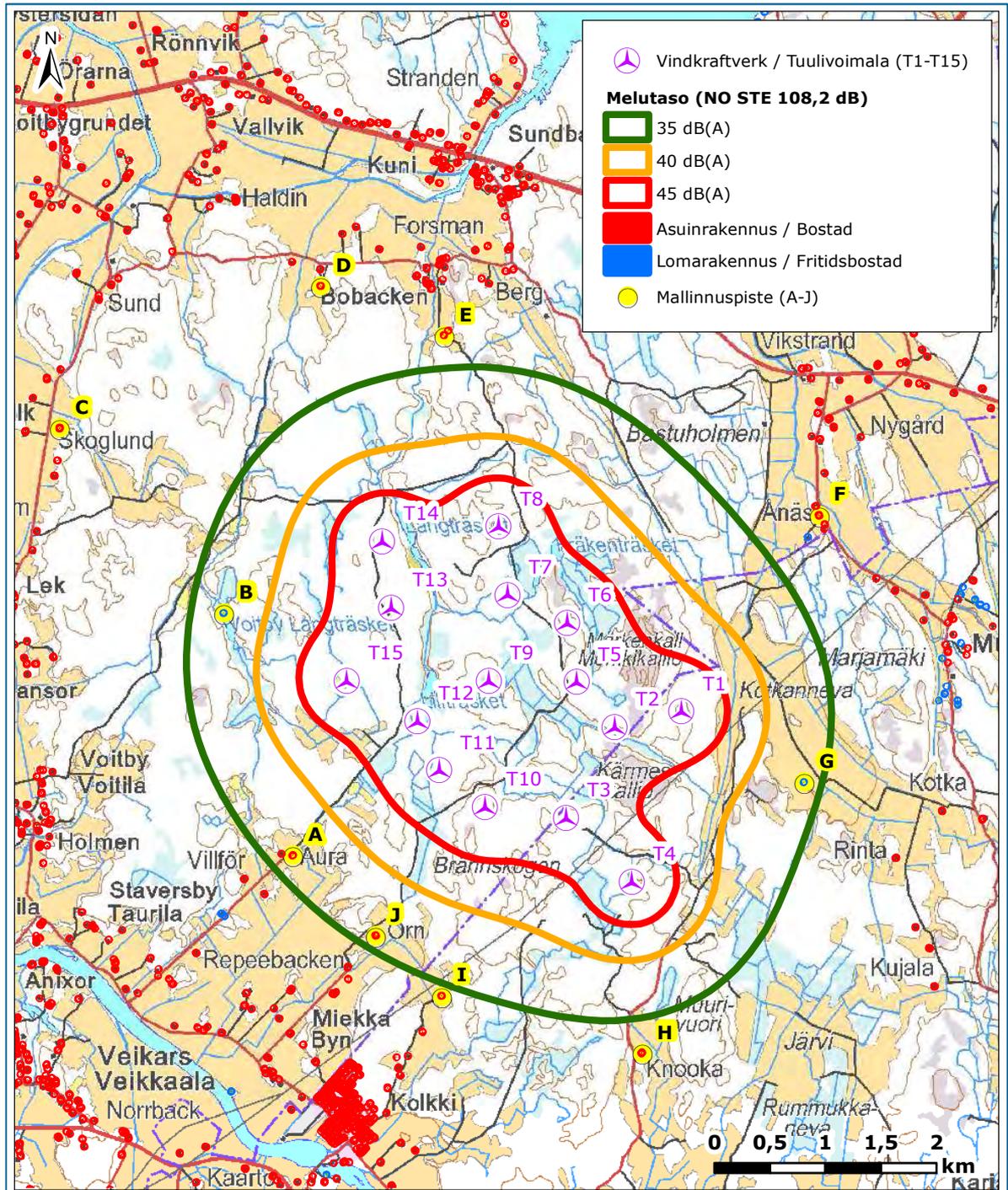
Useissa maissa on annettu raja-arvoja tai suosituksia hyväksyttävän välkevaikutuksen määrästä. Esimerkiksi Tanskassa sovelletaan todellisen tilanteen raja-arvona enintään kymmenen tuntia vuodessa. Ruotsissa vastaava suositus on kahdeksan tuntia vuodessa ja 30 minuuttia päivässä.

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### 3 MELU- JA VARJOSTUSMALLINNUSTEN TULOKSET

#### 3.1 Melun laskentatulokset ISO 9613-2

Lähimmät loma- ja asuinrakennukset sijaitsevat noin 1,3 km päässä lähimmästä voimalasta. Lähimpien loma- ja asuinrakennusten pihapiirissä melutasot jäävät laskelmien mukaan alle 40 dB(A). Katso tarkemmat laskentatulokset liitteestä 1.



Kuva 2. Laskennalliset melutasot Vestas V136-3.45 MW "NO STE" voimaloilla standardin ISO 9613-2 mukaisesti. Napakorkeus = 172 m.

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**Taulukko 6. Laskennalliset melutasot standardin ISO 9613-2 mukaisesti kohteissa A-J.**

Laskentapiste	ETRS89- TM35 Itä	ETRS89- TM35 Pohjoinen	Z (m)	Laskenta- korkeus (m)	Melutaso dB(A)
A Asuinrakennus (Langkujavägen 200)	244 392	7 07 85	10,0	4,0	36,3
B Lomarakennus (Voitby Långträsket)	243 772	7 009 284	12,8	4,0	37,0
C Asuinrakennus (Voitbyntie 480)	242 293	7 010 963	5,0	4,0	27,1
D Asuinrakennus (Kunintie 289)	244 642	7 012 253	5,0	4,0	29,7
E Asuinrakennus (Sandhedsvägen 65)	245 754	7 011 805	10,0	4,0	33,2
F Asuinrakennus (Mullontie 128)	249 130	7 010 173	7,5	4,0	31,9
G Lomarakennus/Partiomaja (Korpilahdenkuja 134)	248 995	7 007 749	10,0	4,0	36,1
H Asuinrakennus (Kotkannevantie 269)	247 537	7 005 291	18,5	4,0	32,9
I Asuinrakennus (Klumpintie 171)	245 733	7 005 809	12,5	4,0	34,4
J Asuinrakennus (Klumpvägen 170)	245 136	7 006 355	10,0	4,0	35,8

### 3.2 Matalataajuiset melutasot

Sisätilojen laskennallisia tuloksia on verrattu Sosiaali- ja terveysministeriön (STM) Asumisterveysasetuksessa (545/2015) annettuihin toimenpiderajoihin. Nämä ovat enimmäisarvoja, jotka on laadittu yöaikaiselle melulle nukkumiseen tarkoitettuihin tiloihin. Toimenpiderajaa on verrattu myös äänitasoon tarkasteltujen rakennusten ulkopuolella. Taulukkoon 7 on koottu matalataajuisen melun laskentatuloksia ja verrattu niitä STM:n toimenpiderajoihin. Toimenpiderajaa on verrattu myös äänitasoon tarkasteltujen rakennusten ulkopuolella. Taulukossa näkyy toimenpiderajan alitus (negatiivinen arvo) tai ylitys (positiivinen arvo).

**Taulukko 7. Matalataajuisen melun mallinnustulokset (V136-3.45 x 15 x HH172 "NO STE") herkissä kohteissa verrattuna Sosiaali- ja terveysministeriön toimenpiderajaan.**

Rakennus	Äänitaso ulkona		Äänitaso sisällä	
	L eq,1h – Asumisterveys- ohje sisällä	Hz	L eq,1h – Asumisterveys- ohje sisällä	Hz
A Asuinrakennus (Langkujavägen 200)	6,2	125	-7,6	50
B Lomarakennus (Voitby Långträsket)	6,5	125	-7,3	50
C Asuinrakennus (Voitbyntie 480)	0,0	125	-13,2	50
D Asuinrakennus (Kunintie 289)	1,7	125	-11,7	50
E Asuinrakennus (Sandhedsvägen 65)	4,0	125	-9,6	50
F Asuinrakennus (Mullontie 128)	3,3	125	-10,2	50
G Lomarakennus-Partiomaja (Korpilahdenkuja 134)	5,9	125	-7,9	50
H Asuinrakennus (Kotkannevantie 269)	3,6	125	-10,0	50
I Asuinrakennus (Klumpintie 171)	4,9	125	-8,8	50
J Asuinrakennus (Klumpvägen 170)	5,9	125	-7,9	50

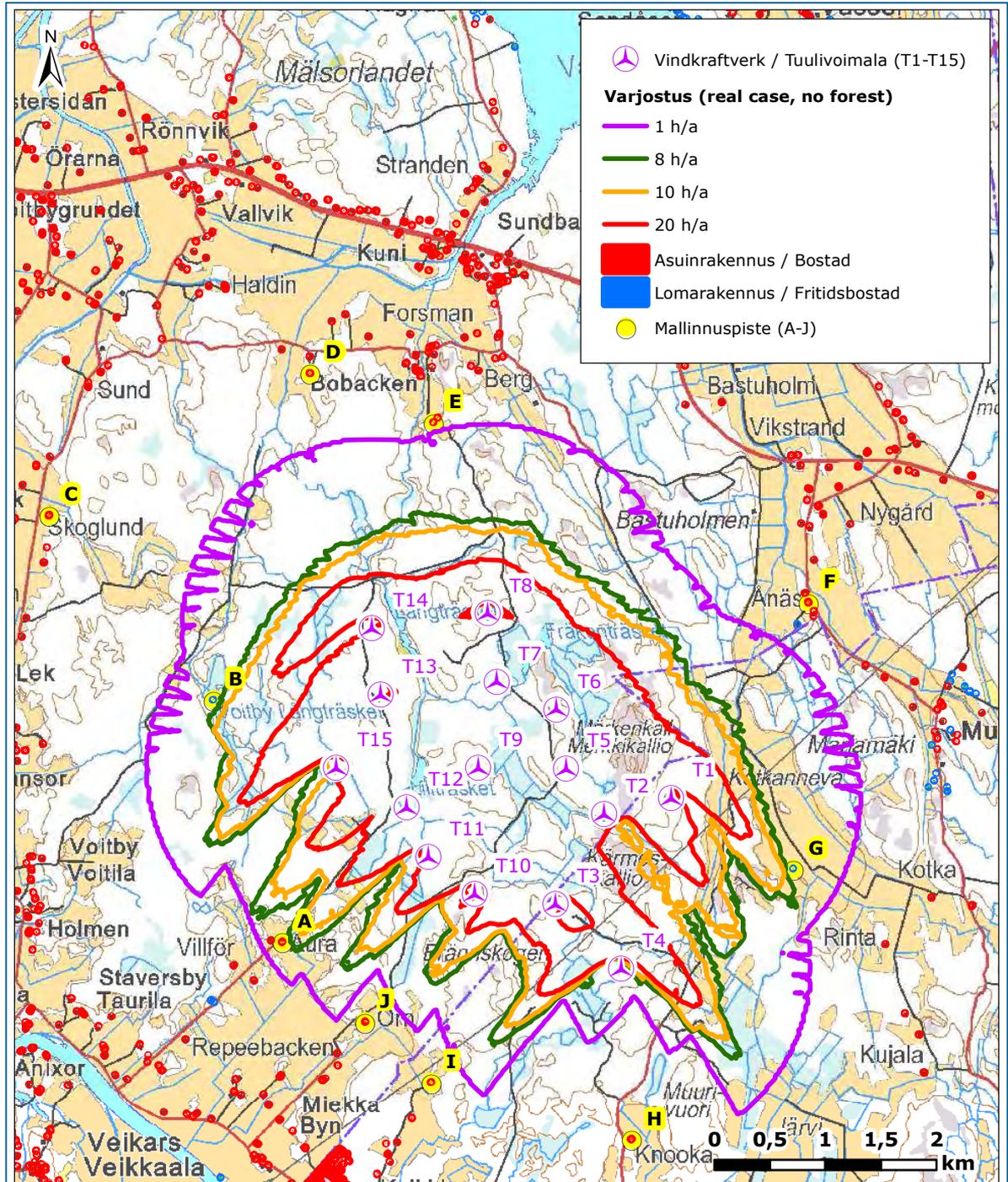
Matalataajuiset äänitasot jäävät kaikissa rakennuksissa toimenpiderajojen alapuolelle, kun rakenteiden ääneneristävyys huomioidaan. Rakennuskohtaiset matalataajuiset äänitasot lähimpien rakennusten osalta on esitetty liitteessä 2. Rakennusten kirjaintunnukset ovat samat kuin ISO 9613-2 mallinnuksessa (Liite 1).

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### 3.3 Varjostusmallinnusten tulokset

#### Real case, no forest

Tuulivoimaloiden läheisyydessä sijaitsevien asuin- ja lomarakennusten kohdalla varjostustunnit ovat "real case, no forest"-laskentatulosten perusteella alle 8 tuntia vuodessa kaikissa tarkastelualueissa (A-J). Katso tarkemmat laskentatulokset liitteestä 3.

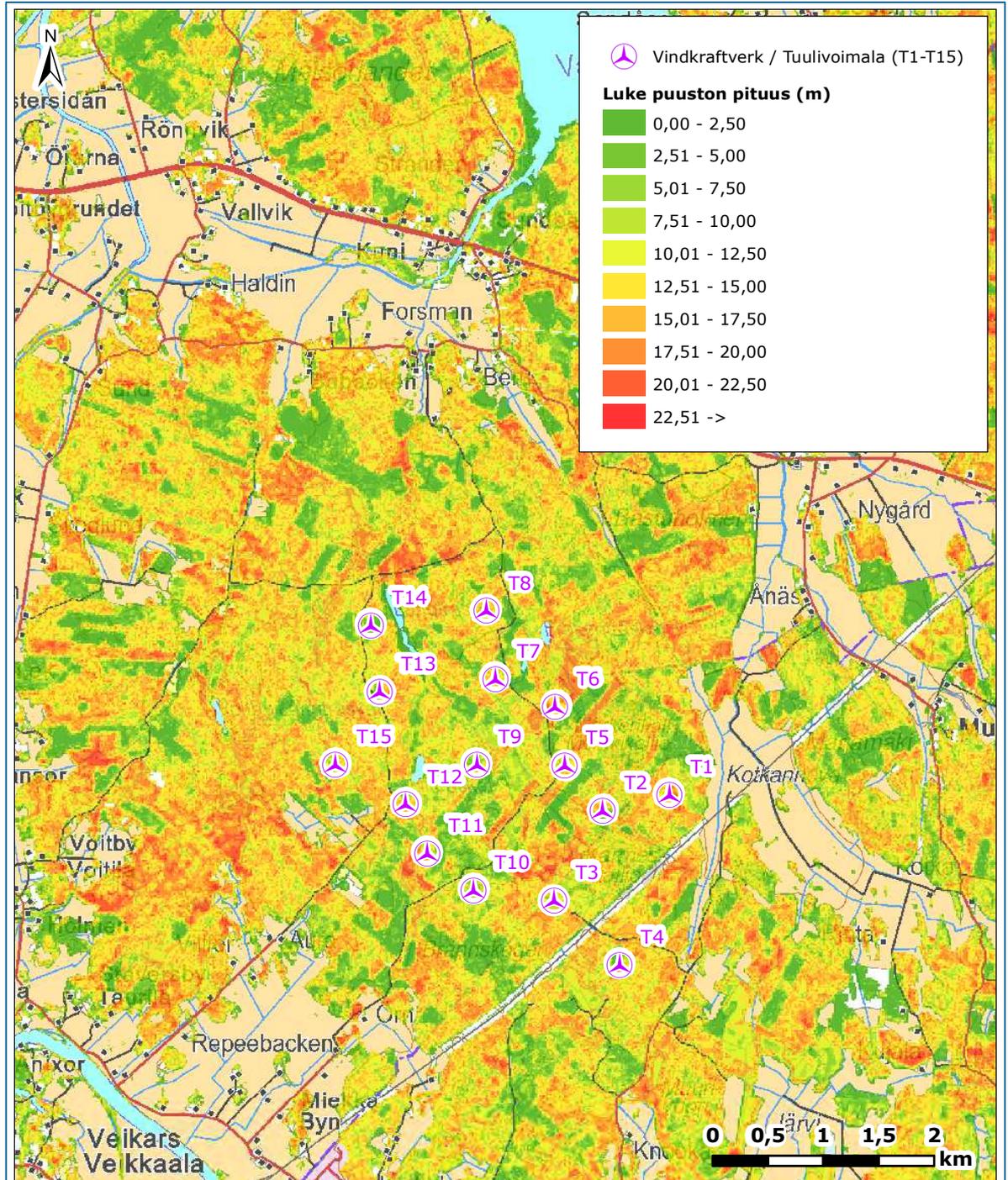


Kuva 3. Varjostusmallinnus V136-3.45 MW x 15 x HH172, puuston suojaavaa vaikutusta ei huomioitu.

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Real case, forest luke

Varjostusmallinnuksessa puuston korkeustiedot perustuvat Luonnonvarakeskus (Luke) vuoden 2013 monilähteisestä valtakunnan metsien inventoinnista, (Kuva 4).

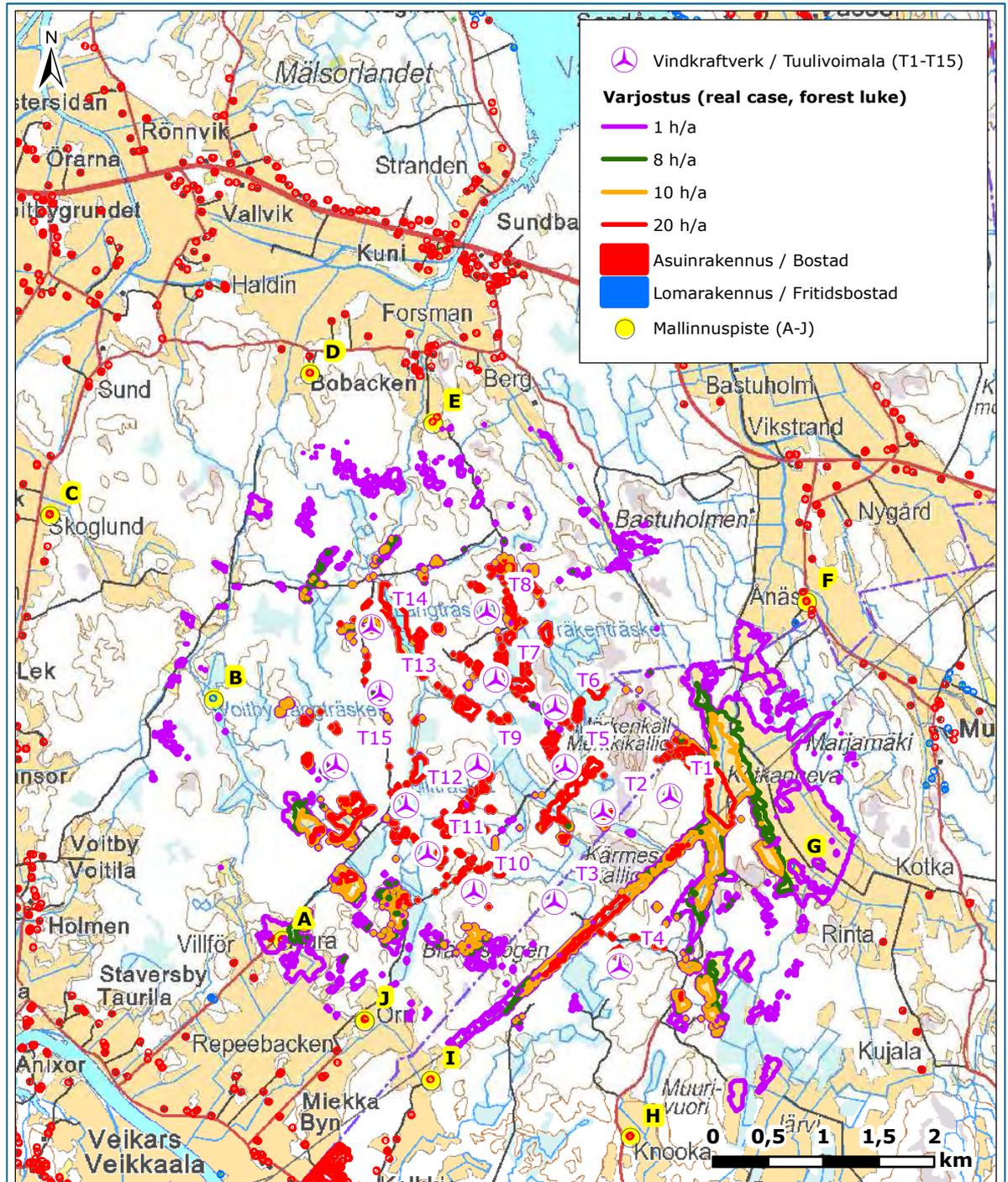


**Kuva 4. Varjostusmallinnuksessa käytetyt puuston korkeudet, perustuvat Luonnonvarakeskus (Luke) vuoden 2013 monilähteisestä valtakunnan metsien inventoinnista.**

Kun puuston suojaava vaikutus huomioidaan, laskentatuloksista nähdään, että varjostusvaikutukset ovat merkittävästi lievemät (Kuva 5).

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Tuulivoimaloiden läheisyydessä sijaitsevien asuin- ja lomarakennusten kohdalla varjostustunnit ovat "real case, forest luke"-laskentatulosten perusteella alle 8 tuntia vuodessa kaikissa tarkastelukohteissa (A-J). Katso tarkemmat laskentatulokset liitteestä 4.



Kuva 5. Varjostusmallinnus V136-3.45 MW x 15 x HH172, puuston suojaavaa vaikutus on huomioitu.

13.6.2016

**Taulukko 8. Laskennalliset varjostustunnit vuodessa lähialueen laskentapisteissä, kun puuston suojaavaa vaikutusta ei ole huomioitu "real case, no forest"**

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentapiste (m)	Varjostus (h/a)
A Asuinrakennus (Langkujavägen 200)	244 392	7 07 85	10,0	5 x 5	6:47
B Lomarakennus (Voitby Långträsket)	243 772	7 009 284	12,8	5 x 5	7:32
C Asuinrakennus (Voitbyntie 480)	242 293	7 010 963	5,0	5 x 5	0:00
D Asuinrakennus (Kunintie 289)	244 642	7 012 253	5,0	5 x 5	0:00
E Asuinrakennus (Sandhedsvägen 65)	245 754	7 011 805	10,0	5 x 5	0:00
F Asuinrakennus (Mullontie 128)	249 130	7 010 173	7,5	5 x 5	0:00
G Lomarakennus/Partiomaja (Korpilahdenkuja 134)	248 995	7 007 749	10,0	5 x 5	5:24
H Asuinrakennus (Kotkannevantie 269)	247 537	7 005 291	18,5	5 x 5	0:00
I Asuinrakennus (Klumpintie 171)	245 733	7 005 809	12,5	5 x 5	0:00
J Asuinrakennus (Klumpvägen 170)	245 136	7 006 355	10,0	5 x 5	0:00

**Taulukko 9. Laskennalliset varjostustunnit vuodessa lähialueen laskentapisteissä (HH147), kun puuston suojaavaa vaikutusta on huomioitu "real case, forest luke"**

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentapiste (m)	Varjostus (h/a)
A Asuinrakennus (Langkujavägen 200)	244 392	7 07 85	10,0	5 x 5	6:47
B Lomarakennus (Voitby Långträsket)	243 772	7 009 284	12,8	5 x 5	0:00
C Asuinrakennus (Voitbyntie 480)	242 293	7 010 963	5,0	5 x 5	0:00
D Asuinrakennus (Kunintie 289)	244 642	7 012 253	5,0	5 x 5	0:00
E Asuinrakennus (Sandhedsvägen 65)	245 754	7 011 805	10,0	5 x 5	0:00
F Asuinrakennus (Mullontie 128)	249 130	7 010 173	7,5	5 x 5	0:00
G Lomarakennus/Partiomaja (Korpilahdenkuja 134)	248 995	7 007 749	10,0	5 x 5	0:00
H Asuinrakennus (Kotkannevantie 269)	247 537	7 005 291	18,5	5 x 5	0:00
I Asuinrakennus (Klumpintie 171)	245 733	7 005 809	12,5	5 x 5	0:00
J Asuinrakennus (Klumpvägen 170)	245 136	7 006 355	10,0	5 x 5	0:00

**FCG Suunnittelu ja Tekniikka Oy**Hans Vadbäck  
Ins. LaatiijaJakob Kjellman  
MMT Laaduntarkistus/Hyväksyjä

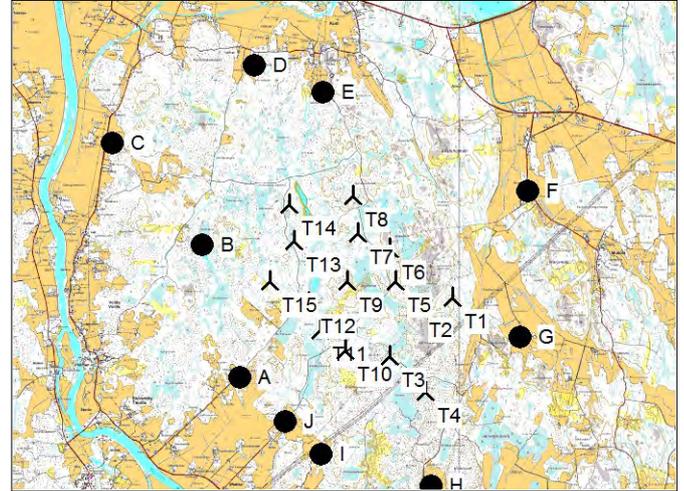
## **Liite 1: Melun leviämismallinnuksen tulokset YM 2/2014**

## DECIBEL - Main Result

Calculation: V136-3.45 x 15 x HH172 NO STE (108,2 dB)

Calculation is done according to Finnish guideline " Ympäristöhallinnon ohjeita 2 | 2014" from the Ministry of the Environment of Finland

All coordinates are in  
Finish TM ETRS-TM35FIN-ETRS89



### WTGs

Row data/Description	East	North	Z [m]	WTG type				Noise data				Wind speed [m/s]	Status	LwA.ref [dB(A)]	Pure tones	
				Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Creator	Name					
T1	247 894	7 008 402	20,0	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T10	246 126	7 007 532	23,2	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T11	245 712	7 007 870	15,0	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T12	245 517	7 008 318	15,0	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T13	245 281	7 009 344	17,5	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T14	245 200	7 009 948	17,5	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T15	244 881	7 008 680	15,0	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T2	247 294	7 008 259	23,6	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T3	246 855	7 007 441	25,0	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T4	247 445	7 006 854	26,8	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T5	246 950	7 008 670	25,0	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T6	246 864	7 009 208	20,3	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T7	246 326	7 009 461	17,7	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T8	246 247	7 010 081	21,5	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f
T9	246 160	7 008 681	29,6	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	USER	Mode 0 - Clean blade	108,2	8,0	From other hub height	108,2	No f

f) From other hub height

### Calculation Results

#### Sound Level

Noise sensitive area  
No. Name

No.	Name	East	North	Z [m]	Imission height [m]	Demands Noise [dB(A)]	Sound Level		Distance to noise demand [m]	Demands fulfilled ? Noise 2 dB penalty applied for one or more WTGs
							From WTGs [dB(A)]	From WTGs [dB(A)]		
A	Asuinrakennus (Langkujavägen 200)	244 392	7 007 085	10,0	4,0	40,0	36,3	511	Yes	No
B	Lomarakennus (Voitby Långträsket)	243 772	7 009 284	12,8	4,0	40,0	37,0	372	Yes	No
C	Asuinrakennus (Voitbyntie 480)	242 293	7 010 963	5,0	4,0	40,0	27,1	2 263	Yes	No
D	Asuinrakennus (Kunintie 289)	244 642	7 012 253	5,0	4,0	40,0	29,7	1 577	Yes	No
E	Asuinrakennus (Sandhedsvägen 65)	245 754	7 011 805	10,0	4,0	40,0	33,2	946	Yes	No
F	Asuinrakennus (Mullontie 128)	249 130	7 010 173	7,5	4,0	40,0	31,9	1 304	Yes	No
G	Lomarakennus/Partiomaja (Korpilahdenkuja 134)	248 995	7 007 749	10,0	4,0	40,0	36,1	476	Yes	No
H	Asuinrakennus (Kotkannevantie 269)	247 537	7 005 291	18,5	4,0	40,0	32,9	844	Yes	No
I	Asuinrakennus (Klumpintie 171)	245 733	7 005 809	12,5	4,0	40,0	34,4	821	Yes	No
J	Asuinrakennus (Klumpvägen 170)	245 136	7 006 355	10,0	4,0	40,0	35,8	567	Yes	No

Project:

Merkkikallio

Licensed user:

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Osmontie 34, PO Box 950  
FI-00601 Helsinki  
+358104095666  
Hans Vadback / hans.vadback@fcg.fi  
Calculated:  
10.6.2016 9:39/3.0.619

## DECIBEL - Main Result

Calculation: V136-3.45 x 15 x HH172 NO STE (108,2 dB)

Distances (m)

WTG	A	B	C	D	E	F	G	H	I	J
T1	3739	4212	6154	5037	4017	2158	1279	3129	3373	3432
T10	1790	2932	5140	4945	4286	3997	2875	2646	1766	1537
T11	1535	2399	4607	4508	3932	4118	3282	3157	2060	1620
T12	1668	1993	4167	4028	3492	4058	3521	3637	2517	1998
T13	2425	1509	3396	2976	2504	3934	4039	4635	3561	2990
T14	2972	1574	3076	2370	1936	3934	4383	5207	4170	3591
T15	1667	1262	3448	3578	3242	4500	4215	4303	2993	2337
T2	3128	3665	5681	4791	3863	2650	1774	2976	2903	2876
T3	2487	3589	5759	5293	4497	3552	2160	2254	1979	2032
T4	3060	4401	6585	6079	5228	3719	1788	1565	2004	2361
T5	3007	3234	5187	4259	3353	2646	2241	3427	3107	2939
T6	3256	3091	4892	3767	2822	2461	2581	3972	3580	3333
T7	3061	2558	4300	3258	2411	2891	3168	4339	3697	3324
T8	3521	2598	4048	2699	1792	2882	3601	4957	4300	3885
T9	2380	2461	4486	3878	3148	3321	2982	3657	2901	2540

## DECIBEL - Detailed results

Calculation: V136-3.45 x 15 x HH172 NO STE (108,2 dB) Noise calculation model: ISO 9613-2 Finland 8,0 m/s  
Assumptions

Calculated L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet  
(when calculated with ground attenuation, then Dc = Domega)

LWA,ref:	Sound pressure level at WTG
K:	Pure tone
Dc:	Directivity correction
Adiv:	the attenuation due to geometrical divergence
Aatm:	the attenuation due to atmospheric absorption
Agr:	the attenuation due to ground effect
Abar:	the attenuation due to a barrier
Amisc:	the attenuation due to miscellaneous other effects
Cmet:	Meteorological correction

## Calculation Results

Noise sensitive area: A Asuinrakennus (Langkujavägen 200)

WTG		Wind speed: 8,0 m/s											
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
T1	3 739	3 743	0	17,22	108,2	0,00	82,46	-	-	0,00	0,00	-	0,00
T10	1 790	1 799	0	27,50	108,2	0,00	76,10	-	-	0,00	0,00	-	0,00
T11	1 535	1 544	0	29,50	108,2	0,00	74,78	-	-	0,00	0,00	-	0,00
T12	1 668	1 677	0	28,43	108,2	0,00	75,49	-	-	0,00	0,00	-	0,00
T13	2 425	2 432	0	23,39	108,2	0,00	78,72	-	-	0,00	0,00	-	0,00
T14	2 972	2 977	0	20,52	108,2	0,00	80,48	-	-	0,00	0,00	-	0,00
T15	1 667	1 676	0	28,44	108,2	0,00	75,48	-	-	0,00	0,00	-	0,00
T2	3 128	3 133	0	19,79	108,2	0,00	80,92	-	-	0,00	0,00	-	0,00
T3	2 487	2 494	0	23,04	108,2	0,00	78,94	-	-	0,00	0,00	-	0,00
T4	3 060	3 065	0	20,11	108,2	0,00	80,73	-	-	0,00	0,00	-	0,00
T5	3 007	3 013	0	20,36	108,2	0,00	80,58	-	-	0,00	0,00	-	0,00
T6	3 256	3 261	0	19,22	108,2	0,00	81,27	-	-	0,00	0,00	-	0,00
T7	3 061	3 066	0	20,10	108,2	0,00	80,73	-	-	0,00	0,00	-	0,00
T8	3 521	3 525	0	18,09	108,2	0,00	81,94	-	-	0,00	0,00	-	0,00
T9	2 380	2 387	0	23,64	108,2	0,00	78,56	-	-	0,00	0,00	-	0,00
Sum	36,25												

- Data undefined due to calculation with octave data

Noise sensitive area: B Lomarakennus (Voitby Långträsket)

WTG		Wind speed: 8,0 m/s											
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]
T1	4 212	4 216	0	15,49	108,2	0,00	83,50	-	-	0,00	0,00	-	0,00
T10	2 932	2 937	0	20,72	108,2	0,00	80,36	-	-	0,00	0,00	-	0,00
T11	2 399	2 405	0	23,54	108,2	0,00	78,62	-	-	0,00	0,00	-	0,00
T12	1 993	2 000	0	26,07	108,2	0,00	77,02	-	-	0,00	0,00	-	0,00
T13	1 509	1 519	0	29,71	108,2	0,00	74,63	-	-	0,00	0,00	-	0,00
T14	1 574	1 583	0	29,18	108,2	0,00	74,99	-	-	0,00	0,00	-	0,00
T15	1 262	1 273	0	31,96	108,2	0,00	73,10	-	-	0,00	0,00	-	0,00
T2	3 665	3 670	0	17,51	108,2	0,00	82,29	-	-	0,00	0,00	-	0,00
T3	3 589	3 593	0	17,81	108,2	0,00	82,11	-	-	0,00	0,00	-	0,00
T4	4 401	4 404	0	14,85	108,2	0,00	83,88	-	-	0,00	0,00	-	0,00
T5	3 234	3 239	0	19,31	108,2	0,00	81,21	-	-	0,00	0,00	-	0,00
T6	3 091	3 096	0	19,97	108,2	0,00	80,81	-	-	0,00	0,00	-	0,00
T7	2 558	2 564	0	22,64	108,2	0,00	79,18	-	-	0,00	0,00	-	0,00
T8	2 598	2 604	0	22,43	108,2	0,00	79,31	-	-	0,00	0,00	-	0,00
T9	2 461	2 468	0	23,18	108,2	0,00	78,85	-	-	0,00	0,00	-	0,00
Sum	37,00												

- Data undefined due to calculation with octave data

## DECIBEL - Detailed results

Calculation: V136-3.45 x 15 x HH172 NO STE (108,2 dB) Noise calculation model: ISO 9613-2 Finland 8,0 m/s  
Noise sensitive area: C Asuinrakennus (Voitbyntie 480)

WTG		Wind speed: 8,0 m/s												
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]	
T1	6 154	6 156	0	10,31	108,2	0,00	86,79	-	-	0,00	0,00	-	0,00	
T10	5 140	5 143	0	12,61	108,2	0,00	85,23	-	-	0,00	0,00	-	0,00	
T11	4 607	4 610	0	14,19	108,2	0,00	84,27	-	-	0,00	0,00	-	0,00	
T12	4 167	4 170	0	15,65	108,2	0,00	83,40	-	-	0,00	0,00	-	0,00	
T13	3 396	3 400	0	18,61	108,2	0,00	81,63	-	-	0,00	0,00	-	0,00	
T14	3 076	3 082	0	20,03	108,2	0,00	80,78	-	-	0,00	0,00	-	0,00	
T15	3 448	3 453	0	18,39	108,2	0,00	81,76	-	-	0,00	0,00	-	0,00	
T2	5 681	5 684	0	11,31	108,2	0,00	86,09	-	-	0,00	0,00	-	0,00	
T3	5 759	5 762	0	11,14	108,2	0,00	86,21	-	-	0,00	0,00	-	0,00	
T4	6 585	6 587	0	9,47	108,2	0,00	87,37	-	-	0,00	0,00	-	0,00	
T5	5 187	5 190	0	12,48	108,2	0,00	85,30	-	-	0,00	0,00	-	0,00	
T6	4 892	4 896	0	13,32	108,2	0,00	84,80	-	-	0,00	0,00	-	0,00	
T7	4 300	4 304	0	15,19	108,2	0,00	83,68	-	-	0,00	0,00	-	0,00	
T8	4 048	4 052	0	16,07	108,2	0,00	83,15	-	-	0,00	0,00	-	0,00	
T9	4 486	4 491	0	14,57	108,2	0,00	84,05	-	-	0,00	0,00	-	0,00	
Sum	27,08													

- Data undefined due to calculation with octave data

## Noise sensitive area: D Asuinrakennus (Kunintie 289)

WTG		Wind speed: 8,0 m/s												
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]	
T1	5 037	5 040	0	12,90	108,2	0,00	85,05	-	-	0,00	0,00	-	0,00	
T10	4 945	4 949	0	13,16	108,2	0,00	84,89	-	-	0,00	0,00	-	0,00	
T11	4 508	4 512	0	14,50	108,2	0,00	84,09	-	-	0,00	0,00	-	0,00	
T12	4 028	4 032	0	16,14	108,2	0,00	83,11	-	-	0,00	0,00	-	0,00	
T13	2 976	2 982	0	20,50	108,2	0,00	80,49	-	-	0,00	0,00	-	0,00	
T14	2 370	2 377	0	23,71	108,2	0,00	78,52	-	-	0,00	0,00	-	0,00	
T15	3 578	3 583	0	17,86	108,2	0,00	82,08	-	-	0,00	0,00	-	0,00	
T2	4 791	4 794	0	13,62	108,2	0,00	84,61	-	-	0,00	0,00	-	0,00	
T3	5 293	5 296	0	12,19	108,2	0,00	85,48	-	-	0,00	0,00	-	0,00	
T4	6 079	6 082	0	10,47	108,2	0,00	86,68	-	-	0,00	0,00	-	0,00	
T5	4 259	4 263	0	15,33	108,2	0,00	83,59	-	-	0,00	0,00	-	0,00	
T6	3 767	3 771	0	17,11	108,2	0,00	82,53	-	-	0,00	0,00	-	0,00	
T7	3 258	3 263	0	19,21	108,2	0,00	81,27	-	-	0,00	0,00	-	0,00	
T8	2 699	2 705	0	21,89	108,2	0,00	79,64	-	-	0,00	0,00	-	0,00	
T9	3 878	3 883	0	16,69	108,2	0,00	82,78	-	-	0,00	0,00	-	0,00	
Sum	29,72													

- Data undefined due to calculation with octave data

## Noise sensitive area: E Asuinrakennus (Sandhedsvägen 65)

WTG		Wind speed: 8,0 m/s												
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]	
T1	4 017	4 021	0	16,18	108,2	0,00	83,09	-	-	0,00	0,00	-	0,00	
T10	4 286	4 290	0	15,24	108,2	0,00	83,65	-	-	0,00	0,00	-	0,00	
T11	3 932	3 936	0	16,49	108,2	0,00	82,90	-	-	0,00	0,00	-	0,00	
T12	3 492	3 497	0	18,21	108,2	0,00	81,87	-	-	0,00	0,00	-	0,00	
T13	2 504	2 510	0	22,94	108,2	0,00	78,99	-	-	0,00	0,00	-	0,00	
T14	1 936	1 944	0	26,46	108,2	0,00	76,78	-	-	0,00	0,00	-	0,00	
T15	3 242	3 247	0	19,28	108,2	0,00	81,23	-	-	0,00	0,00	-	0,00	
T2	3 863	3 867	0	16,75	108,2	0,00	82,75	-	-	0,00	0,00	-	0,00	
T3	4 497	4 501	0	14,54	108,2	0,00	84,07	-	-	0,00	0,00	-	0,00	
T4	5 228	5 231	0	12,36	108,2	0,00	85,37	-	-	0,00	0,00	-	0,00	
T5	3 353	3 358	0	18,79	108,2	0,00	81,52	-	-	0,00	0,00	-	0,00	
T6	2 822	2 828	0	21,26	108,2	0,00	80,03	-	-	0,00	0,00	-	0,00	
T7	2 411	2 417	0	23,47	108,2	0,00	78,67	-	-	0,00	0,00	-	0,00	
T8	1 792	1 801	0	27,48	108,2	0,00	76,11	-	-	0,00	0,00	-	0,00	
T9	3 148	3 153	0	19,70	108,2	0,00	80,98	-	-	0,00	0,00	-	0,00	
Sum	33,20													

- Data undefined due to calculation with octave data

## DECIBEL - Detailed results

Calculation: V136-3.45 x 15 x HH172 NO STE (108,2 dB) Noise calculation model: ISO 9613-2 Finland 8,0 m/s  
Noise sensitive area: F Asuinrakennus (Mullontie 128)

WTG		Wind speed: 8,0 m/s												
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]	
T1	2 158	2 165	0	24,99	108,2	0,00	77,71	-	-	0,00	0,00	-	0,00	
T10	3 997	4 001	0	16,25	108,2	0,00	83,04	-	-	0,00	0,00	-	0,00	
T11	4 118	4 122	0	15,82	108,2	0,00	83,30	-	-	0,00	0,00	-	0,00	
T12	4 058	4 062	0	16,03	108,2	0,00	83,17	-	-	0,00	0,00	-	0,00	
T13	3 934	3 938	0	16,48	108,2	0,00	82,91	-	-	0,00	0,00	-	0,00	
T14	3 934	3 938	0	16,48	108,2	0,00	82,90	-	-	0,00	0,00	-	0,00	
T15	4 500	4 504	0	14,53	108,2	0,00	84,07	-	-	0,00	0,00	-	0,00	
T2	2 650	2 656	0	22,15	108,2	0,00	79,49	-	-	0,00	0,00	-	0,00	
T3	3 552	3 557	0	17,96	108,2	0,00	82,02	-	-	0,00	0,00	-	0,00	
T4	3 719	3 724	0	17,29	108,2	0,00	82,42	-	-	0,00	0,00	-	0,00	
T5	2 646	2 652	0	22,17	108,2	0,00	79,47	-	-	0,00	0,00	-	0,00	
T6	2 461	2 468	0	23,18	108,2	0,00	78,85	-	-	0,00	0,00	-	0,00	
T7	2 891	2 896	0	20,92	108,2	0,00	80,24	-	-	0,00	0,00	-	0,00	
T8	2 882	2 888	0	20,96	108,2	0,00	80,21	-	-	0,00	0,00	-	0,00	
T9	3 321	3 327	0	18,93	108,2	0,00	81,44	-	-	0,00	0,00	-	0,00	
Sum	31,85													

- Data undefined due to calculation with octave data

Noise sensitive area: G Lomarakennus/Partiomaja (Korpilahdenkuja 134)

WTG		Wind speed: 8,0 m/s												
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]	
T1	1 279	1 291	0	31,78	108,2	0,00	73,22	-	-	0,00	0,00	-	0,00	
T10	2 875	2 880	0	21,00	108,2	0,00	80,19	-	-	0,00	0,00	-	0,00	
T11	3 282	3 287	0	19,10	108,2	0,00	81,34	-	-	0,00	0,00	-	0,00	
T12	3 521	3 525	0	18,09	108,2	0,00	81,94	-	-	0,00	0,00	-	0,00	
T13	4 039	4 043	0	16,10	108,2	0,00	83,13	-	-	0,00	0,00	-	0,00	
T14	4 383	4 386	0	14,91	108,2	0,00	83,84	-	-	0,00	0,00	-	0,00	
T15	4 215	4 218	0	15,48	108,2	0,00	83,50	-	-	0,00	0,00	-	0,00	
T2	1 774	1 783	0	27,61	108,2	0,00	76,03	-	-	0,00	0,00	-	0,00	
T3	2 160	2 168	0	24,98	108,2	0,00	77,72	-	-	0,00	0,00	-	0,00	
T4	1 788	1 797	0	27,51	108,2	0,00	76,09	-	-	0,00	0,00	-	0,00	
T5	2 241	2 248	0	24,48	108,2	0,00	78,04	-	-	0,00	0,00	-	0,00	
T6	2 581	2 587	0	22,52	108,2	0,00	79,25	-	-	0,00	0,00	-	0,00	
T7	3 168	3 173	0	19,61	108,2	0,00	81,03	-	-	0,00	0,00	-	0,00	
T8	3 601	3 606	0	17,76	108,2	0,00	82,14	-	-	0,00	0,00	-	0,00	
T9	2 982	2 988	0	20,47	108,2	0,00	80,51	-	-	0,00	0,00	-	0,00	
Sum	36,09													

- Data undefined due to calculation with octave data

Noise sensitive area: H Asuinrakennus (Kotkannevantie 269)

WTG		Wind speed: 8,0 m/s												
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]	
T1	3 129	3 134	0	19,79	108,2	0,00	80,92	-	-	0,00	0,00	-	0,00	
T10	2 646	2 652	0	22,17	108,2	0,00	79,47	-	-	0,00	0,00	-	0,00	
T11	3 157	3 162	0	19,66	108,2	0,00	81,00	-	-	0,00	0,00	-	0,00	
T12	3 637	3 640	0	17,62	108,2	0,00	82,22	-	-	0,00	0,00	-	0,00	
T13	4 635	4 638	0	14,10	108,2	0,00	84,33	-	-	0,00	0,00	-	0,00	
T14	5 207	5 209	0	12,42	108,2	0,00	85,34	-	-	0,00	0,00	-	0,00	
T15	4 303	4 306	0	15,18	108,2	0,00	83,68	-	-	0,00	0,00	-	0,00	
T2	2 976	2 981	0	20,51	108,2	0,00	80,49	-	-	0,00	0,00	-	0,00	
T3	2 254	2 261	0	24,40	108,2	0,00	78,09	-	-	0,00	0,00	-	0,00	
T4	1 565	1 575	0	29,25	108,2	0,00	74,94	-	-	0,00	0,00	-	0,00	
T5	3 427	3 432	0	18,48	108,2	0,00	81,71	-	-	0,00	0,00	-	0,00	
T6	3 972	3 975	0	16,34	108,2	0,00	82,99	-	-	0,00	0,00	-	0,00	
T7	4 339	4 342	0	15,06	108,2	0,00	83,75	-	-	0,00	0,00	-	0,00	
T8	4 957	4 960	0	13,13	108,2	0,00	84,91	-	-	0,00	0,00	-	0,00	
T9	3 657	3 661	0	17,54	108,2	0,00	82,27	-	-	0,00	0,00	-	0,00	
Sum	32,87													

- Data undefined due to calculation with octave data

## DECIBEL - Detailed results

Calculation: V136-3.45 x 15 x HH172 NO STE (108,2 dB) Noise calculation model: ISO 9613-2 Finland 8,0 m/s  
Noise sensitive area: I Asuinrakennus (Klumpintie 171)

WTG		Wind speed: 8,0 m/s												
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]	
T1	3 373	3 377	0	18,71	108,2	0,00	81,57	-	-	0,00	0,00	-	0,00	
T10	1 766	1 775	0	27,68	108,2	0,00	75,98	-	-	0,00	0,00	-	0,00	
T11	2 060	2 067	0	25,63	108,2	0,00	77,31	-	-	0,00	0,00	-	0,00	
T12	2 517	2 522	0	22,88	108,2	0,00	79,04	-	-	0,00	0,00	-	0,00	
T13	3 561	3 565	0	17,93	108,2	0,00	82,04	-	-	0,00	0,00	-	0,00	
T14	4 170	4 174	0	15,64	108,2	0,00	83,41	-	-	0,00	0,00	-	0,00	
T15	2 993	2 998	0	20,43	108,2	0,00	80,54	-	-	0,00	0,00	-	0,00	
T2	2 903	2 908	0	20,86	108,2	0,00	80,27	-	-	0,00	0,00	-	0,00	
T3	1 979	1 987	0	26,16	108,2	0,00	76,96	-	-	0,00	0,00	-	0,00	
T4	2 004	2 012	0	25,99	108,2	0,00	77,07	-	-	0,00	0,00	-	0,00	
T5	3 107	3 112	0	19,89	108,2	0,00	80,86	-	-	0,00	0,00	-	0,00	
T6	3 580	3 584	0	17,85	108,2	0,00	82,09	-	-	0,00	0,00	-	0,00	
T7	3 697	3 701	0	17,38	108,2	0,00	82,37	-	-	0,00	0,00	-	0,00	
T8	4 300	4 303	0	15,19	108,2	0,00	83,68	-	-	0,00	0,00	-	0,00	
T9	2 901	2 907	0	20,86	108,2	0,00	80,27	-	-	0,00	0,00	-	0,00	
Sum	34,36													

- Data undefined due to calculation with octave data

## Noise sensitive area: J Asuinrakennus (Klumpvägen 170)

WTG		Wind speed: 8,0 m/s												
No.	Distance [m]	Sound distance [m]	Penalty [dB]	Calculated [dB(A)]	LwA,ref [dB(A)]	Dc [dB]	Adiv [dB]	Aatm [dB]	Agr [dB]	Abar [dB]	Amisc [dB]	A [dB]	Cmet [dB]	
T1	3 432	3 437	0	18,46	108,2	0,00	81,72	-	-	0,00	0,00	-	0,00	
T10	1 537	1 548	0	29,47	108,2	0,00	74,79	-	-	0,00	0,00	-	0,00	
T11	1 620	1 629	0	28,81	108,2	0,00	75,24	-	-	0,00	0,00	-	0,00	
T12	1 998	2 006	0	26,04	108,2	0,00	77,05	-	-	0,00	0,00	-	0,00	
T13	2 990	2 995	0	20,44	108,2	0,00	80,53	-	-	0,00	0,00	-	0,00	
T14	3 591	3 595	0	17,81	108,2	0,00	82,11	-	-	0,00	0,00	-	0,00	
T15	2 337	2 343	0	23,90	108,2	0,00	78,40	-	-	0,00	0,00	-	0,00	
T2	2 876	2 882	0	20,99	108,2	0,00	80,19	-	-	0,00	0,00	-	0,00	
T3	2 032	2 040	0	25,80	108,2	0,00	77,19	-	-	0,00	0,00	-	0,00	
T4	2 361	2 368	0	23,76	108,2	0,00	78,49	-	-	0,00	0,00	-	0,00	
T5	2 939	2 945	0	20,68	108,2	0,00	80,38	-	-	0,00	0,00	-	0,00	
T6	3 333	3 338	0	18,88	108,2	0,00	81,47	-	-	0,00	0,00	-	0,00	
T7	3 324	3 328	0	18,92	108,2	0,00	81,44	-	-	0,00	0,00	-	0,00	
T8	3 885	3 889	0	16,66	108,2	0,00	82,80	-	-	0,00	0,00	-	0,00	
T9	2 540	2 547	0	22,74	108,2	0,00	79,12	-	-	0,00	0,00	-	0,00	
Sum	35,78													

- Data undefined due to calculation with octave data

## DECIBEL - Assumptions for noise calculation

Calculation: V136-3.45 x 15 x HH172 NO STE (108,2 dB) Noise calculation model: ISO 9613-2 Finland 8,0 m/s

Noise calculation model:

ISO 9613-2 Finland

Wind speed:

8,0 m/s

Ground attenuation:

General, fixed, Ground factor: 0,4

Meteorological coefficient, CO:

0,0 dB

Type of demand in calculation:

1: WTG noise is compared to demand (DK, DE, SE, NL etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Pure and Impulse tone penalty are added to WTG source noise

Height above ground level, when no value in NSA object:

4,0 m Don't allow override of model height with height from NSA object

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0,0 dB(A)

Octave data required

Air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[db/km]							
0,1	0,4	1,1	2,4	4,1	8,8	26,6	95,0

WTG: VESTAS V136-3.45 3450 136.0 !O!

Noise: Mode 0 - Clean blade 108,2

Source Source/Date Creator Edited  
Manufacturer 23.11.2015 USER 27.5.2016 13:02  
Based on Document no.: DMS 0055-9919\_V00

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data								
					63	125	250	500	1000	2000	4000	8000	
					[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
From other hub height	172,0	8,0	108,2	No	86,7	95,0	96,9	101,0	104,3	102,2	90,8	68,6	

NSA: Asuinrakennus (Langkujavägen 200)-A

Predefined calculation standard:

Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

NSA: Lomarakennus (Voitby Långträsket)-B

Predefined calculation standard:

Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

NSA: Asuinrakennus (Voitbyntie 480)-C

Predefined calculation standard:

Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

NSA: Asuinrakennus (Kunintie 289)-D

Predefined calculation standard:

Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

Project:

Merkkikallio

Licensed user:

FCG Suunnittelu ja tekniikka Oy  
Osmontie 34, PO Box 950  
FI-00601 Helsinki  
+358104095666  
Hans Vadback / hans.vadback@fcg.fi  
Calculated:  
10.6.2016 9:39/3.0.619

## DECIBEL - Assumptions for noise calculation

Calculation: V136-3.45 x 15 x HH172 NO STE (108,2 dB) Noise calculation model: ISO 9613-2 Finland 8,0 m/s

NSA: Asuinrakennus (Sandhedsvägen 65)-E

Predefined calculation standard:

Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

NSA: Asuinrakennus (Mullontie 128)-F

Predefined calculation standard:

Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

NSA: Lomarakennus/Partiomaja (Korpilahdenkuja 134)-G

Predefined calculation standard:

Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

NSA: Asuinrakennus (Kotkannevantie 269)-H

Predefined calculation standard:

Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

NSA: Asuinrakennus (Klumpintie 171)-I

Predefined calculation standard:

Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

NSA: Asuinrakennus (Klumpvägen 170)-J

Predefined calculation standard:

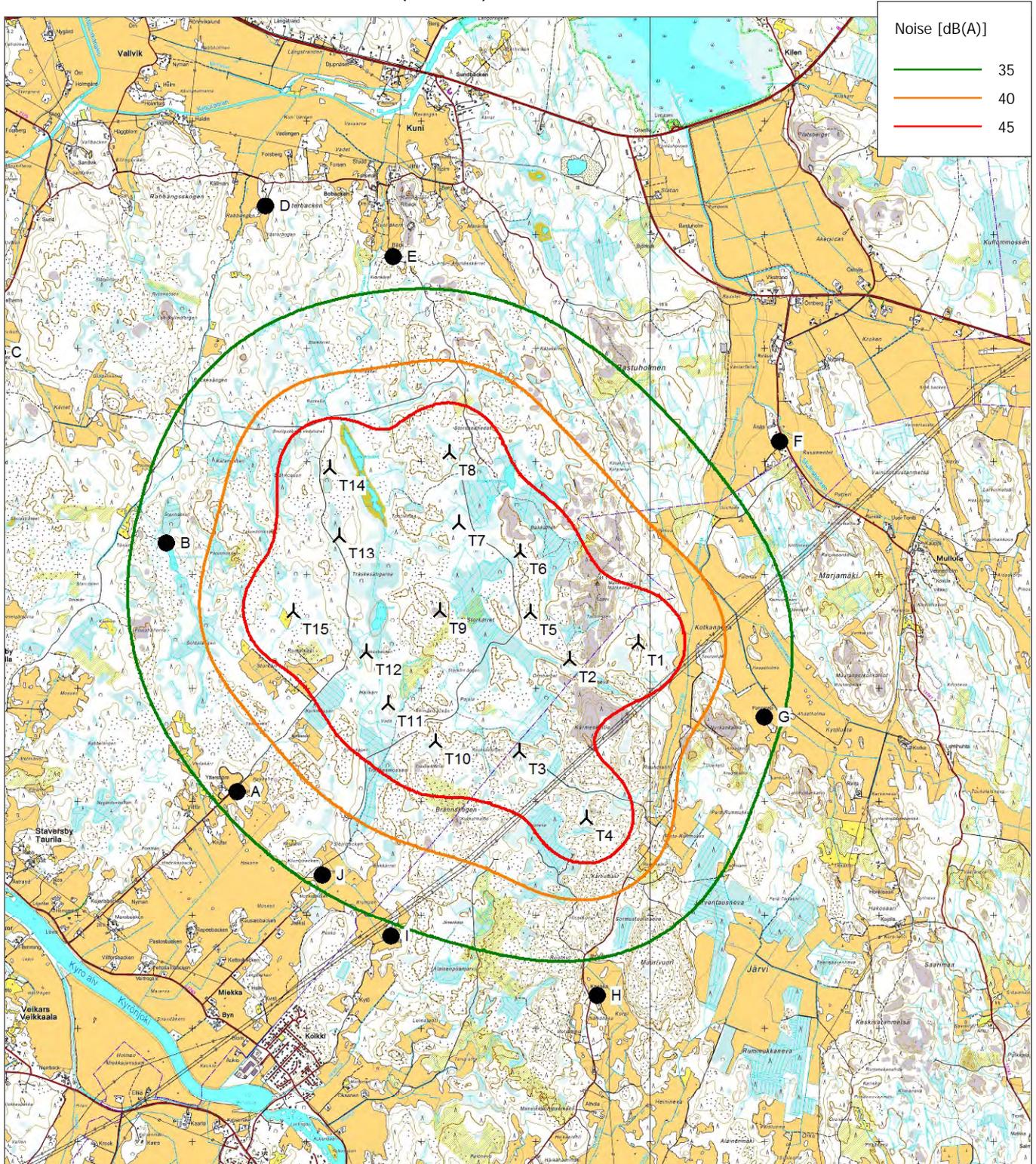
Imission height(a.g.l.): Use standard value from calculation model

Noise demand: 40,0 dB(A)

No distance demand

### DECIBEL - Map 8,0 m/s

Calculation: V136-3.45 x 15 x HH172 NO STE (108,2 dB) Noise calculation model: ISO 9613-2 Finland 8,0 m/s



0 500 1000 1500 2000 m

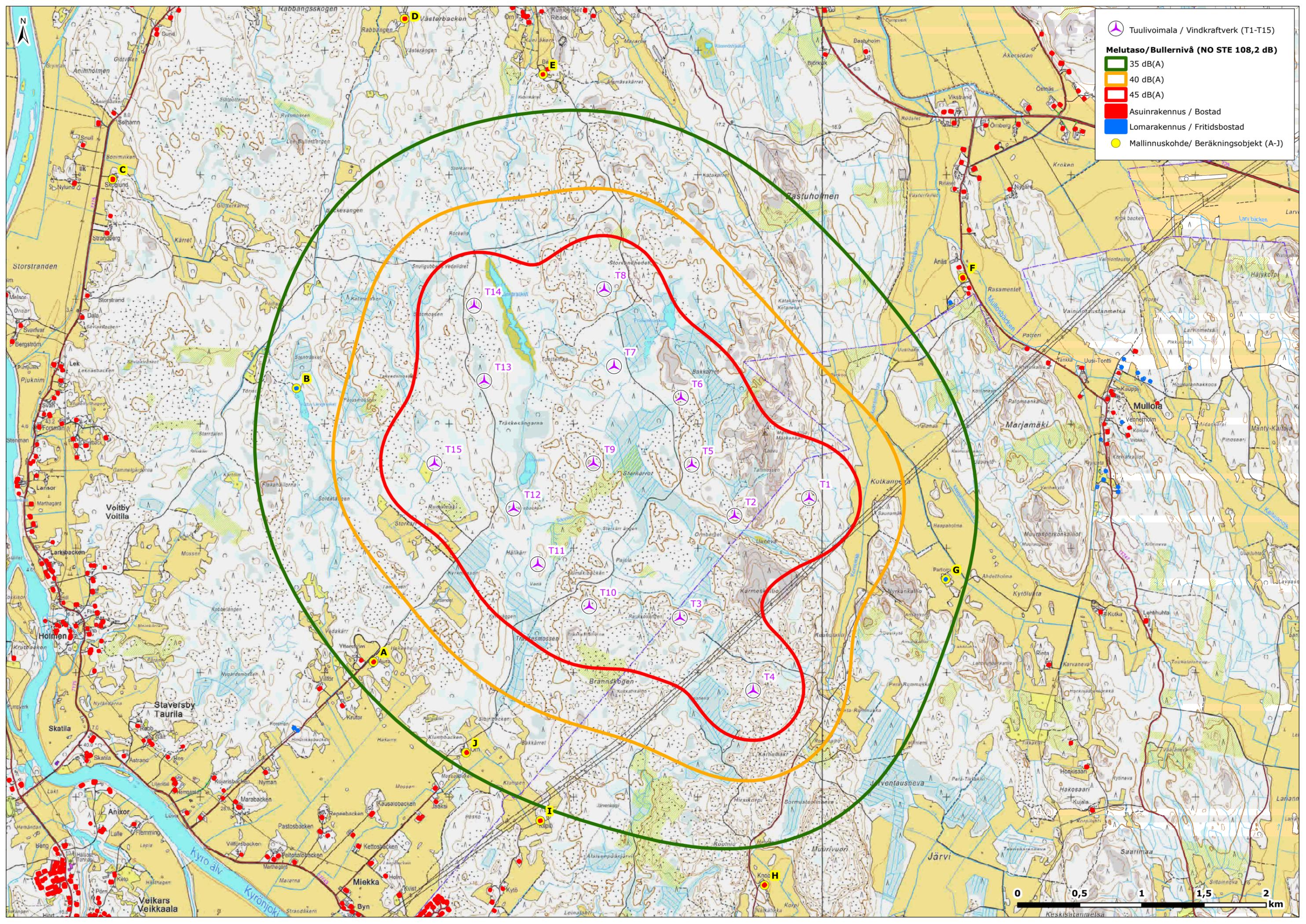
Map: Peruskarttarasteri, Print scale 1:50 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 246 344 North: 7 008 467

✈ New WTG

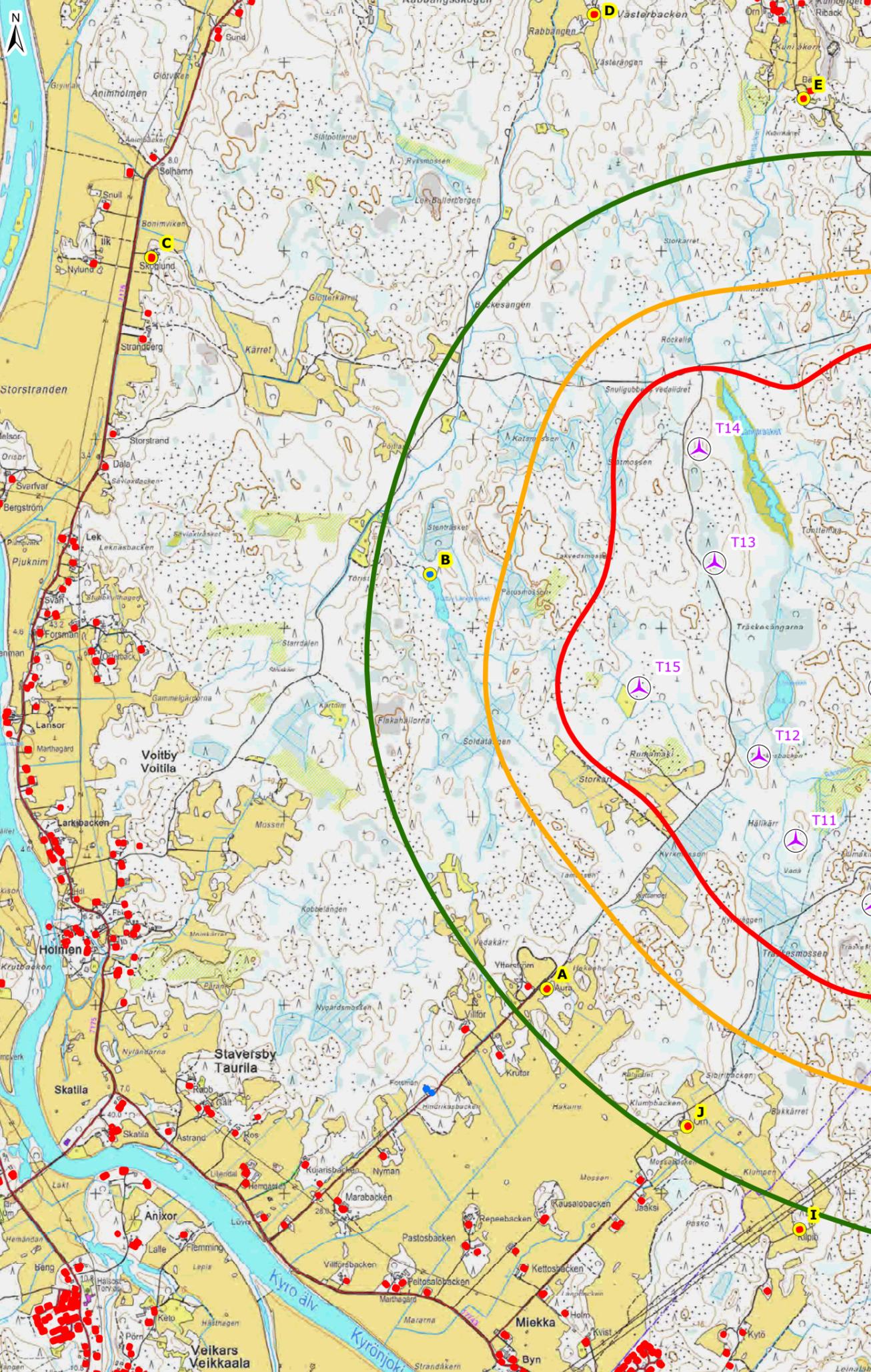
● Noise sensitive area

Noise calculation model: ISO 9613-2 Finland. Wind speed: 8,0 m/s

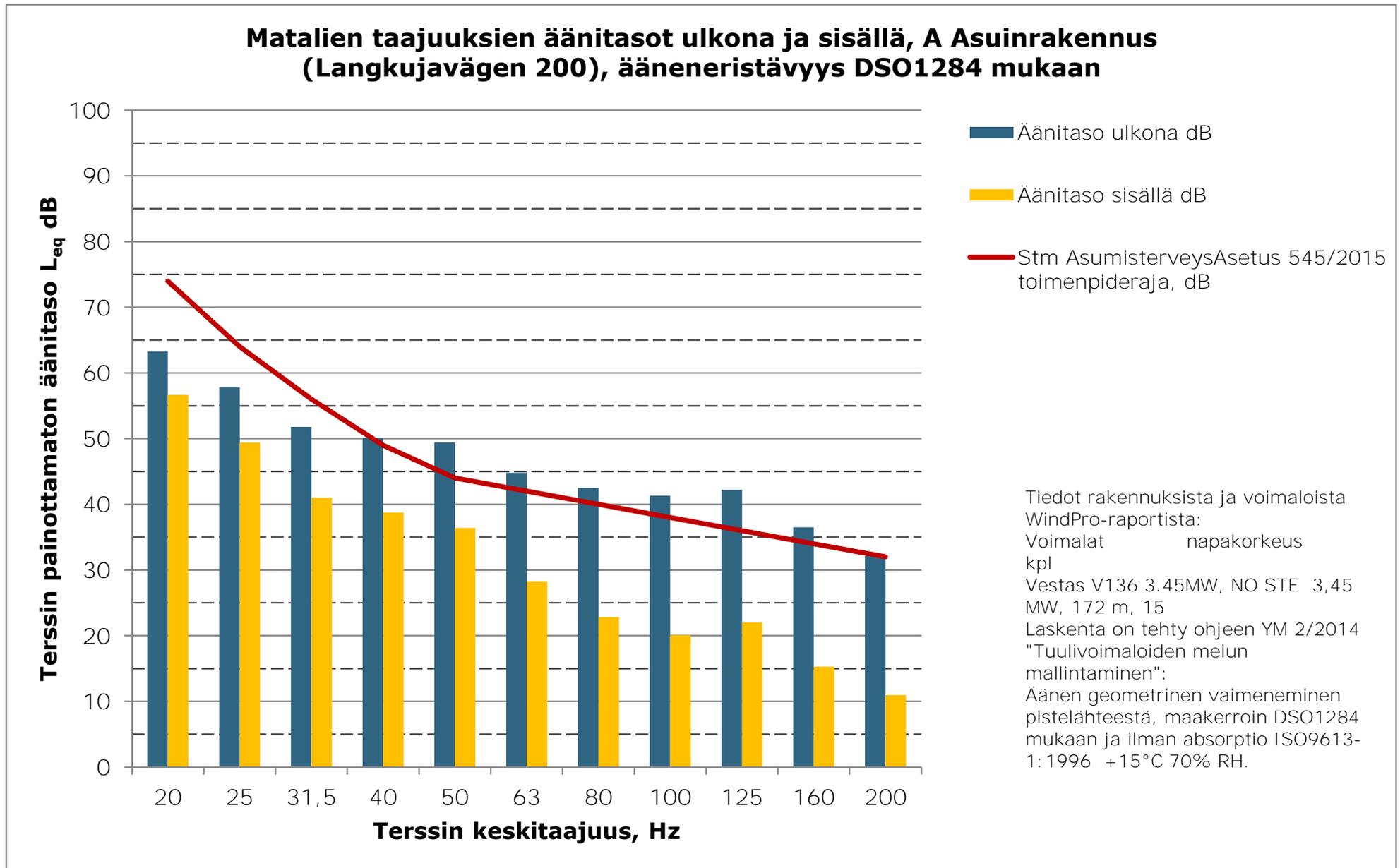
Height above sea level from active line object

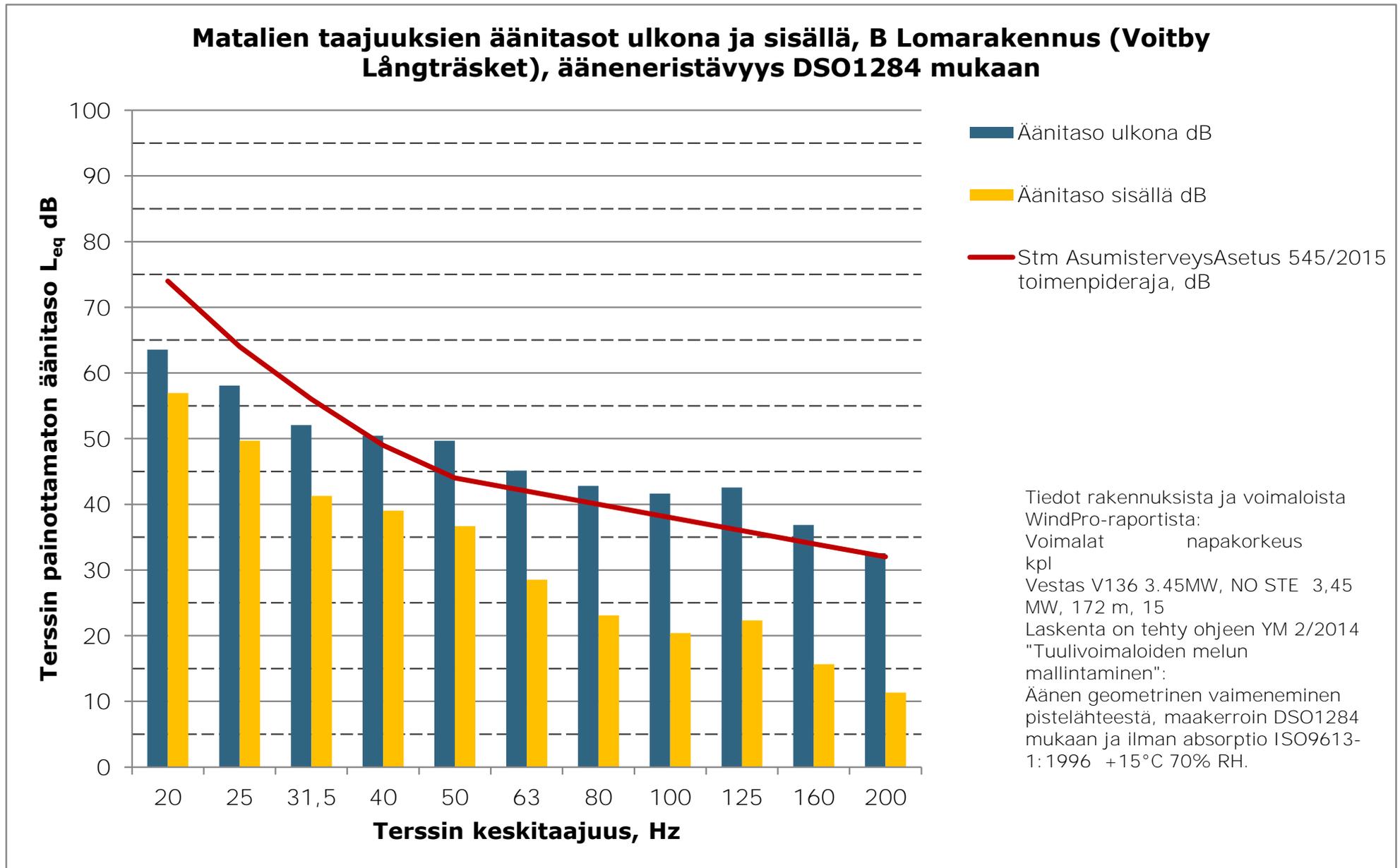


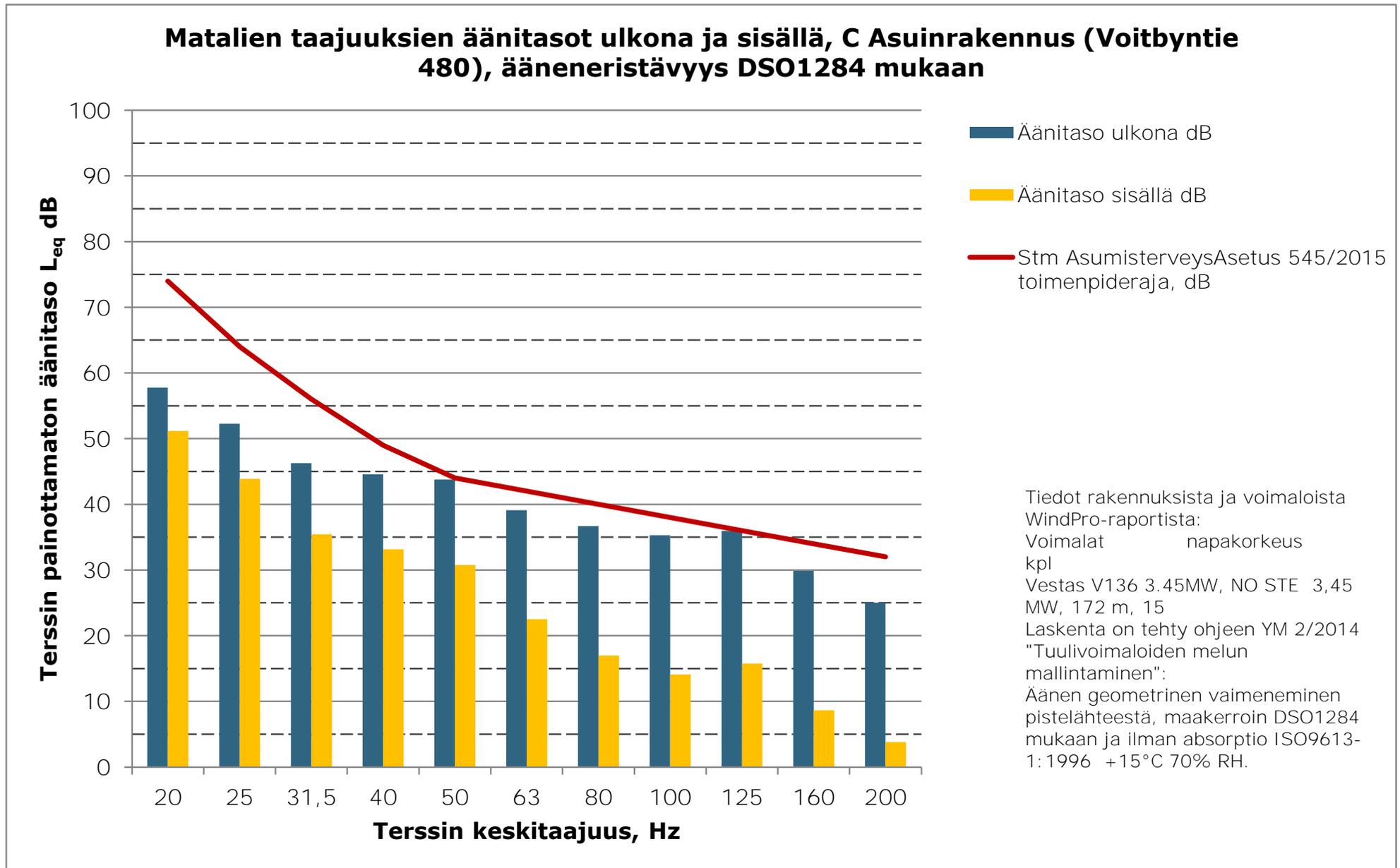
-  Tuulivoimala / Vindkraftverk (T1-T15)
- Melutaso/Bullernivå (NO STE 108,2 dB)**
-  35 dB(A)
-  40 dB(A)
-  45 dB(A)
-  Asuinrakennus / Bostad
-  Lomarakennus / Fritidsbostad
-  Mallinuskohde/ Beräkningsobjekt (A-J)

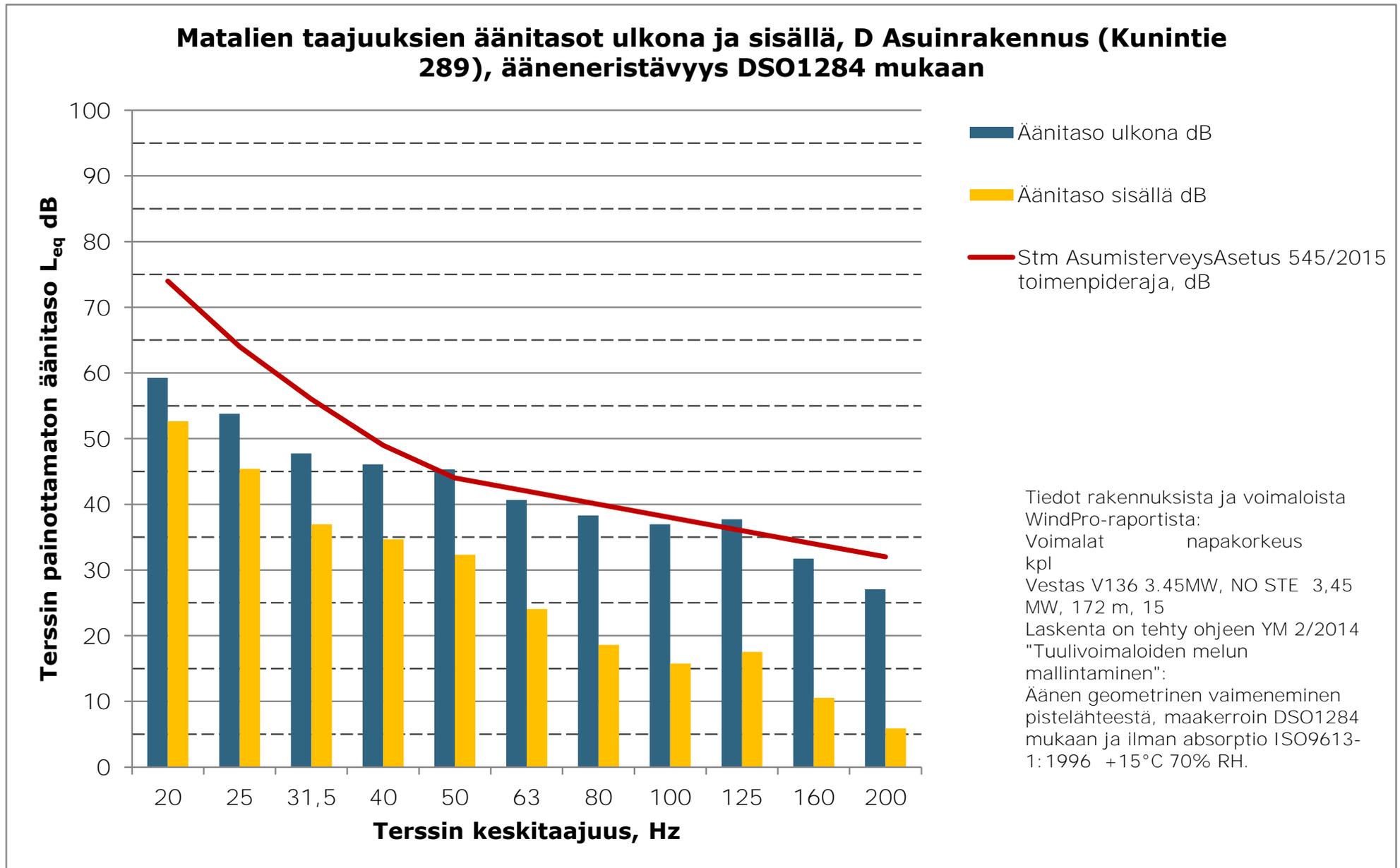


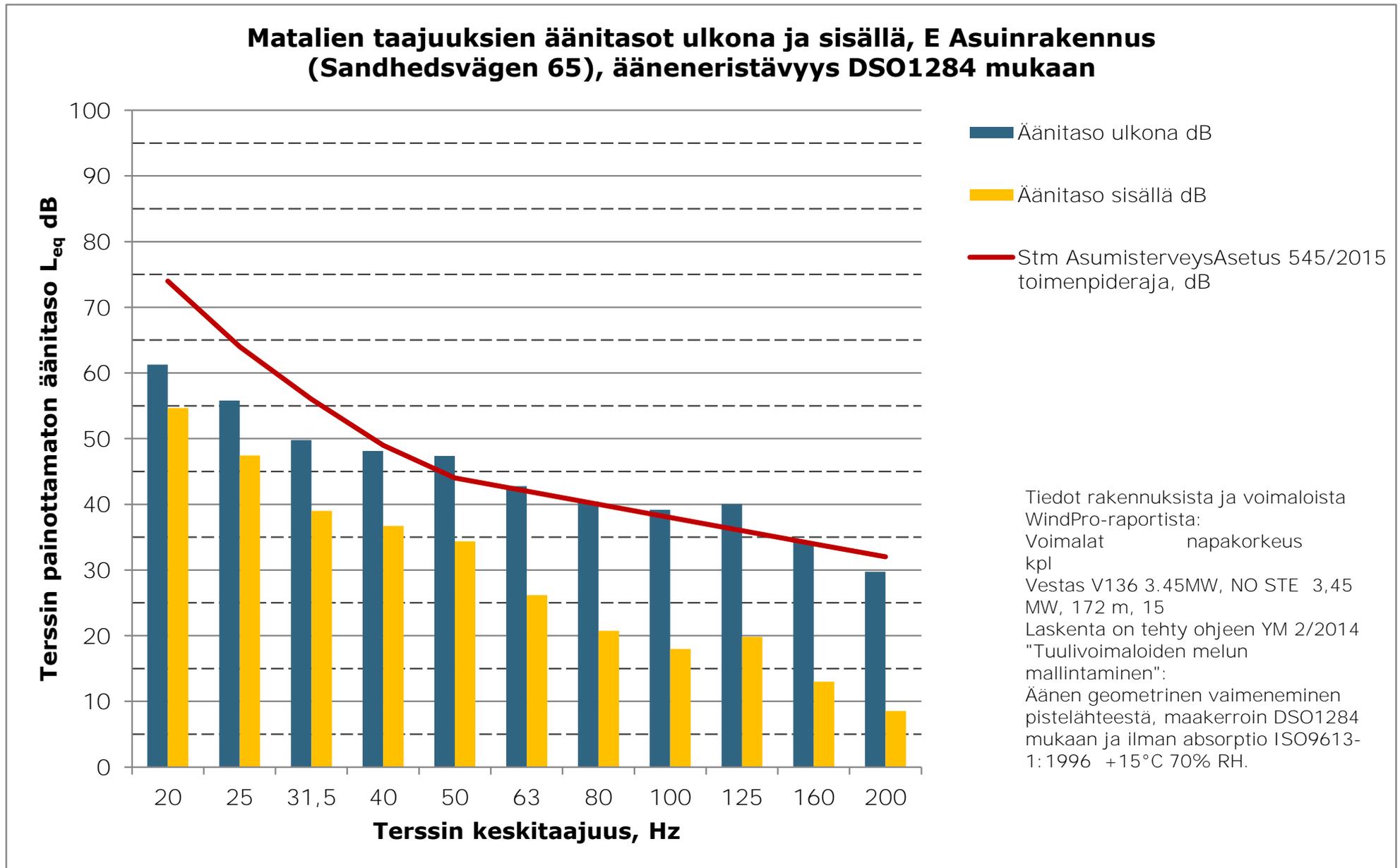
## **Liite 2: Matalataajuisen melun rakennuskohtaiset arvot (A-J)**

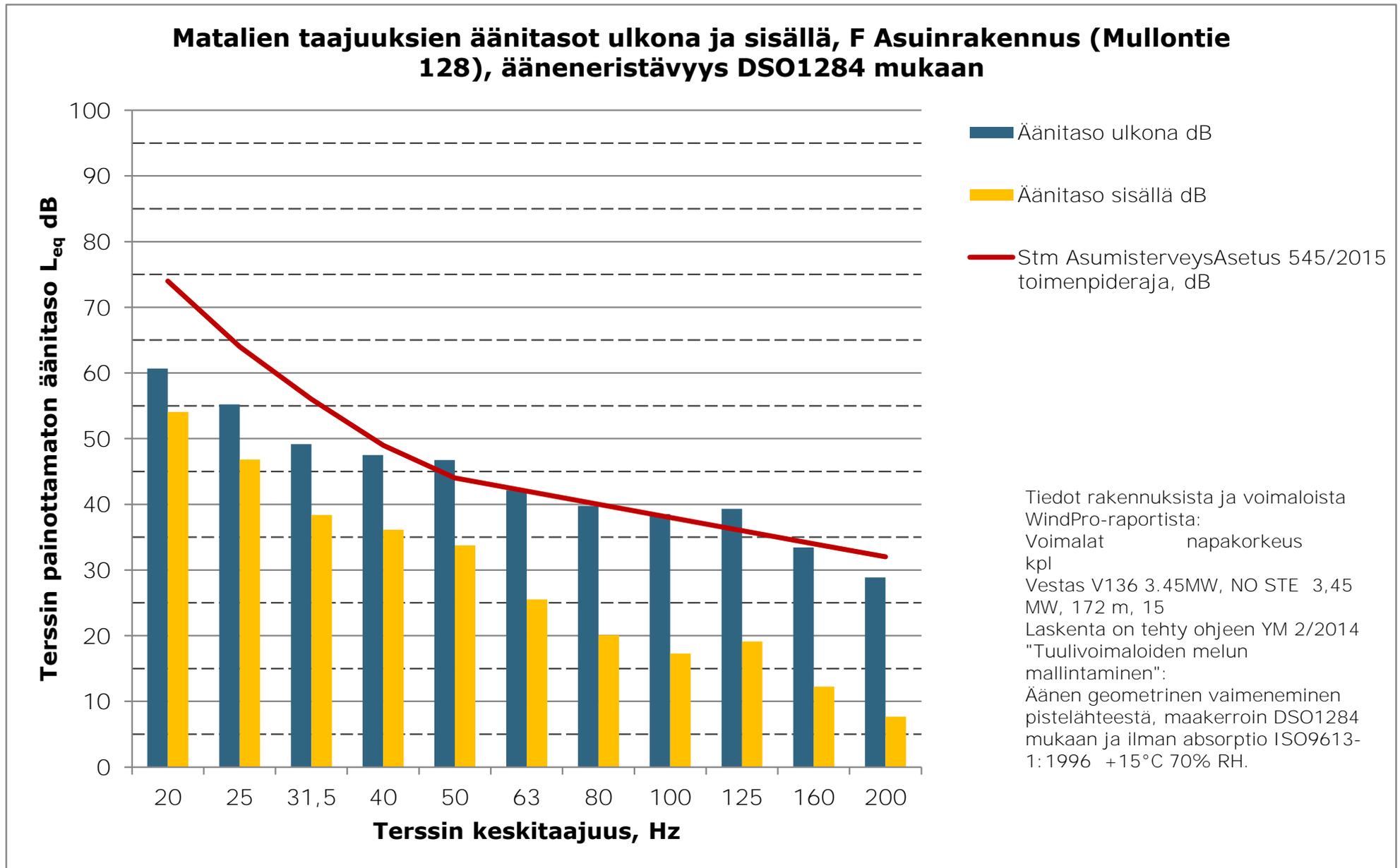


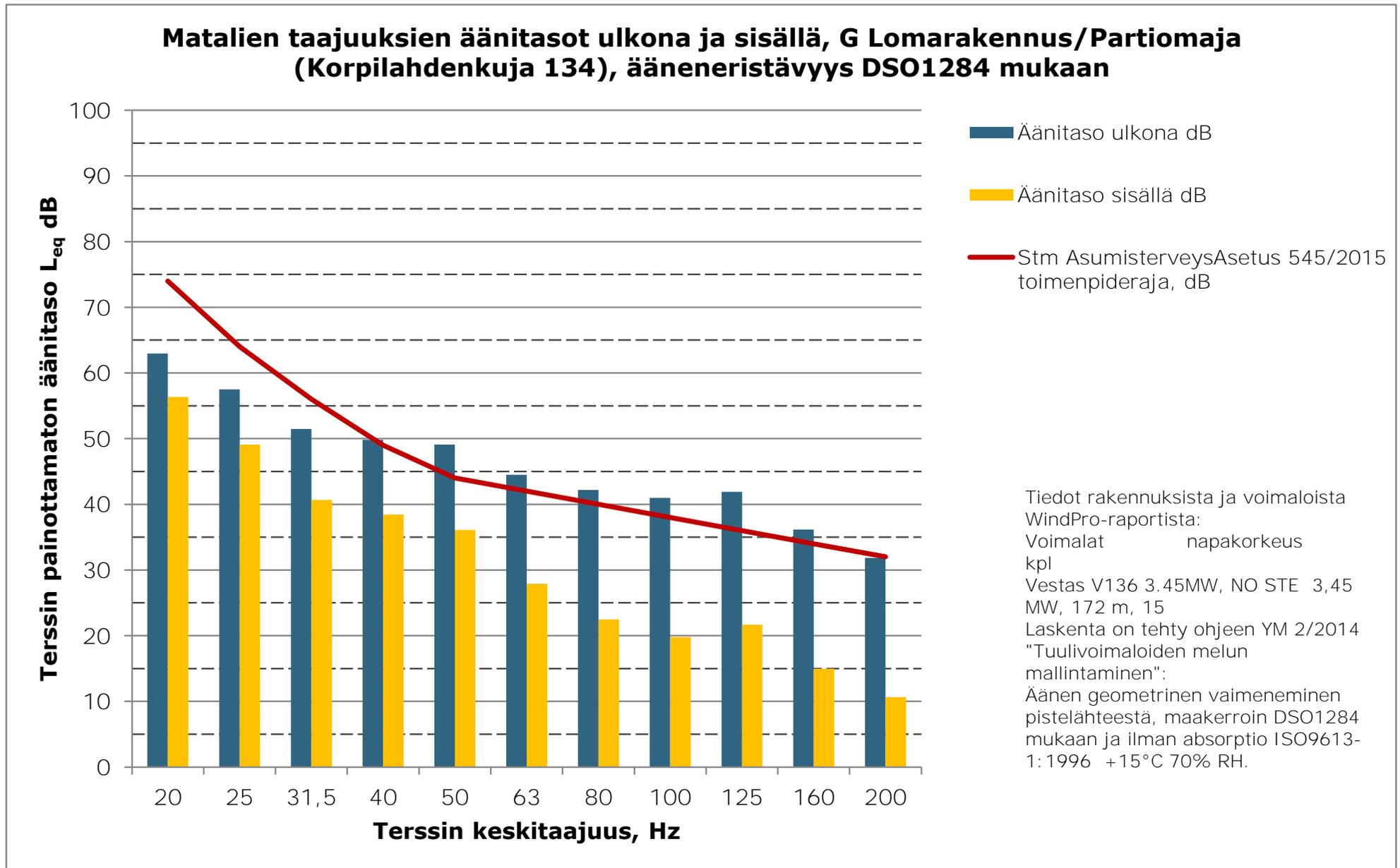


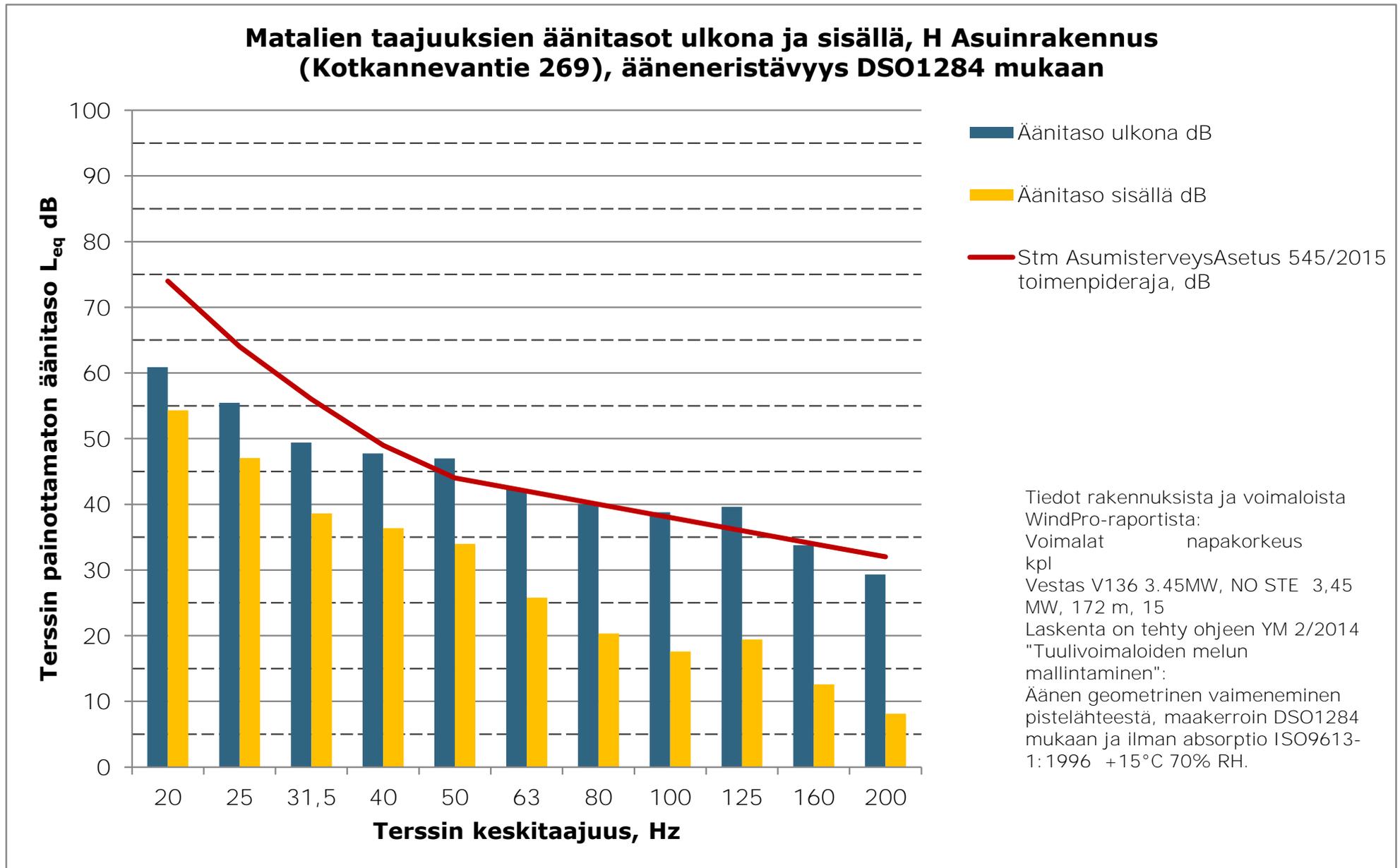


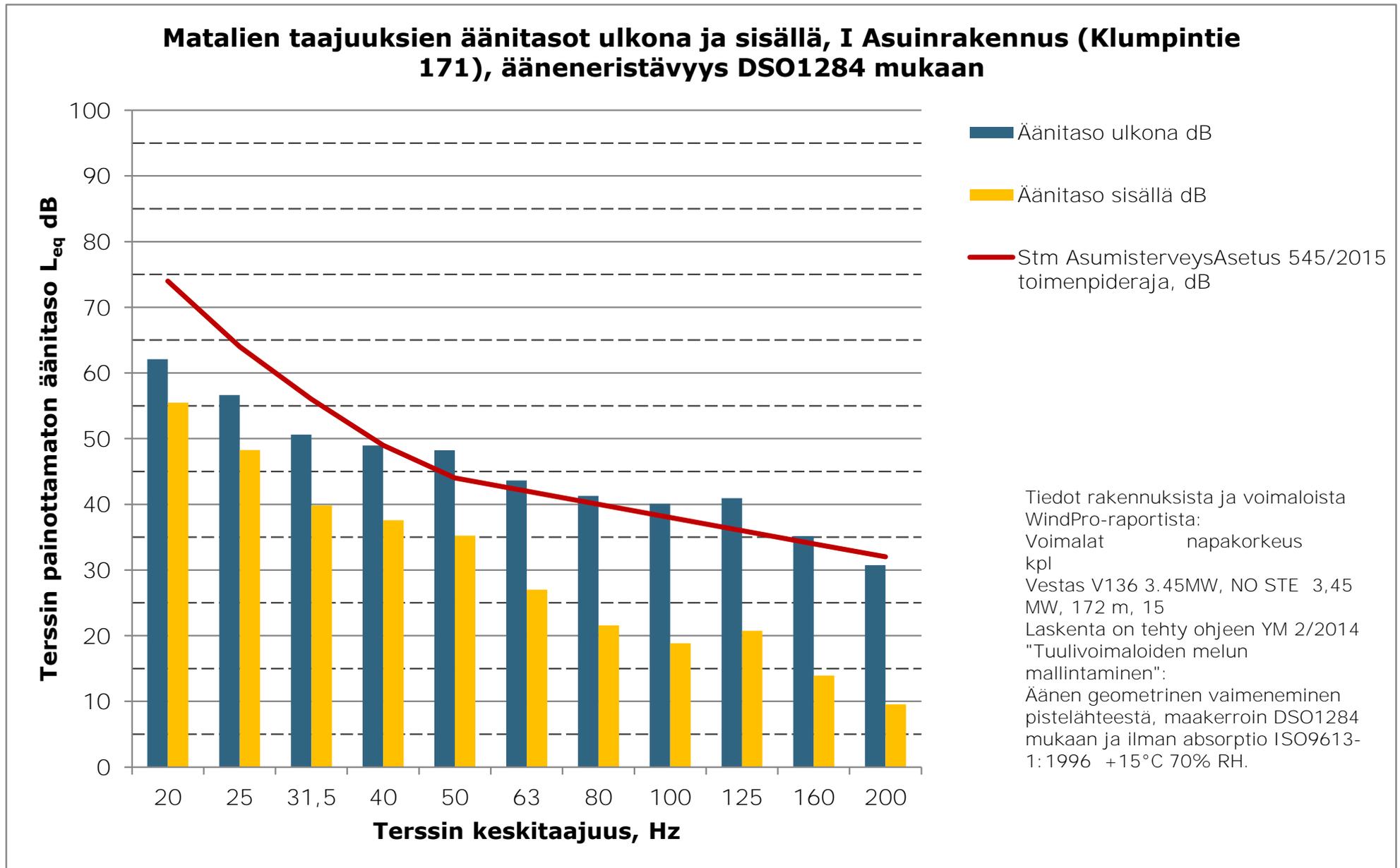




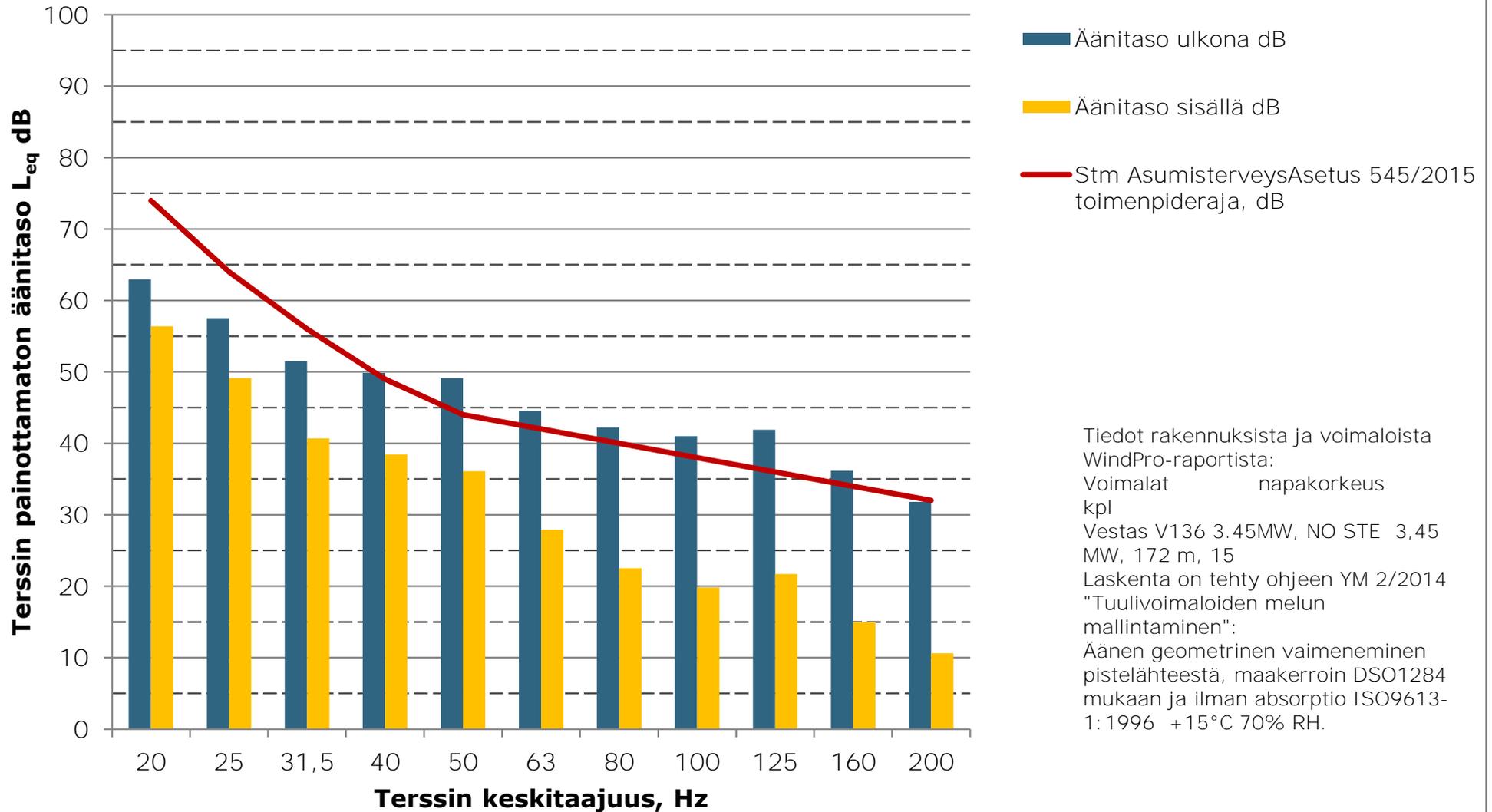








### Matalien taajuuksien äänitasot ulkona ja sisällä, J Asuinrakennus (Klumpvägen 170), ääneneristävyys DSO1284 mukaan



### **Liite 3: Varjostusmallinnusten tulokset "real case, no forest"**

## SHADOW - Main Result

Calculation: V136 x 15 x HH172 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  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational hours are calculated from WTGs in calculation and wind distribution:  
Tuuliatlas lib 30051

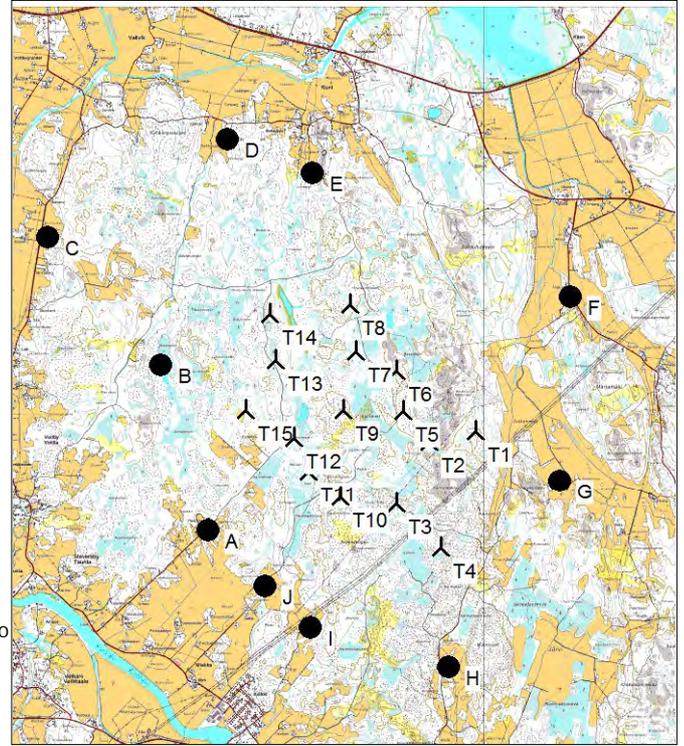
Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
Idle start wind speed: Cut in wind speed from power curve

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: Merkkikallio\_height contour lines.wpo  
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]
T1	247 894	7 008 402	20,0	T1	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T10	246 126	7 007 532	23,2	T10	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T11	245 712	7 007 870	15,0	T11	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T12	245 517	7 008 318	15,0	T12	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T13	245 281	7 009 344	17,5	T13	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T14	245 200	7 009 948	17,5	T14	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T15	244 881	7 008 680	15,0	T15	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T2	247 294	7 008 259	23,6	T2	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T3	246 855	7 007 441	25,0	T3	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T4	247 445	7 006 854	26,8	T4	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T5	246 950	7 008 670	25,0	T5	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T6	246 864	7 009 208	20,3	T6	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T7	246 326	7 009 461	17,7	T7	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T8	246 247	7 010 081	21,5	T8	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T9	246 160	7 008 681	29,6	T9	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	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	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	°	°	
A	Asuinrakennus (Langkujavägen 200)	244 392	7 007 085	10,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
B	Lomarakennus (Voitby Långträsket)	243 772	7 009 284	12,8	5,0	5,0	1,0	0,0	0,0	"Green house mode"
C	Asuinrakennus (Voitbyntie 480)	242 293	7 010 963	5,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
D	Asuinrakennus (Kunintie 289)	244 642	7 012 253	5,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
E	Asuinrakennus (Sandhedsvägen 65)	245 754	7 011 805	10,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
F	Asuinrakennus (Mullontie 128)	249 130	7 010 173	7,5	5,0	5,0	1,0	0,0	0,0	"Green house mode"
G	Lomarakennus/Partiomaja (Korpilahdenkuja 134)	248 995	7 007 749	10,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
H	Asuinrakennus (Kotkannevantie 269)	247 537	7 005 291	18,5	5,0	5,0	1,0	0,0	0,0	"Green house mode"

To be continued on next page...

Project:

Merkkikallio

Licensed user:

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 Osmontie 34, PO Box 950  
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 +358104095666  
 Hans Vadback / hans.vadback@fcg.fi  
 Calculated:  
 10.6.2016 11:06/3.0.619

## SHADOW - Main Result

Calculation: V136 x 15 x HH172 real case\_no forest

...continued from previous page

No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south CW [°]	Slope of window [°]	Direction mode
I	Asuinrakennus (Klumpintie 171)	245 733	7 005 809	12,5	5,0	5,0	1,0	0,0	0,0	"Green house mode"
J	Asuinrakennus (Klumpvägen 170)	245 136	7 006 355	10,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"

## Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Asuinrakennus (Langkujavägen 200)	6:47
B	Lomarakennus (Voitby Långträsket)	7:32
C	Asuinrakennus (Voitbyntie 480)	0:00
D	Asuinrakennus (Kunintie 289)	0:00
E	Asuinrakennus (Sandhedsvägen 65)	0:00
F	Asuinrakennus (Mullontie 128)	0:00
G	Lomarakennus/Partiomaja (Korpilahdenkuja 134)	5:24
H	Asuinrakennus (Kotkannevantie 269)	0:00
I	Asuinrakennus (Klumpintie 171)	0:00
J	Asuinrakennus (Klumpvägen 170)	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
T1	T1	18:44	5:24
T10	T10	0:00	0:00
T11	T11	21:36	6:47
T12	T12	0:00	0:00
T13	T13	8:10	1:59
T14	T14	12:00	3:41
T15	T15	10:31	1:54
T2	T2	0:00	0:00
T3	T3	0:00	0:00
T4	T4	0:00	0:00
T5	T5	0:00	0:00
T6	T6	0:00	0:00
T7	T7	0:00	0:00
T8	T8	0:00	0:00
T9	T9	0:00	0:00

Project:

Merkkikallio

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Osmontie 34, PO Box 950
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+358104095666
Hans Vadback / hans.vadback@fcg.fi
Calculated:
10.6.2016 11:06/3.0.619

SHADOW - Calendar

Calculation: V136 x 15 x HH172 real case\_no forestShadow receptor: A - Asuinrakennus (Langkujavägen 200)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January to December) and rows for days (1 to 31). Each cell contains a time range (hh:mm) and a numerical value. Summary rows at the bottom show total 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: V136 x 15 x HH172 real case\_no forestShadow receptor: B - Lomarakennus (Voitby Långträsket)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June
1	10:10	09:08	07:41	06:56	05:15	03:47
	15:02	16:25	17:51	20:20	21:47	23:16
2	10:10	09:06	07:38	06:53	05:12	03:45
	15:04	16:28	17:54	20:22	21:50	23:19
3	10:09	09:03	07:35	06:49	05:09	03:42
	15:06	16:32	17:57	20:25	21:53	23:21
4	10:08	09:00	07:31	08:21 (T15) 06:46	05:06	03:40
	15:08	16:35	18:00	8 08:29 (T15) 20:28	21:56	23:23
5	10:07	08:57	07:28	08:17 (T15) 06:43	05:03	05:50 (T14) 03:39
	15:10	16:38	18:03	14 08:31 (T15) 20:31	21:59	5 05:55 (T14) 23:25
6	10:05	08:54	07:25	08:15 (T15) 06:39	07:21 (T13) 04:59	05:47 (T14) 03:37
	15:12	16:41	18:06	18 08:33 (T15) 20:34	3 07:24 (T13) 22:02	11 05:58 (T14) 23:28
7	10:04	08:51	07:21	08:13 (T15) 06:36	07:17 (T13) 04:56	05:45 (T14) 03:35
	15:14	16:44	18:08	21 08:34 (T15) 20:37	11 07:28 (T13) 22:05	14 05:59 (T14) 23:30
8	10:03	08:48	07:18	08:12 (T15) 06:32	07:15 (T13) 04:53	05:44 (T14) 03:33
	15:16	16:47	18:11	23 08:35 (T15) 20:39	15 07:30 (T13) 22:08	16 06:00 (T14) 23:32
9	10:01	08:45	07:14	08:11 (T15) 06:29	07:12 (T13) 04:50	05:42 (T14) 03:32
	15:19	16:50	18:14	24 08:35 (T15) 20:42	18 07:30 (T13) 22:11	19 06:01 (T14) 23:33
10	10:00	08:42	07:11	08:11 (T15) 06:26	07:11 (T13) 04:47	05:42 (T14) 03:30
	15:21	16:53	18:17	25 08:36 (T15) 20:45	20 07:31 (T13) 22:14	20 06:02 (T14) 23:35
11	09:58	08:39	07:08	08:10 (T15) 06:22	07:11 (T13) 04:44	05:42 (T14) 03:29
	15:24	16:56	18:20	25 08:35 (T15) 20:48	20 07:31 (T13) 22:17	20 06:02 (T14) 23:37
12	09:56	08:36	07:04	08:10 (T15) 06:19	07:10 (T13) 04:41	05:42 (T14) 03:28
	15:26	17:00	18:23	25 08:35 (T15) 20:51	22 07:32 (T13) 22:20	21 06:03 (T14) 23:38
13	09:54	08:33	07:01	08:09 (T15) 06:15	07:09 (T13) 04:38	05:41 (T14) 03:27
	15:29	17:03	18:26	25 08:34 (T15) 20:54	22 07:31 (T13) 22:23	21 06:02 (T14) 23:40
14	09:52	08:30	06:58	08:10 (T15) 06:12	07:09 (T13) 04:35	05:40 (T14) 03:26
	15:32	17:06	18:29	24 08:34 (T15) 20:57	22 07:31 (T13) 22:26	22 06:02 (T14) 23:41
15	09:51	08:26	06:54	08:10 (T15) 06:09	07:10 (T13) 04:32	05:41 (T14) 03:25
	15:34	17:09	18:31	22 08:32 (T15) 21:00	20 07:30 (T13) 22:29	21 06:02 (T14) 23:42
16	09:48	08:23	06:51	08:11 (T15) 06:05	07:10 (T13) 04:29	05:41 (T14) 03:24
	15:37	17:12	18:34	20 08:31 (T15) 21:02	19 07:29 (T13) 22:32	22 06:03 (T14) 23:43
17	09:46	08:20	06:47	08:11 (T15) 06:02	07:10 (T13) 04:26	05:41 (T14) 03:24
	15:40	17:15	18:37	18 08:29 (T15) 21:05	18 07:28 (T13) 22:35	21 06:02 (T14) 23:44
18	09:44	08:17	06:44	08:13 (T15) 05:59	07:11 (T13) 04:23	05:42 (T14) 03:23
	15:43	17:18	18:40	14 08:27 (T15) 21:08	15 07:26 (T13) 22:38	20 06:02 (T14) 23:45
19	09:42	08:14	06:41	08:15 (T15) 05:55	07:12 (T13) 04:20	05:42 (T14) 03:23
	15:46	17:21	18:43	8 08:23 (T15) 21:11	12 07:24 (T13) 22:41	20 06:02 (T14) 23:45
20	09:40	08:11	06:37	07:15 (T13) 05:52	04:17	05:42 (T14) 03:23
	15:49	17:24	18:46	21:14	6 07:21 (T13) 22:44	19 06:01 (T14) 23:46
21	09:37	08:07	06:34	05:48	04:14	05:43 (T14) 03:23
	15:51	17:27	18:48	21:17	22:47	17 06:00 (T14) 23:46
22	09:35	08:04	06:30	05:45	04:12	05:44 (T14) 03:23
	15:54	17:30	18:51	21:20	22:49	16 06:00 (T14) 23:46
23	09:32	08:01	06:27	05:42	04:09	05:45 (T14) 03:23
	15:57	17:33	18:54	21:23	22:52	14 05:59 (T14) 23:47
24	09:30	07:58	06:24	05:38	04:06	05:46 (T14) 03:23
	16:01	17:36	18:57	21:26	22:55	12 05:58 (T14) 23:46
25	09:27	07:54	06:20	05:35	04:04	05:48 (T14) 03:24
	16:04	17:39	19:00	21:29	22:58	8 05:56 (T14) 23:46
26	09:25	07:51	06:17	05:32	04:01	05:50 (T14) 03:25
	16:07	17:42	19:03	21:32	23:01	4 05:54 (T14) 23:46
27	09:22	07:48	06:13	05:29	03:59	03:25
	16:10	17:45	19:05	21:35	23:03	23:45
28	09:20	07:45	06:10	05:25	03:56	03:26
	16:13	17:48	19:08	21:38	23:06	23:45
29	09:17	07:41	06:06	05:22	03:54	03:28
	16:16	17:51	19:11	21:41	23:09	23:44
30	09:14	07:37	06:03	05:19	03:51	03:29
	16:19	17:54	19:14	21:44	23:11	23:43
31	09:11	07:33	06:00	05:16	03:49	
	16:22	17:57	19:17	21:47	23:14	
Potential sun hours	182	242	363	447	559	604
Total, worst case			314	243	363	
Sun reduction			0,34	0,45	0,53	
Oper. time red.			0,97	0,97	0,97	
Wind dir. red.			0,58	0,56	0,62	
Total reduction			0,19	0,25	0,32	
Total, real			59	60	116	

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: V136 x 15 x HH172 real case\_no forestShadow receptor: B - Lomarakenus (Voitby Långträsket)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	July	August	September	October	November	December			
1	03:30	04:46	05:52 (T14)	06:16	07:10 (T13)	07:38	08:48 (T15)	08:07	09:36
	23:42	22:30	21 06:13 (T14)	20:49	20 07:30 (T13)	19:06	25 09:13 (T15)	16:25	15:07
2	03:32	04:49	05:52 (T14)	06:19	07:10 (T13)	07:41	08:48 (T15)	08:10	09:39
	23:41	22:27	20 06:12 (T14)	20:45	20 07:30 (T13)	19:03	25 09:13 (T15)	16:21	15:05
3	03:33	04:52	05:53 (T14)	06:21	07:10 (T13)	07:44	08:48 (T15)	08:13	09:41
	23:39	22:24	19 06:12 (T14)	20:42	18 07:28 (T13)	18:59	25 09:13 (T15)	16:18	15:03
4	03:35	04:55	05:53 (T14)	06:24	07:12 (T13)	07:46	08:48 (T15)	08:17	09:43
	23:38	22:21	17 06:10 (T14)	20:38	15 07:27 (T13)	18:56	25 09:13 (T15)	16:15	15:02
5	03:37	04:58	05:54 (T14)	06:27	07:13 (T13)	07:49	08:48 (T15)	08:20	09:46
	23:37	22:18	16 06:10 (T14)	20:35	11 07:24 (T13)	18:53	24 09:12 (T15)	16:12	15:00
6	03:38	05:01	05:55 (T14)	06:30	07:16 (T13)	07:52	08:49 (T15)	08:23	09:48
	23:35	22:14	13 06:08 (T14)	20:31	5 07:21 (T13)	18:49	22 09:11 (T15)	16:09	14:59
7	03:40	05:04	05:57 (T14)	06:32		07:55	08:50 (T15)	08:26	09:50
	23:33	22:11	10 06:07 (T14)	20:28		18:46	20 09:10 (T15)	16:06	14:57
8	03:42	05:07		06:35		07:58	08:51 (T15)	08:29	09:52
	23:32	22:08		20:25		18:42	17 09:08 (T15)	16:04	14:56
9	03:45	05:10		06:38		08:00	08:54 (T15)	08:32	09:54
	23:30	22:05		20:21		18:39	11 09:05 (T15)	16:01	14:55
10	03:47	05:13		06:41		08:03		08:35	09:56
	23:28	22:02		20:18		18:36		15:58	14:54
11	03:49	05:16		06:43		08:06		08:38	09:58
	23:26	21:58		20:14		18:32		15:55	14:53
12	03:51	05:19		06:46		08:09		08:41	10:00
	23:24	21:55		20:11		18:29		15:52	14:52
13	03:54	05:22		06:49		08:12		08:44	10:02
	23:21	21:52		20:08		18:26		15:49	14:51
14	03:56	05:25		06:52		08:14		08:47	10:03
	23:19	21:49		20:04		18:22		15:47	14:51
15	03:59	05:27		06:54		08:17		08:50	10:05
	23:17	21:45		20:01		18:19		15:44	14:50
16	04:01	05:30		06:57		08:20		08:53	10:06
	23:14	21:42		19:57		18:16		15:41	14:50
17	04:04	05:33		07:00		08:23		08:56	10:07
	23:12	21:39		19:54		18:12		15:38	14:50
18	04:07	05:58 (T14)	05:36	07:03		08:26		08:59	10:08
	23:09	6 06:04 (T14)	21:36	19:50		18:09		15:36	14:50
19	04:09	05:56 (T14)	05:39	07:05		08:29		09:02	10:09
	23:07	10 06:06 (T14)	21:32	19:47		18:06		15:33	14:50
20	04:12	05:56 (T14)	05:42	07:08		08:32		09:05	10:10
	23:04	12 06:08 (T14)	21:29	19:44		18:03		15:31	14:50
21	04:15	05:54 (T14)	05:45	07:11		08:35		09:08	10:11
	23:02	15 06:09 (T14)	21:26	19:40		17:59		15:28	14:50
22	04:18	05:54 (T14)	05:48	07:13		08:38		09:11	10:11
	22:59	16 06:10 (T14)	21:22	19:37		17:56		15:26	14:51
23	04:20	05:53 (T14)	05:50	07:16		08:41		09:14	10:12
	22:56	17 06:10 (T14)	21:19	7 07:25 (T13)	19:33	17:53		15:24	14:51
24	04:23	05:53 (T14)	05:53	07:16 (T13)	07:19		09:01 (T15)	08:43	10:12
	22:53	19 06:12 (T14)	21:16	12 07:28 (T13)	19:30	4 09:05 (T15)	17:50	15:21	14:52
25	04:26	05:52 (T14)	05:56	07:14 (T13)	07:22		08:57 (T15)	07:46	10:13
	22:50	20 06:12 (T14)	21:12	16 07:30 (T13)	19:26	12 09:09 (T15)	16:47	15:19	14:53
26	04:29	05:52 (T14)	05:59	07:12 (T13)	07:24		08:55 (T15)	07:49	10:13
	22:48	20 06:12 (T14)	21:09	18 07:30 (T13)	19:23	17 09:12 (T15)	16:43	15:17	14:54
27	04:32	05:52 (T14)	06:02	07:12 (T13)	07:27		08:52 (T15)	07:52	10:13
	22:45	21 06:13 (T14)	21:05	19 07:31 (T13)	19:20	20 09:12 (T15)	16:40	15:15	14:55
28	04:35	05:51 (T14)	06:05	07:11 (T13)	07:30		08:51 (T15)	07:55	10:12
	22:42	22 06:13 (T14)	21:02	21 07:32 (T13)	19:16	22 09:13 (T15)	16:37	15:13	14:56
29	04:38	05:52 (T14)	06:07	07:10 (T13)	07:33		08:50 (T15)	07:58	10:12
	22:39	21 06:13 (T14)	20:59	21 07:31 (T13)	19:13	24 09:14 (T15)	16:34	15:11	14:57
30	04:40	05:52 (T14)	06:10	07:10 (T13)	07:35		08:50 (T15)	08:01	10:12
	22:36	21 06:13 (T14)	20:55	22 07:32 (T13)	19:09	24 09:14 (T15)	16:31	15:09	14:58
31	04:43	05:51 (T14)	06:13	07:09 (T13)			08:04		10:11
	22:33	21 06:12 (T14)	20:52	22 07:31 (T13)			16:28		15:00
Potential sun hours	594	502		392		308		206	152
Total, worst case	241	274		212		194			
Sun reduction	0,50	0,47		0,39		0,27			
Oper. time red.	0,97	0,97		0,97		0,97			
Wind dir. red.	0,62	0,59		0,57		0,58			
Total reduction	0,30	0,26		0,21		0,15			
Total, real	72	73		45		29			

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: V136 x 15 x HH172 real case\_no forestShadow receptor: C - Asuinrakennus (Voitbyntie 480)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:11	09:09	07:41	06:56	05:16	03:47	03:30	04:46	06:16	07:38	08:08	09:36
	15:02	16:25	17:51	20:20	21:47	23:17	23:42	22:30	20:49	19:06	16:25	15:07
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:19	07:41	08:11	09:39
	15:04	16:28	17:54	20:23	21:50	23:19	23:41	22:27	20:45	19:03	16:22	15:05
3	10:09	09:03	07:35	06:50	05:09	03:42	03:33	04:52	06:21	07:44	08:14	09:41
	15:06	16:32	17:57	20:25	21:53	23:21	23:40	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:47	08:17	09:44
	15:08	16:35	18:00	20:28	21:56	23:24	23:38	22:21	20:38	18:56	16:15	15:02
5	10:07	08:57	07:28	06:43	05:03	03:38	03:36	04:58	06:27	07:49	08:20	09:46
	15:10	16:38	18:03	20:31	21:59	23:26	23:37	22:18	20:35	18:53	16:12	15:00
6	10:06	08:54	07:25	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:23	09:48
	15:12	16:41	18:06	20:34	22:02	23:28	23:35	22:15	20:32	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:33	07:55	08:26	09:51
	15:14	16:44	18:09	20:37	22:05	23:30	23:34	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:58	08:29	09:53
	15:16	16:47	18:11	20:40	22:08	23:32	23:32	22:08	20:25	18:43	16:04	14:56
9	10:02	08:45	07:15	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:32	09:55
	15:19	16:50	18:14	20:42	22:11	23:34	23:30	22:05	20:21	18:39	16:01	14:55
10	10:00	08:42	07:11	06:26	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:57
	15:21	16:53	18:17	20:45	22:14	23:36	23:28	22:02	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:44	08:06	08:38	09:59
	15:24	16:57	18:20	20:48	22:17	23:37	23:26	21:59	20:15	18:32	15:55	14:53
12	09:57	08:36	07:05	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	17:00	18:23	20:51	22:20	23:39	23:24	21:55	20:11	18:29	15:52	14:52
13	09:55	08:33	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:12	08:44	10:02
	15:29	17:03	18:26	20:54	22:23	23:40	23:22	21:52	20:08	18:26	15:49	14:51
14	09:53	08:30	06:58	06:12	04:35	03:26	03:56	05:25	06:52	08:15	08:47	10:04
	15:31	17:06	18:29	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:47	14:51
15	09:51	08:27	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:32	21:00	22:29	23:43	23:17	21:46	20:01	18:19	15:44	14:50
16	09:49	08:24	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:03	22:32	23:44	23:15	21:42	19:57	18:16	15:41	14:50
17	09:47	08:20	06:48	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:08
	15:40	17:15	18:37	21:06	22:35	23:44	23:12	21:39	19:54	18:13	15:38	14:50
18	09:44	08:17	06:44	05:59	04:23	03:23	04:07	05:36	07:03	08:26	08:59	10:09
	15:43	17:18	18:40	21:09	22:38	23:45	23:10	21:36	19:51	18:09	15:36	14:50
19	09:42	08:14	06:41	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:10
	15:46	17:21	18:43	21:11	22:41	23:46	23:07	21:32	19:47	18:06	15:33	14:50
20	09:40	08:11	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
	15:49	17:24	18:46	21:14	22:44	23:46	23:04	21:29	19:44	18:03	15:31	14:50
21	09:38	08:08	06:34	05:49	04:14	03:23	04:15	05:45	07:11	08:35	09:08	10:11
	15:51	17:27	18:49	21:17	22:47	23:47	23:02	21:26	19:40	17:59	15:28	14:50
22	09:35	08:04	06:31	05:45	04:12	03:23	04:17	05:48	07:14	08:38	09:11	10:12
	15:54	17:30	18:51	21:20	22:50	23:47	22:59	21:22	19:37	17:56	15:26	14:51
23	09:33	08:01	06:27	05:42	04:09	03:23	04:20	05:51	07:16	08:41	09:14	10:12
	15:57	17:33	18:54	21:23	22:53	23:47	22:56	21:19	19:33	17:53	15:24	14:51
24	09:30	07:58	06:24	05:39	04:06	03:23	04:23	05:53	07:19	08:44	09:17	10:13
	16:01	17:36	18:57	21:26	22:55	23:47	22:54	21:16	19:30	17:50	15:21	14:52
25	09:28	07:55	06:20	05:35	04:04	03:24	04:26	05:56	07:22	07:47	09:20	10:13
	16:04	17:39	19:00	21:29	22:58	23:47	22:51	21:12	19:27	16:47	15:19	14:53
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:50	09:23	10:13
	16:07	17:42	19:03	21:32	23:01	23:46	22:48	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:29	03:58	03:25	04:32	06:02	07:27	07:53	09:26	10:13
	16:10	17:45	19:06	21:35	23:04	23:46	22:45	21:06	19:20	16:40	15:15	14:55
28	09:20	07:45	06:10	05:25	03:56	03:26	04:35	06:05	07:30	07:56	09:28	10:13
	16:13	17:48	19:08	21:38	23:06	23:45	22:42	21:02	19:16	16:37	15:13	14:56
29	09:17	07:41	06:07	05:22	03:54	03:27	04:38	06:08	07:33	07:59	09:31	10:13
	16:16	17:51	19:11	21:41	23:09	23:44	22:39	20:59	19:13	16:34	15:11	14:57
30	09:14	07:37	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:02	09:34	10:12
	16:19	17:54	19:14	21:44	23:12	23:43	22:36	20:55	19:10	16:31	15:09	14:58
31	09:12	07:34	06:00	05:15	03:49	03:27	04:43	06:13	07:38	08:05	09:37	10:12
	16:22	17:57	19:17	21:47	23:14	23:43	22:33	20:52	19:10	16:28	15:06	14:59
Potential sun hours	182	242	363	447	559	605	594	502	392	308	206	151
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: V136 x 15 x HH172 real case\_no forestShadow receptor: D - Asuinrakennus (Kunintie 289)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:11	09:09	07:41	06:56	05:15	03:46	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:20	21:47	23:17	23:42	22:30	20:49	19:06	16:24	15:06
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:11	09:39
	15:03	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:35	06:49	05:09	03:42	03:33	04:52	06:21	07:44	08:14	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:40	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:34	04:55	06:24	07:46	08:17	09:44
	15:07	16:34	18:00	20:28	21:56	23:24	23:39	22:21	20:38	18:56	16:15	15:01
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:20	09:46
	15:09	16:38	18:03	20:31	21:59	23:26	23:37	22:18	20:35	18:52	16:12	15:00
6	10:06	08:54	07:25	06:39	04:59	03:36	03:38	05:01	06:30	07:52	08:23	09:48
	15:11	16:41	18:05	20:34	22:02	23:28	23:35	22:15	20:32	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:34	03:40	05:04	06:32	07:55	08:26	09:51
	15:14	16:44	18:08	20:37	22:05	23:30	23:34	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:58	08:29	09:53
	15:16	16:47	18:11	20:39	22:08	23:32	23:32	22:08	20:25	18:42	16:03	14:56
9	10:02	08:45	07:14	06:29	04:50	03:31	03:44	05:10	06:38	08:00	08:32	09:55
	15:18	16:50	18:14	20:42	22:11	23:34	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:41	08:03	08:35	09:57
	15:21	16:53	18:17	20:45	22:14	23:36	23:28	22:02	20:18	18:36	15:57	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:59
	15:23	16:56	18:20	20:48	22:17	23:37	23:26	21:59	20:14	18:32	15:55	14:53
12	09:57	08:36	07:04	06:19	04:40	03:27	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:39	23:24	21:55	20:11	18:29	15:52	14:52
13	09:55	08:33	07:01	06:15	04:37	03:26	03:53	05:21	06:49	08:12	08:44	10:02
	15:28	17:03	18:26	20:54	22:23	23:40	23:22	21:52	20:08	18:26	15:49	14:51
14	09:53	08:30	06:58	06:12	04:34	03:25	03:56	05:24	06:52	08:14	08:47	10:04
	15:31	17:06	18:29	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:50
15	09:51	08:27	06:54	06:08	04:31	03:24	03:58	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:31	21:00	22:29	23:43	23:17	21:46	20:01	18:19	15:44	14:50
16	09:49	08:23	06:51	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:03	22:32	23:44	23:15	21:42	19:57	18:16	15:41	14:50
17	09:47	08:20	06:47	06:02	04:25	03:23	04:03	05:33	07:00	08:23	08:56	10:08
	15:40	17:15	18:37	21:05	22:35	23:45	23:12	21:39	19:54	18:12	15:38	14:49
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:09
	15:42	17:18	18:40	21:08	22:38	23:45	23:10	21:36	19:50	18:09	15:36	14:49
19	09:42	08:14	06:41	05:55	04:20	03:22	04:09	05:39	07:05	08:29	09:02	10:10
	15:45	17:21	18:43	21:11	22:41	23:46	23:07	21:32	19:47	18:06	15:33	14:49
20	09:40	08:11	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:46	21:14	22:44	23:46	23:04	21:29	19:44	18:03	15:30	14:49
21	09:37	08:07	06:34	05:48	04:14	03:22	04:14	05:45	07:11	08:35	09:08	10:11
	15:51	17:27	18:48	21:17	22:47	23:47	23:02	21:26	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:22	04:17	05:47	07:13	08:38	09:11	10:12
	15:54	17:30	18:51	21:20	22:50	23:47	22:59	21:22	19:37	17:56	15:26	14:50
23	09:33	08:01	06:27	05:42	04:09	03:22	04:20	05:50	07:16	08:41	09:14	10:12
	15:57	17:33	18:54	21:23	22:53	23:47	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:58	06:24	05:38	04:06	03:23	04:23	05:53	07:19	08:44	09:17	10:13
	16:00	17:36	18:57	21:26	22:55	23:47	22:54	21:16	19:30	17:50	15:21	14:51
25	09:28	07:54	06:20	05:35	04:03	03:23	04:26	05:56	07:22	08:46	09:20	10:13
	16:03	17:39	19:00	21:29	22:58	23:47	22:51	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:17	05:32	04:01	03:24	04:29	05:59	07:24	08:49	09:23	10:13
	16:06	17:42	19:03	21:32	23:01	23:46	22:48	21:09	19:23	16:43	15:16	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:31	06:02	07:27	08:52	09:25	10:13
	16:09	17:45	19:05	21:35	23:04	23:46	22:45	21:06	19:20	16:40	15:14	14:54
28	09:20	07:45	06:10	05:25	03:56	03:26	04:34	06:04	07:30	08:55	09:28	10:13
	16:13	17:48	19:08	21:38	23:06	23:45	22:42	21:02	19:16	16:37	15:12	14:55
29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:33	08:58	09:31	10:13
	16:16	17:49	19:08	21:41	23:09	23:44	22:39	20:59	19:13	16:34	15:10	14:57
30	09:14	07:37	06:03	05:19	03:51	03:28	04:40	06:10	07:35	09:01	09:34	10:12
	16:19	17:50	19:09	21:44	23:12	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:33	06:00	05:15	03:49	03:31	04:43	06:13	07:38	09:04	09:37	10:12
	16:22	17:51	19:09	21:47	23:14	23:43	22:33	20:52	19:16	16:27	15:00	14:59
Potential sun hours	182	242	363	447	559	605	594	502	392	308	206	151
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: V136 x 15 x HH172 real case\_no forestShadow receptor: E - Asuinrakennus (Sandhedsvägen 65)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:11	09:09	07:41	06:56	05:15	03:46	03:29	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:06
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:39
	15:03	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:40	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:05	03:40	03:34	04:55	06:24	07:46	08:16	09:44
	15:07	16:34	18:00	20:28	21:56	23:24	23:38	22:21	20:38	18:56	16:15	15:01
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:20	09:46
	15:09	16:37	18:02	20:31	21:59	23:26	23:37	22:18	20:35	18:52	16:12	15:00
6	10:06	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:23	09:48
	15:11	16:41	18:05	20:34	22:02	23:28	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:34	03:40	05:04	06:32	07:55	08:26	09:50
	15:14	16:44	18:08	20:37	22:05	23:30	23:34	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:53
	15:16	16:47	18:11	20:39	22:08	23:32	23:32	22:08	20:25	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:31	03:44	05:10	06:38	08:00	08:32	09:55
	15:18	16:50	18:14	20:42	22:11	23:34	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:41	08:03	08:35	09:57
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18	18:36	15:57	14:53
11	09:58	08:39	07:08	06:22	04:43	03:28	03:49	05:15	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:26	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:40	03:27	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:39	23:24	21:55	20:11	18:29	15:52	14:52
13	09:55	08:33	07:01	06:15	04:37	03:26	03:53	05:21	06:49	08:12	08:44	10:02
	15:28	17:02	18:26	20:54	22:23	23:40	23:22	21:52	20:07	18:26	15:49	14:51
14	09:53	08:30	06:57	06:12	04:34	03:25	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:50
15	09:51	08:26	06:54	06:08	04:31	03:24	03:58	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:31	21:00	22:29	23:42	23:17	21:45	20:01	18:19	15:43	14:50
16	09:49	08:23	06:51	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:15	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:25	03:23	04:03	05:33	07:00	08:23	08:56	10:07
	15:39	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:49
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:09
	15:42	17:18	18:40	21:08	22:38	23:45	23:10	21:36	19:50	18:09	15:36	14:49
19	09:42	08:14	06:40	05:55	04:20	03:22	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:41	23:46	23:07	21:32	19:47	18:06	15:33	14:49
20	09:40	08:11	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:46	21:14	22:44	23:46	23:04	21:29	19:43	18:02	15:30	14:49
21	09:37	08:07	06:34	05:48	04:14	03:22	04:14	05:44	07:11	08:35	09:08	10:11
	15:51	17:27	18:48	21:17	22:47	23:47	23:02	21:26	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:22	04:17	05:47	07:13	08:38	09:11	10:12
	15:54	17:30	18:51	21:20	22:50	23:47	22:59	21:22	19:37	17:56	15:26	14:50
23	09:33	08:01	06:27	05:42	04:09	03:22	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:47	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:58	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:13
	16:00	17:36	18:57	21:26	22:55	23:47	22:53	21:16	19:30	17:49	15:21	14:51
25	09:27	07:54	06:20	05:35	04:03	03:23	04:26	05:56	07:21	07:46	09:20	10:13
	16:03	17:39	19:00	21:29	22:58	23:46	22:51	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:17	05:32	04:01	03:24	04:28	05:59	07:24	07:49	09:23	10:13
	16:06	17:42	19:02	21:32	23:01	23:46	22:48	21:09	19:23	16:43	15:16	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:31	06:02	07:27	07:52	09:25	10:13
	16:09	17:45	19:05	21:35	23:04	23:46	22:45	21:05	19:20	16:40	15:14	14:54
28	09:20	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:13
	16:12	17:48	19:08	21:38	23:06	23:45	22:42	21:02	19:16	16:37	15:12	14:55
29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:31	10:12
	16:16	17:52	19:11	21:41	23:09	23:44	22:39	20:59	19:13	16:34	15:10	14:57
30	09:14	07:37	06:03	05:18	03:51	03:28	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:55	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:30	15:08	14:58
31	09:11	07:34	06:00	05:15	03:48	03:25	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:58	19:17	21:44	23:14	23:45	22:33	20:52	19:16	16:27	15:07	14:59
Potential sun hours	182	242	363	447	559	605	594	502	392	308	206	151
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: V136 x 15 x HH172 real case\_no forestShadow receptor: F - Asuinrakennus (Mullontie 128)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:29	04:46	06:15	07:38	08:07	09:36
	15:01	16:25	17:51	20:19	21:46	23:16	23:42	22:30	20:48	19:06	16:24	15:06
2	10:09	09:05	07:37	06:52	05:12	03:44	03:31	04:49	06:18	07:40	08:10	09:38
	15:03	16:28	17:53	20:22	21:49	23:18	23:41	22:27	20:45	19:02	16:21	15:04
3	10:09	09:02	07:34	06:49	05:09	03:42	03:32	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:56	20:25	21:52	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:05	03:40	03:34	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	17:59	20:28	21:55	23:23	23:38	22:20	20:38	18:55	16:15	15:01
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:26	07:49	08:19	09:45
	15:09	16:37	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:22	09:48
	15:11	16:40	18:05	20:33	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:35	04:56	03:34	03:40	05:03	06:32	07:54	08:25	09:50
	15:13	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:45	16:06	14:57
8	10:02	08:48	07:17	06:32	04:53	03:33	03:42	05:06	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:49	03:31	03:44	05:09	06:38	08:00	08:31	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:54
10	09:59	08:42	07:11	06:25	04:46	03:30	03:46	05:12	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:17	18:35	15:57	14:53
11	09:58	08:39	07:07	06:22	04:43	03:28	03:48	05:15	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:54	14:52
12	09:56	08:35	07:04	06:18	04:40	03:27	03:51	05:18	06:46	08:08	08:41	10:00
	15:26	16:59	18:22	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:37	03:26	03:53	05:21	06:48	08:11	08:44	10:01
	15:28	17:02	18:25	20:53	22:23	23:40	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:25	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:05	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:50
15	09:50	08:26	06:54	06:08	04:31	03:24	03:58	05:27	06:54	08:17	08:50	10:04
	15:34	17:08	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:43	14:50
16	09:48	08:23	06:50	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:36	17:11	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:15	15:41	14:49
17	09:46	08:20	06:47	06:01	04:25	03:23	04:03	05:33	06:59	08:23	08:56	10:07
	15:39	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:53	18:12	15:38	14:49
18	09:44	08:17	06:44	05:58	04:22	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:37	23:45	23:09	21:35	19:50	18:09	15:35	14:49
19	09:42	08:13	06:40	05:55	04:20	03:22	04:09	05:39	07:05	08:28	09:02	10:09
	15:45	17:21	18:42	21:11	22:40	23:45	23:07	21:32	19:47	18:05	15:33	14:49
20	09:39	08:10	06:37	05:51	04:17	03:22	04:11	05:41	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:30	14:49
21	09:37	08:07	06:33	05:48	04:14	03:22	04:14	05:44	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:22	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:36	17:56	15:25	14:50
23	09:32	08:01	06:27	05:41	04:08	03:22	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:52	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:18	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:29	17:49	15:21	14:51
25	09:27	07:54	06:20	05:35	04:03	03:23	04:25	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:18	14:52
26	09:24	07:51	06:16	05:31	04:00	03:24	04:28	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:46	22:47	21:08	19:23	16:43	15:16	14:53
27	09:22	07:47	06:13	05:28	03:58	03:25	04:31	06:01	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:34	23:03	23:45	22:44	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:09	05:25	03:55	03:26	04:34	06:04	07:29	07:55	09:28	10:12
	16:12	17:48	19:08	21:37	23:06	23:44	22:42	21:02	19:16	16:37	15:12	14:55
29	09:16	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:15	17:51	19:11	21:40	23:08	23:44	22:39	20:58	19:12	16:33	15:10	14:56
30	09:14	07:37	06:03	05:18	03:51	03:28	04:40	06:10	07:35	08:01	09:33	10:12
	16:18	17:54	19:13	21:43	23:11	23:43	22:36	20:55	19:09	16:30	15:08	14:58
31	09:11	07:34	06:00	05:15	03:48	03:25	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:58	19:17	21:46	23:14	23:43	22:33	20:52	16:27	15:03	14:59	14:59
Potential sun hours	182	242	363	447	559	605	594	502	392	308	206	151
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:

Merkkikallio

Licensed user:

FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Hans Vadback / hans.vadback@fcg.fi
Calculated:
10.6.2016 11:06/3.0.619

SHADOW - Calendar

Calculation: V136 x 15 x HH172 real case\_no forestShadow receptor: G - Lomarakenus/Partiomaja (Korpilahdenkuja 134)
Assumptions for shadow calculations
Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465
Idle start wind speed: Cut in wind speed from power curve

Table with columns for months (January to December) and rows for each day (1-31) showing sun rise, set, and shadow reduction data. Includes summary rows for 'Potential sun hours' 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: V136 x 15 x HH172 real case\_no forestShadow receptor: H - Asuinrakennus (Kotkannevantie 269)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:35
	15:02	16:25	17:51	20:19	21:46	23:15	23:41	22:29	20:48	19:06	16:24	15:07
2	10:09	09:05	07:37	06:53	05:12	03:45	03:32	04:49	06:18	07:40	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:43	03:33	04:52	06:21	07:43	08:13	09:40
	15:06	16:31	17:57	20:25	21:52	23:20	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	08:59	07:31	06:46	05:06	03:41	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:55	23:22	23:37	22:20	20:38	18:56	16:15	15:02
5	10:06	08:56	07:28	06:42	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:02	20:30	21:58	23:25	23:36	22:17	20:34	18:52	16:12	15:00
6	10:05	08:53	07:24	06:39	04:59	03:37	03:39	05:01	06:29	07:52	08:22	09:47
	15:12	16:41	18:05	20:33	22:01	23:27	23:34	22:14	20:31	18:49	16:09	14:59
7	10:03	08:51	07:21	06:36	04:56	03:35	03:41	05:04	06:32	07:54	08:25	09:50
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	15:16	16:47	18:11	20:39	22:07	23:31	23:31	22:07	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:10	23:33	23:29	22:04	20:21	18:39	16:01	14:55
10	09:59	08:41	07:11	06:25	04:47	03:31	03:47	05:13	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:13	23:34	23:27	22:01	20:17	18:35	15:58	14:54
11	09:57	08:38	07:07	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:37	09:57
	15:24	16:56	18:20	20:48	22:16	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:35	07:04	06:19	04:41	03:28	03:52	05:19	06:46	08:08	08:40	09:59
	15:26	16:59	18:23	20:50	22:19	23:37	23:23	21:55	20:11	18:29	15:52	14:52
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	15:29	17:03	18:25	20:53	22:22	23:39	23:21	21:51	20:07	18:25	15:49	14:52
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:46	10:02
	15:32	17:06	18:28	20:56	22:25	23:40	23:18	21:48	20:04	18:22	15:46	14:51
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18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26	08:59	10:08
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19	09:41	08:13	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:28	09:01	10:09
	15:46	17:21	18:42	21:11	22:40	23:44	23:06	21:32	19:47	18:06	15:33	14:50
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	15:49	17:24	18:45	21:14	22:43	23:45	23:03	21:28	19:43	18:02	15:31	14:50
21	09:37	08:07	06:33	05:48	04:14	03:23	04:15	05:45	07:10	08:34	09:07	10:10
	15:51	17:27	18:48	21:17	22:46	23:45	23:01	21:25	19:40	17:59	15:28	14:50
22	09:34	08:04	06:30	05:45	04:12	03:23	04:18	05:47	07:13	08:37	09:10	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:51
23	09:32	08:00	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:13	10:11
	15:57	17:33	18:54	21:22	22:52	23:46	22:55	21:18	19:33	17:53	15:24	14:51
24	09:29	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:25	22:54	23:45	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:04	17:39	18:59	21:28	22:57	23:45	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:16	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
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31	09:11	07:35	06:01	05:17	03:49	03:31	04:43	06:13	07:38	08:04	09:36	10:10
	16:22	17:57	19:17	21:46	23:13	23:41	22:32	20:51	19:04	16:27	15:00	14:50
Potential sun hours	183	243	363	447	558	604	593	502	392	308	207	152
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: V136 x 15 x HH172 real case\_no forestShadow receptor: I - Asuinrakennus (Klumpintie 171)  
Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

#### Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:35
	15:02	16:25	17:51	20:19	21:46	23:16	23:41	22:29	20:48	19:06	16:25	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:19	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:03	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:43	03:33	04:52	06:21	07:43	08:13	09:40
	15:06	16:32	17:57	20:25	21:52	23:20	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:41	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:55	23:23	23:37	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:03	20:31	21:58	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:39	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:01	23:27	23:34	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:41	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:04	23:29	23:33	22:11	20:28	18:46	16:06	14:58
8	10:02	08:48	07:18	06:32	04:53	03:34	03:43	05:07	06:35	07:57	08:28	09:52
	15:17	16:47	18:11	20:39	22:07	23:31	23:31	22:08	20:24	18:42	16:04	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:10	23:33	23:29	22:04	20:21	18:39	16:01	14:55
10	09:59	08:42	07:11	06:25	04:47	03:31	03:47	05:13	06:41	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:13	23:34	23:27	22:01	20:18	18:36	15:58	14:54
11	09:57	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:37	09:58
	15:24	16:56	18:20	20:48	22:16	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:52	05:19	06:46	08:09	08:41	09:59
	15:26	17:00	18:23	20:51	22:19	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:22	23:39	23:21	21:52	20:07	18:26	15:49	14:52
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	15:32	17:06	18:28	20:56	22:25	23:40	23:18	21:48	20:04	18:22	15:47	14:51
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16	09:48	08:23	06:51	06:05	04:29	03:25	04:02	05:30	06:57	08:20	08:53	10:05
	15:37	17:12	18:34	21:02	22:31	23:42	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:43	23:11	21:39	19:54	18:12	15:39	14:50
18	09:44	08:17	06:44	05:58	04:23	03:24	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:41	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:46	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:49	17:24	18:45	21:14	22:43	23:45	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:15	03:23	04:15	05:45	07:11	08:34	09:08	10:10
	15:52	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:34	08:04	06:30	05:45	04:12	03:23	04:18	05:48	07:13	08:37	09:11	10:11
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23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:13	10:11
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24	09:30	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
	16:01	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:04	17:39	19:00	21:29	22:57	23:45	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
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27	09:22	07:48	06:13	05:29	03:59	03:26	04:32	06:02	07:27	07:52	09:25	10:12
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28	09:19	07:44	06:10	05:25	03:56	03:27	04:35	06:05	07:30	07:55	09:27	10:12
	16:13	17:48	19:08	21:37	23:05	23:44	22:41	21:02	19:16	16:37	15:13	14:56
29	09:16		07:06	05:22	03:54	03:28	04:38	06:07	07:32	07:58	09:30	10:12
	16:16		20:11	21:40	23:08	23:43	22:38	20:58	19:13	16:34	15:11	14:57
30	09:14		07:03	05:19	03:51	03:29	04:41	06:10	07:35	08:01	09:33	10:11
	16:19		20:14	21:43	23:11	23:42	22:35	20:55	19:09	16:31	15:09	14:59
31	09:11		07:00		03:49		04:44	06:13		08:04		10:11
	16:22		20:16		23:13		22:32	20:52		16:28		15:00
Potential sun hours	183	243	363	447	558	604	593	502	392	308	207	152
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)	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: V136 x 15 x HH172 real case\_no forestShadow receptor: J - Asuinrakennus (Klumpvägen 170)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

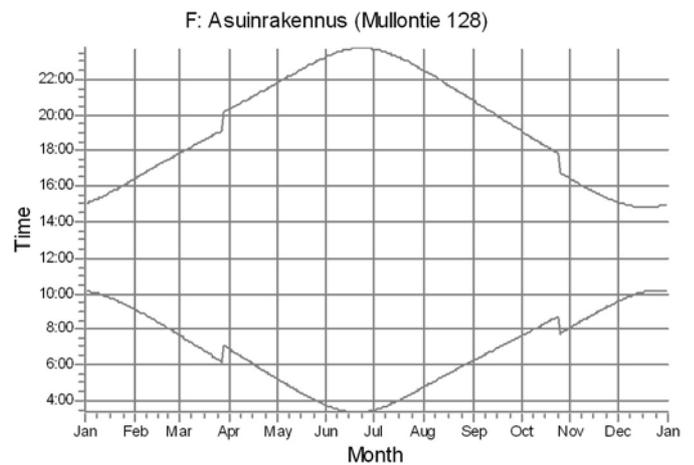
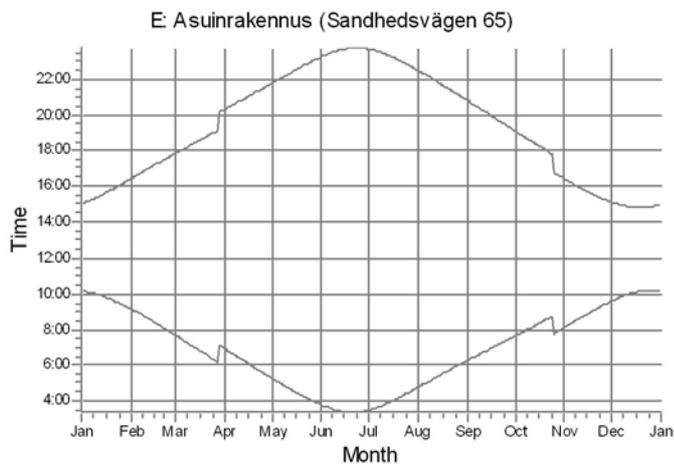
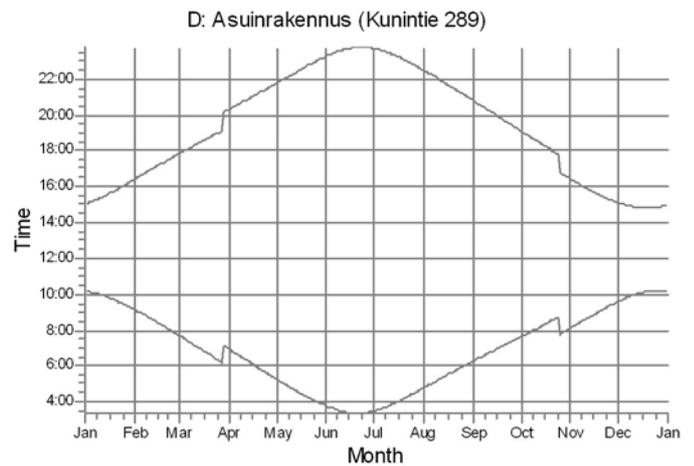
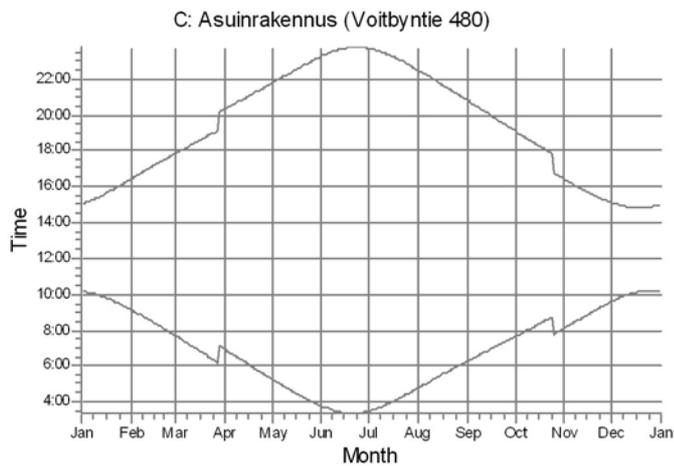
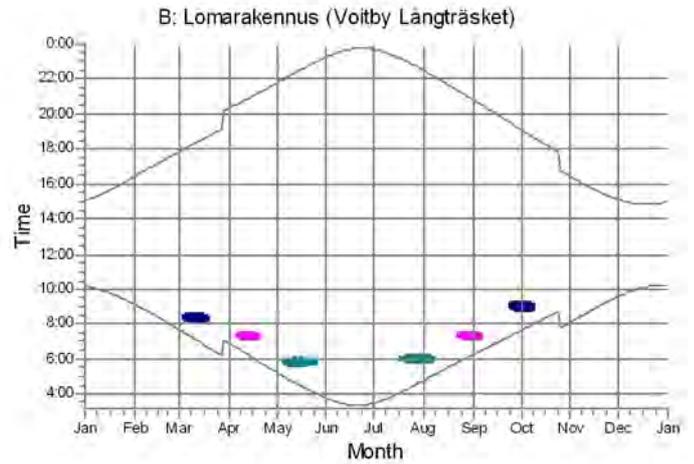
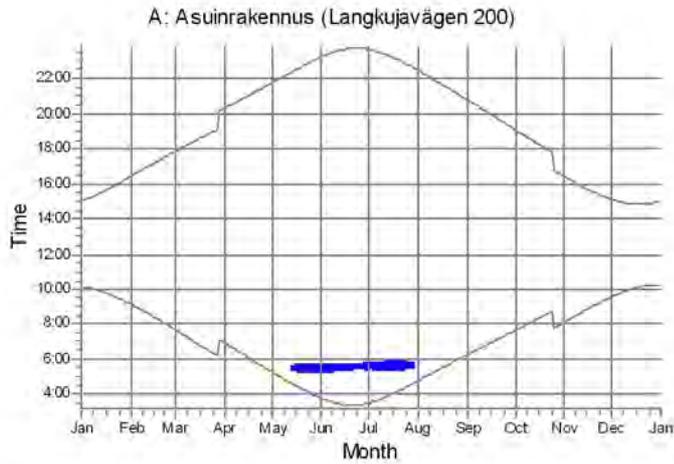
	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:16	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:41	22:30	20:48	19:06	16:25	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:19	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:40	22:26	20:45	19:03	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:43	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:32	17:57	20:25	21:53	23:20	23:39	22:23	20:42	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:41	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:02
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	15:10	16:38	18:03	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	05:00	03:37	03:39	05:01	06:30	07:52	08:22	09:48
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	15:29	17:03	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:26	15:49	14:52
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:25	06:52	08:14	08:47	10:03
	15:32	17:06	18:28	20:56	22:26	23:40	23:19	21:48	20:04	18:22	15:47	14:51
15	09:50	08:26	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:01	18:19	15:44	14:51
16	09:48	08:23	06:51	06:05	04:29	03:25	04:02	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:43	23:11	21:39	19:54	18:12	15:39	14:50
18	09:44	08:17	06:44	05:58	04:23	03:24	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:46	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
	15:49	17:24	18:46	21:14	22:43	23:45	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:15	03:23	04:15	05:45	07:11	08:34	09:08	10:10
	15:52	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:18	05:48	07:13	08:37	09:11	10:11
	15:55	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:37	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:11
	15:58	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:24	14:51
24	09:30	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
	16:01	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:04	17:39	19:00	21:29	22:57	23:46	22:50	21:12	19:26	16:47	15:19	14:53
26	09:24	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:07	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:54
27	09:22	07:48	06:13	05:29	03:59	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:35	23:03	23:45	22:44	21:05	19:20	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:27	04:35	06:05	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:41	21:02	19:16	16:37	15:13	14:56
29	09:16	07:06	05:22	03:54	03:28	04:38	04:38	06:07	07:32	07:58	09:30	10:12
	16:16	07:06	05:22	03:54	03:28	04:38	04:38	06:07	07:32	07:58	09:30	10:12
30	09:14	07:03	05:19	03:51	03:29	04:41	06:10	07:35	08:01	09:33	10:11	10:11
	16:19	07:03	05:19	03:51	03:29	04:41	06:10	07:35	08:01	09:33	10:11	10:11
31	09:11	07:00	05:16	03:49	03:27	04:44	06:13	07:38	08:04	09:36	10:10	10:11
	16:22	07:00	05:16	03:49	03:27	04:44	06:13	07:38	08:04	09:36	10:10	10:11
Potential sun hours	183	243	363	447	558	604	593	502	392	308	207	152
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: V136 x 15 x HH172 real case\_no forest

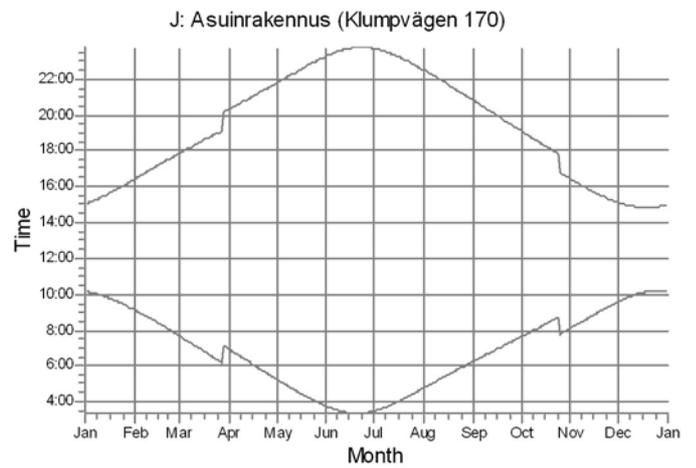
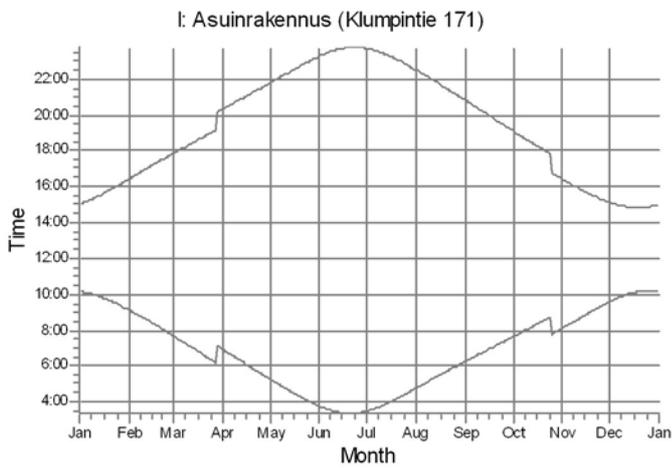
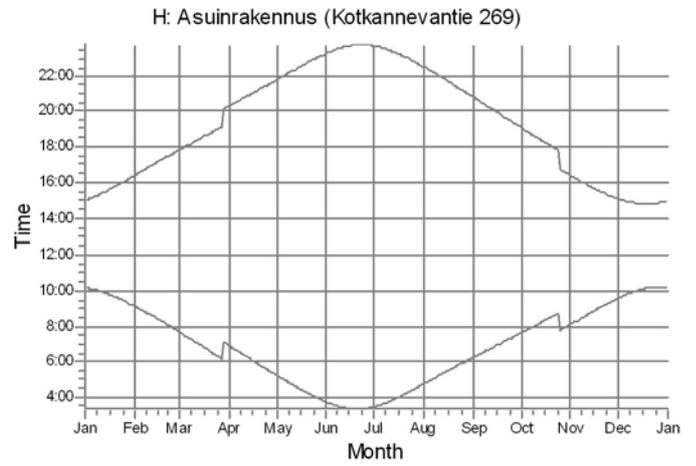
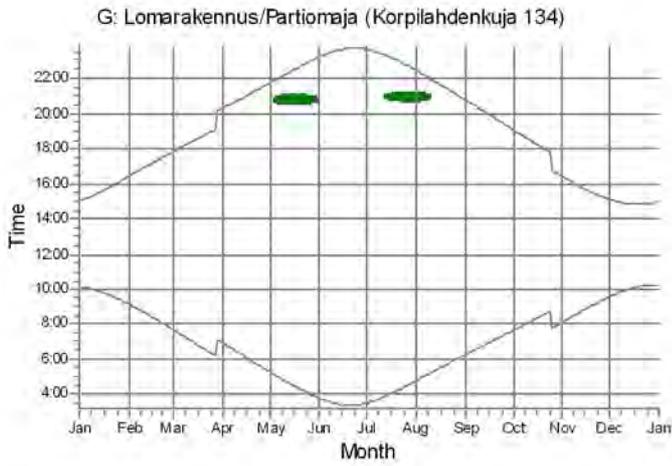


WTGs



### SHADOW - Calendar, graphical

Calculation: V136 x 15 x HH172 real case\_no forest



WTGs

 T1: T1

### SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T1 - T1

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10 15:02	09:08 16:25	07:41 17:51	06:56 20:19	05:15 21:46	03:46 23:16	03:30 23:42	04:46 20:47-21:12/25	06:16 20:48	07:38 19:06	08:07 16:24	09:36 15:06
2	10:09 15:04	09:05 16:28	07:38 17:54	06:53 20:22	05:12 21:49	03:44 23:18	03:31 23:40	04:49 20:46-21:11/25	06:18 20:45	07:40 19:02	08:10 16:21	09:38 15:05
3	10:08 15:05	09:02 16:31	07:34 17:57	06:49 20:25	05:09 21:52	03:42 23:21	03:33 23:39	04:52 20:47-21:11/24	06:21 20:41	07:43 18:59	08:13 16:18	09:41 15:03
4	10:07 15:07	09:00 16:34	07:31 17:59	06:46 20:28	05:06 21:55	03:40 23:23	03:35 23:38	04:55 20:47-21:10/23	06:24 20:38	07:46 18:56	08:16 16:15	09:43 15:01
5	10:06 15:09	08:57 16:37	07:28 18:02	06:42 20:31	05:02 21:58	03:38 23:25	03:36 23:36	04:58 20:48-21:09/21	06:27 20:35	07:49 18:52	08:19 16:12	09:45 15:00
6	10:05 15:12	08:54 16:41	07:24 18:05	06:39 20:33	04:59 22:01	03:38 23:27	03:38 23:35	05:01 20:49-21:08/19	06:29 20:31	07:52 18:49	08:22 16:09	09:48 14:58
7	10:04 15:14	08:51 16:44	07:21 18:08	06:35 20:36	04:56 22:04	03:35 23:29	03:40 23:33	05:04 20:50-21:06/16	06:32 20:28	07:54 18:45	08:25 16:06	09:50 14:57
8	10:02 15:16	08:48 16:47	07:18 18:11	06:32 20:39	04:53 22:08	03:33 23:31	03:42 23:31	05:07 20:52-21:04/12	06:35 20:24	07:57 18:42	08:28 16:03	09:52 14:56
9	10:01 15:18	08:45 16:50	07:14 18:14	06:29 20:42	04:50 22:11	03:32 23:33	03:44 23:29	05:10 20:55-21:01/6	06:38 20:21	08:00 18:39	08:31 16:00	09:54 14:55
10	09:59 15:21	08:42 16:53	07:11 18:17	06:25 20:45	04:47 22:14	03:30 23:35	03:46 23:27	05:13 22:01	06:40 20:17	08:03 18:35	08:34 15:57	09:56 14:54
11	09:58 15:23	08:39 16:56	07:07 18:20	06:22 20:48	04:44 22:17	03:29 23:36	03:49 23:25	05:15 20:14	06:43 18:32	08:06 18:32	08:38 15:55	09:58 14:53
12	09:56 15:26	08:35 16:59	07:04 18:23	06:18 20:51	04:40 22:20	03:28 23:38	03:51 23:23	05:18 21:55	06:46 20:11	08:08 18:29	08:41 15:52	10:00 14:52
13	09:54 15:29	08:32 17:02	07:01 18:25	06:15 20:53	04:37 22:23	03:26 23:39	03:54 23:21	05:21 21:52	06:49 20:07	08:11 18:25	08:44 15:49	10:01 14:51
14	09:52 15:31	08:29 17:05	06:57 18:28	06:12 20:56	04:34 22:26	03:26 23:41	03:56 23:19	05:24 21:48	06:51 20:04	08:14 18:22	08:47 15:46	10:03 14:51
15	09:50 15:34	08:26 17:09	06:54 18:31	06:08 20:59	04:31 22:29	03:25 23:42	03:58 23:16	05:12 21:45	06:54 20:00	08:17 18:19	08:50 15:44	10:04 14:50
16	09:48 15:37	08:23 17:12	06:50 18:34	06:05 21:02	04:28 22:32	03:24 23:43	04:01 23:14	05:15 21:42	06:57 19:57	08:20 18:15	08:53 15:41	10:06 14:50
17	09:46 15:40	08:20 17:15	06:47 18:37	06:02 21:05	04:26 22:34	03:23 23:44	04:04 23:11	05:17 21:38	06:59 19:54	08:23 18:12	08:56 15:38	10:07 14:50
18	09:44 15:42	08:17 17:18	06:44 18:40	05:58 21:08	04:23 22:37	03:23 23:44	04:06 23:09	05:36 21:35	07:02 19:50	08:26 18:09	08:59 15:36	10:08 14:49
19	09:42 15:45	08:13 17:21	06:40 18:42	05:55 21:11	04:20 22:40	03:23 23:45	04:09 23:06	05:39 21:32	07:05 19:47	08:28 18:06	09:02 15:33	10:09 14:49
20	09:39 15:48	08:10 17:24	06:37 18:45	05:51 21:14	04:17 22:43	03:22 23:46	04:12 23:04	05:42 21:29	07:08 19:43	08:31 18:02	09:05 15:31	10:10 14:50
21	09:37 15:51	08:07 17:27	06:33 18:48	05:48 21:17	04:14 22:46	03:22 23:46	04:14 23:01	05:44 21:25	07:10 19:40	08:34 17:59	09:08 15:28	10:10 14:50
22	09:35 15:54	08:04 17:30	06:30 18:51	05:45 21:20	04:11 22:49	03:23 23:46	04:17 22:58	05:47 21:22	07:13 19:36	08:37 17:56	09:11 15:26	10:11 14:50
23	09:32 15:57	08:01 17:33	06:27 18:54	05:41 21:23	04:09 22:52	03:23 23:46	04:20 22:56	05:50 21:19	07:16 19:33	08:40 17:53	09:14 15:23	10:12 14:51
24	09:30 16:00	07:57 17:36	06:23 18:57	05:38 21:26	04:06 22:55	03:23 23:46	04:23 22:53	05:53 21:15	07:19 19:30	08:43 17:49	09:16 15:21	10:12 14:52
25	09:27 16:03	07:54 17:39	06:20 18:59	05:35 21:29	04:03 22:57	03:24 23:46	04:26 22:50	05:56 21:12	07:21 19:26	07:46 16:46	09:19 15:19	10:12 14:52
26	09:24 16:06	07:51 17:42	06:16 19:02	05:32 21:32	04:01 23:00	03:24 23:45	04:29 22:47	05:59 21:08	07:24 19:23	07:49 16:43	09:22 15:16	10:12 14:53
27	09:22 16:09	07:47 17:45	06:13 19:05	05:28 21:34	03:58 23:03	03:25 23:45	04:31 22:44	06:01 21:05	07:27 19:19	07:52 16:40	09:25 15:14	10:12 14:54
28	09:19 16:12	07:44 17:48	06:10 19:08	05:25 21:37	03:56 23:06	03:26 23:44	04:34 22:41	06:04 21:02	07:29 19:16	07:55 16:37	09:28 15:12	10:12 14:55
29	09:16 16:16	07:41 18:01	06:06 19:11	05:22 21:40	03:53 23:08	03:27 23:43	04:37 22:39	06:07 20:58	07:32 19:13	07:58 16:34	09:30 15:10	10:12 14:57
30	09:14 16:19	07:39 18:06	06:03 19:16	05:18 21:43	03:51 23:11	03:28 23:43	04:40 22:36	06:10 20:55	07:35 19:09	08:01 16:30	09:33 15:08	10:11 14:58
31	09:11 16:22	07:36 18:13	06:05 19:20	05:19 21:46	03:49 23:13	03:27 23:43	04:43 22:33	06:13 20:52	08:04 16:27	08:04 15:00	09:11 14:50	10:11 15:00
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	558	0	395	171	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T10 - T10

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:41	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:43	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:41	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:03	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:01	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:26	15:49	14:51
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:11	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:46	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:45	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:10	08:34	09:08	10:10
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:37	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:07	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:54
27	09:22	07:48	06:13	05:28	03:58	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:35	23:03	23:45	22:44	21:05	19:19	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:27	04:35	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:41	21:02	19:16	16:37	15:13	14:56
29	09:16	07:40	06:06	05:22	03:54	03:28	04:38	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:41	23:08	23:43	22:39	20:58	19:13	16:34	15:11	14:57
30	09:14	07:37	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:09	14:58
31	09:11	07:30	06:00	05:15	03:49	03:27	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:13	23:43	22:33	20:52	19:02	16:28	15:06	14:59
Potential sun hours	183	243	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T11 - T11

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Table with 12 columns (Jan-Dec) and 1 row of values: 1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

Table with 12 columns (N-Sum) and 1 row of values: 950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

Main data table with columns for months (January-December) and rows for each day (1-31). Includes columns for Sun rise, Sun set, and Sum of minutes with flicker.

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

Day in month Sun rise (hh:mm) Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T12 - T12

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:19	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:40	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:46
	15:10	16:38	18:03	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:32	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:01	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:26	15:49	14:51
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:01	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:46	17:21	18:43	21:11	22:40	23:45	23:07	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:11	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:53
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:07	17:42	19:02	21:32	23:00	23:46	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:20	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:26	04:35	06:05	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:42	21:02	19:16	16:37	15:12	14:56
29	09:17	07:41	06:06	05:22	03:54	03:28	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:41	23:08	23:44	22:39	20:59	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:09	14:58
31	09:11	07:35	06:00	05:17	03:49	03:31	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:13	23:45	22:33	20:52	19:13	16:28	15:06	14:59
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T13 - T13

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December		
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:10-07:30/20	07:38	08:07	09:36	
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48		19:06	16:24	15:07	
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:10-07:30/20	07:41	08:10	09:38	
	15:04	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45		19:03	16:21	15:05	
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:10-07:28/18	07:43	08:13	09:41	
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42		18:59	16:18	15:03	
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:12-07:27/15	07:46	08:16	09:43	
	15:07	16:35	18:00	20:28	21:56	23:23	23:38	22:21	20:38		18:56	16:15	15:02	
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:13-07:24/11	07:49	08:19	09:46	
	15:10	16:38	18:03	20:31	21:59	23:25	23:37	22:17	20:35		18:52	16:12	15:00	
6	10:05	08:54	07:24	06:39	07:21-07:24/3	04:59	03:37	03:38	05:01	06:30	07:16-07:21/5	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31		18:49	16:09	14:59	
7	10:04	08:51	07:21	06:36	07:17-07:28/11	04:56	03:35	03:40	05:04	06:32	07:55	08:26	09:50	
	15:14	16:44	18:08	20:36	22:05	23:30	23:33	22:11	20:28		18:46	16:06	14:57	
8	10:03	08:48	07:18	06:32	07:15-07:30/15	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52	
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:25		18:42	16:03	14:56	
9	10:01	08:45	07:14	06:29	07:12-07:30/18	04:50	03:32	03:44	05:10	06:38	08:00	08:32	09:54	
	15:19	16:50	18:14	20:42	22:11	23:33	23:30	22:05	20:21		18:39	16:00	14:55	
10	10:00	08:42	07:11	06:25	07:11-07:31/20	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56	
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18		18:36	15:58	14:54	
11	09:58	08:39	07:08	06:22	07:11-07:31/20	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58	
	15:24	16:56	18:20	20:48	22:17	23:37	23:26	21:58	20:14		18:32	15:55	14:53	
12	09:56	08:36	07:04	06:19	07:10-07:32/22	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00	
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11		18:29	15:52	14:52	
13	09:54	08:33	07:01	06:15	07:09-07:31/22	04:38	03:27	03:54	05:21	06:49	08:12	08:44	10:02	
	15:29	17:03	18:26	20:54	22:23	23:40	23:21	21:52	20:07		18:26	15:49	14:51	
14	09:52	08:30	06:57	06:12	07:09-07:31/22	04:35	03:26	03:56	05:24	06:52	08:14	08:47	10:03	
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04		18:22	15:46	14:51	
15	09:50	08:26	06:54	06:08	07:10-07:30/20	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:05	
	15:34	17:09	18:31	20:59	22:29	23:42	23:17	21:45	20:01		18:19	15:44	14:50	
16	09:48	08:23	06:51	06:05	07:10-07:29/19	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06	
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	20:07		18:16	15:41	14:50	
17	09:46	08:20	06:47	06:02	07:10-07:28/18	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07	
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	20:04		18:12	15:38	14:50	
18	09:44	08:17	06:44	05:58	07:11-07:26/15	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08	
	15:43	17:18	18:40	21:08	22:38	23:45	23:09	21:35	20:00		18:09	15:36	14:50	
19	09:42	08:14	06:41	05:55	07:12-07:24/12	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09	
	15:45	17:21	18:43	21:11	22:41	23:45	23:07	21:32	20:05		18:06	15:33	14:50	
20	09:40	08:10	06:37	05:52	07:15-07:21/6	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10	
	15:48	17:24	18:46	21:14	22:44	23:46	23:04	21:29	20:07		18:03	15:31	14:50	
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:11	08:35	09:08	10:11		
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	20:09		17:59	15:28	14:50	
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:11	10:11		
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	20:13		17:56	15:26	14:50	
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:18-07:25/7	07:16	08:40	09:14	10:12	
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	20:13		17:53	15:23	14:51	
24	09:30	07:58	06:23	05:38	04:06	03:23	04:23	05:53	07:16-07:28/12	07:19	08:43	09:17	10:12	
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	20:10		17:50	15:21	14:52	
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:14-07:30/16	07:21	08:46	09:20	10:12	
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	20:15		17:46	15:19	14:52	
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:12-07:30/18	07:24	08:49	09:22	10:13	
	16:06	17:42	19:02	21:32	23:01	23:46	22:48	21:09	20:13		16:43	15:17	14:53	
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:12-07:31/19	07:27	08:52	09:25	10:13	
	16:10	17:45	19:05	21:35	23:03	23:45	22:45	21:05	20:18		16:40	15:14	14:54	
28	09:19	07:44	06:10	05:25	03:56	03:26	04:35	06:05	07:11-07:32/21	07:30	08:55	09:28	10:12	
	16:13	17:48	19:08	21:38	23:06	23:45	22:42	21:02	20:24		16:37	15:12	14:56	
29	09:17		07:06	05:22	03:53	03:27	04:37	06:07	07:10-07:31/21	07:32	08:57	09:31	10:12	
	16:16		20:11	21:41	23:09	23:44	22:39	20:59	20:33		16:34	15:10	14:57	
30	09:14		07:03	05:19	03:51	03:29	04:40	06:10	07:10-07:32/22	07:35	08:01	09:33	10:12	
	16:19		20:14	21:44	23:11	23:43	22:36	20:55	20:39		16:31	15:08	14:58	
31	09:11		07:00		03:49		04:43	06:13	07:09-07:31/22		08:04		10:11	
	16:22		20:17		23:14		22:33	20:52			16:28		15:00	
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	152		
Sum of minutes with flicker	0	0	0	243	0	0	0	158	89	0	0	0		

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T14 - T14

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December	
1	10:10 15:02	09:08 16:25	07:41 17:51	06:56 20:19	05:15 21:47	03:47 23:16	03:30 23:42	04:46 22:30	05:52-06:13/21	06:16 20:48	07:38 19:06	08:07 16:24	09:36 15:07
2	10:10 15:04	09:06 16:28	07:38 17:54	06:53 20:22	05:12 21:50	03:44 23:19	03:31 23:41	04:49 22:27	05:52-06:12/20	06:18 20:45	07:41 19:03	08:10 16:21	09:38 15:05
3	10:09 15:05	09:03 16:31	07:34 17:57	06:49 20:25	05:09 21:53	03:42 23:21	03:33 23:40	04:52 22:24	05:53-06:12/19	06:21 20:42	07:43 18:59	08:13 16:18	09:41 15:03
4	10:08 15:07	09:00 16:34	07:31 18:00	06:46 20:28	05:06 21:56	03:40 23:23	03:35 23:38	04:55 22:21	05:53-06:10/17	06:24 20:38	07:46 18:56	08:16 16:15	09:43 15:01
5	10:07 15:09	08:57 16:38	07:28 18:03	06:42 20:31	05:02 21:59	03:38 23:25	03:36 23:37	04:58 22:17	05:54-06:10/16	06:27 20:35	07:49 18:52	08:19 16:12	09:46 15:00
6	10:05 15:12	08:54 16:41	07:24 18:05	06:39 20:34	04:59 22:02	03:37 23:28	03:38 23:35	05:01 22:14	05:55-06:08/13	06:30 20:31	07:52 18:49	08:23 16:09	09:48 14:58
7	10:04 15:14	08:51 16:44	07:21 18:08	06:36 20:37	04:56 22:05	03:35 23:30	03:40 23:33	05:04 22:11	05:57-06:07/10	06:32 20:28	07:55 18:46	08:26 16:06	09:50 14:57
8	10:03 15:16	08:48 16:47	07:18 18:11	06:32 20:39	04:53 22:08	03:33 23:32	03:42 23:32	05:07 22:08		06:35 20:25	07:57 18:42	08:29 16:03	09:52 14:56
9	10:01 15:18	08:45 16:50	07:14 18:14	06:29 20:42	04:50 22:11	03:32 23:33	03:44 23:30	05:10 22:05		06:38 20:21	08:00 18:39	08:32 16:00	09:54 14:55
10	10:00 15:21	08:42 16:53	07:11 18:17	06:25 20:45	04:47 22:14	03:30 23:35	03:47 23:28	05:13 22:02		06:41 20:18	08:03 18:36	08:35 15:58	09:56 14:54
11	09:58 15:23	08:39 16:56	07:08 18:20	06:22 20:48	04:44 22:17	03:29 23:37	03:49 23:26	05:16 21:58		06:43 20:14	08:06 18:32	08:38 15:55	09:58 14:53
12	09:56 15:26	08:36 16:59	07:04 18:23	06:19 20:51	04:41 22:20	03:28 23:38	03:51 23:24	05:19 21:55		06:46 20:11	08:09 18:29	08:41 15:52	10:00 14:52
13	09:54 15:29	08:33 17:03	07:01 18:26	06:15 20:54	04:38 22:23	03:26 23:40	03:54 23:21	05:21 21:52		06:49 20:07	08:12 18:26	08:44 15:49	10:02 14:51
14	09:52 15:31	08:30 17:06	06:58 18:28	06:12 20:57	04:35 22:26	03:26 23:41	03:56 23:19	05:24 21:49		06:52 20:04	08:14 18:22	08:47 15:46	10:03 14:51
15	09:50 15:34	08:26 17:09	06:54 18:31	06:08 21:00	04:32 22:29	03:25 23:42	03:59 23:17	05:27 21:45		06:54 20:01	08:17 18:19	08:50 15:44	10:05 14:50
16	09:48 15:37	08:23 17:12	06:51 18:34	06:05 21:02	04:29 22:32	03:24 23:43	04:01 23:14	05:30 21:42		06:57 19:57	08:20 18:16	08:53 15:41	10:06 14:50
17	09:46 15:40	08:20 17:15	06:47 18:37	06:02 21:05	04:26 22:35	03:23 23:44	04:04 23:12	05:33 21:39		07:00 19:54	08:23 18:12	08:56 15:38	10:07 14:50
18	09:44 15:43	08:17 17:18	06:44 18:40	05:58 21:08	04:23 22:38	03:23 23:45	04:06 23:09	05:36 21:35		07:02 19:50	08:26 18:09	08:59 15:36	10:08 14:50
19	09:42 15:45	08:14 17:21	06:41 18:43	05:55 21:11	04:20 22:41	03:23 23:45	04:09 23:07	05:39 21:32		07:05 19:47	08:29 18:06	09:02 15:33	10:09 14:50
20	09:40 15:48	08:11 17:24	06:37 18:46	05:52 21:14	04:17 22:44	03:22 23:46	04:12 23:04	05:42 21:29		07:08 19:43	08:32 18:03	09:05 15:31	10:10 14:50
21	09:37 15:51	08:07 17:27	06:34 18:48	05:48 21:17	04:14 22:47	03:22 23:46	04:15 23:02	05:54-06:09/15		07:11 19:40	08:35 17:59	09:08 15:28	10:11 14:50
22	09:35 15:54	08:04 17:30	06:30 18:51	05:45 21:20	04:11 22:49	03:23 23:46	04:17 22:59	05:54-06:10/16		07:13 19:37	08:37 17:56	09:11 15:26	10:11 14:50
23	09:32 15:57	08:01 17:33	06:27 18:54	05:42 21:23	04:09 22:52	03:23 23:47	04:20 22:56	05:53-06:10/17		07:16 19:33	08:40 17:53	09:14 15:23	10:12 14:51
24	09:30 16:00	07:58 17:36	06:23 18:57	05:38 21:26	04:06 22:55	03:23 23:46	04:23 22:53	05:53-06:12/19		07:19 19:30	08:43 17:50	09:17 15:21	10:12 14:52
25	09:27 16:03	07:54 17:39	06:20 19:00	05:35 21:29	04:03 22:58	03:24 23:46	04:26 22:50	05:52-06:12/20		07:21 19:26	07:46 16:46	09:20 15:19	10:13 14:52
26	09:25 16:06	07:51 17:42	06:17 19:02	05:32 21:32	04:01 23:01	03:24 23:46	04:29 22:48	05:52-06:12/20		07:24 19:23	07:49 16:43	09:22 15:17	10:13 14:53
27	09:22 16:10	07:48 17:45	06:13 19:05	05:28 21:35	03:58 23:03	03:25 23:45	04:32 22:45	05:52-06:13/21		07:27 19:20	07:52 16:40	09:25 15:14	10:13 14:54
28	09:19 16:13	07:44 17:48	06:10 19:08	05:25 21:38	03:56 23:06	03:26 23:45	04:34 22:42	05:51-06:13/22		07:30 19:16	07:55 16:37	09:28 15:12	10:12 14:56
29	09:17 16:16		07:06 20:11	05:22 21:41	03:53 23:09	03:27 23:44	04:37 22:39	05:52-06:13/21		07:32 19:13	07:58 16:34	09:31 15:10	10:12 14:57
30	09:14 16:19		07:03 20:14	05:19 21:44	03:51 23:11	03:29 23:43	04:40 22:36	05:52-06:13/21		07:35 19:09	08:01 16:31	09:33 15:08	10:12 14:58
31	09:11 16:22		07:00 20:17		03:49 23:14		04:43 22:33	05:51-06:12/21		07:35 19:09	08:04 16:27	09:33 15:00	10:11 15:00
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	151	
Sum of minutes with flicker	0	0	0	0	363	0	241	116	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
 Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T15 - T15

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December	
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:48-09:13/25	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06		16:24	15:07
2	10:10	09:06	07:38	06:53	05:12	03:45	03:32	04:49	06:19	07:41	08:48-09:13/25	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:41	22:27	20:45	19:03		16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:44	08:48-09:13/25	08:13	09:41
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59		16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:48-09:13/25	08:16	09:43
	15:08	16:35	18:00	20:28	21:56	23:23	23:38	22:21	20:38	18:56		16:15	15:02
5	10:07	08:57	07:28	06:43	05:03	03:39	03:37	04:58	06:27	07:49	08:48-09:12/24	08:19	09:46
	15:10	16:38	18:03	20:31	21:59	23:25	23:36	22:17	20:35	18:52		16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:49-09:11/22	08:22	09:48
	15:12	16:41	18:06	20:34	22:02	23:27	23:35	22:14	20:31	18:49		16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:50-09:10/20	08:26	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46		16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:51-09:08/17	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:25	18:42		16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:54-09:05/11	08:32	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39		16:01	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:41	08:03		08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18	18:36		15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06		08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32		15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09		08:41	10:00
	15:26	17:00	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29		15:52	14:52
13	09:54	08:33	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:12		08:44	10:02
	15:29	17:03	18:26	20:54	22:23	23:40	23:21	21:52	20:07	18:26		15:49	14:51
14	09:52	08:30	06:58	06:12	04:35	03:26	03:56	05:24	06:52	08:14		08:47	10:03
	15:31	17:06	18:29	20:57	22:26	23:41	23:19	21:49	20:04	18:22		15:46	14:51
15	09:50	08:26	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17		08:50	10:05
	15:34	17:09	18:31	20:59	22:29	23:42	23:17	21:45	20:01	18:19		15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20		08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16		15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23		08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12		15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26		08:59	10:08
	15:43	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09		15:36	14:50
19	09:42	08:14	06:41	05:55	04:20	03:23	04:09	05:39	07:05	08:29		09:02	10:09
	15:46	17:21	18:43	21:11	22:41	23:45	23:07	21:32	19:47	18:06		15:33	14:50
20	09:40	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32		09:05	10:10
	15:48	17:24	18:46	21:14	22:43	23:46	23:04	21:29	19:43	18:03		15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:11	08:35		09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59		15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:48	07:13	08:37		09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56		15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40		09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53		15:23	14:51
24	09:30	07:58	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:01-09:05/4	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50		15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:22	08:46	08:57-09:09/12	09:19	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46		15:19	14:53
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	08:49	08:55-09:12/17	09:22	10:12
	16:07	17:42	19:02	21:32	23:00	23:46	22:47	21:09	19:23	16:43		15:17	14:54
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	08:52	08:52-09:12/20	09:25	10:12
	16:10	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:20	16:40		15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:26	04:35	06:05	07:30	08:51	08:51-09:13/22	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:42	21:02	19:16	16:37		15:13	14:56
29	09:17		07:06	05:22	03:54	03:28	04:38	06:07	07:32	08:50	08:50-09:14/24	09:31	10:12
	16:16		20:11	21:41	23:08	23:44	22:39	20:59	19:13	16:34		15:11	14:57
30	09:14		07:03	05:19	03:51	03:29	04:40	06:10	07:35	08:50	08:50-09:14/24	09:33	10:12
	16:19		20:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31		15:09	14:58
31	09:11		07:00		03:49		04:43	06:13		08:04		10:11	
	16:22		20:17		23:14		22:33	20:52		16:28		15:00	
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152	0
Sum of minutes with flicker	0	0	314	0	0	0	0	0	123	194	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T2 - T2

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:46	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:52	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	17:59	20:28	21:55	23:23	23:38	22:20	20:38	18:56	16:15	15:01
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:45
	15:09	16:38	18:02	20:31	21:58	23:25	23:36	22:17	20:35	18:52	16:12	15:00
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	15:12	16:41	18:05	20:33	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:31	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:35	15:57	14:54
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	15:23	16:56	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
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13	09:54	08:32	07:01	06:15	04:37	03:27	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:02	18:25	20:54	22:23	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:26	03:56	05:24	06:51	08:14	08:47	10:03
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	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
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20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
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	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:49	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:29	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:24	07:51	06:16	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:47	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:35	23:03	23:45	22:44	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:37	23:06	23:44	22:41	21:02	19:16	16:37	15:12	14:56
29	09:16	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:40	23:08	23:43	22:39	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:18	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:43	23:11	23:43	22:36	20:55	19:09	16:30	15:08	14:58
31	09:11	07:34	06:00	05:14	03:49	03:31	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:46	23:13	23:45	22:33	20:52	19:12	16:27	15:05	14:59
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T3 - T3

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:46	23:16	23:41	22:29	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:31	17:57	20:25	21:52	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:34	18:00	20:28	21:55	23:23	23:38	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:02	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:02	20:31	21:58	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:01	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:04	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:35	15:58	14:54
11	09:58	08:39	07:07	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:08	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:40	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:31	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:44	23:11	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:13	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:45	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:10	08:34	09:08	10:10
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:13	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:29	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:34	23:03	23:45	22:44	21:05	19:19	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:26	04:35	06:04	07:30	07:55	09:28	10:12
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29	09:16	07:41	06:06	05:22	03:54	03:28	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:40	23:08	23:43	22:38	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:43	23:11	23:42	22:36	20:55	19:09	16:31	15:09	14:58
31	09:11	07:35	06:00	05:15	03:49	03:27	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:46	23:13	23:44	22:33	20:52	19:12	16:27	15:07	14:59
Potential sun hours	183	243	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T4 - T4

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:35
	15:02	16:25	17:51	20:19	21:46	23:16	23:41	22:29	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:40
	15:06	16:31	17:57	20:25	21:52	23:20	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	08:59	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:34	17:59	20:28	21:55	23:23	23:37	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:02	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:02	20:31	21:58	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:01	23:27	23:34	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:04	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:07	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:10	23:33	23:29	22:04	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:13	23:35	23:27	22:01	20:17	18:35	15:58	14:54
11	09:57	08:39	07:07	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:37	09:58
	15:24	16:56	18:20	20:48	22:16	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:35	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:08	08:40	09:59
	15:26	16:59	18:23	20:51	22:19	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:02	18:25	20:53	22:22	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:25	23:40	23:18	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:28	23:41	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:05
	15:37	17:12	18:34	21:02	22:31	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:43	23:11	21:38	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:41	08:13	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:28	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:45	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:10	08:34	09:08	10:10
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:34	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:10	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:13	10:11
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:29	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:28	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:16	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:31	23:00	23:45	22:47	21:08	19:23	16:43	15:17	14:53
27	09:22	07:47	06:13	05:28	03:58	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:34	23:03	23:45	22:44	21:05	19:19	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:26	04:35	06:04	07:30	07:55	09:27	10:12
	16:13	17:48	19:08	21:37	23:05	23:44	22:41	21:02	19:16	16:37	15:12	14:56
29	09:16	07:41	06:06	05:22	03:54	03:28	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:40	23:08	23:43	22:38	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:43	23:11	23:42	22:35	20:55	19:09	16:31	15:09	14:58
31	09:11	07:34	06:00	05:15	03:49	03:27	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:46	23:13	23:44	22:32	20:52	19:06	16:27	15:00	14:59
Potential sun hours	183	243	363	447	559	604	593	502	392	308	207	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T5 - T5

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:40	22:27	20:45	19:02	16:21	15:05
3	10:09	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:01
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:45
	15:09	16:38	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:31	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:40	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:35	15:57	14:54
11	09:58	08:39	07:07	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:37	03:27	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:02	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:31	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:07	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:22	04:15	05:45	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:36	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:49	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:16	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:35	23:03	23:45	22:44	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:42	21:02	19:16	16:37	15:12	14:56
29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:41	23:08	23:44	22:39	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:18	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:35	06:00	05:14	03:49	03:31	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:13	23:45	22:33	20:52	19:11	16:27	15:00	14:59
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T6 - T6

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:41	22:27	20:45	19:02	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:41	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:34	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:01
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:09	16:38	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:32	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:40	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:35	15:57	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:40	03:28	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:37	03:26	03:53	05:21	06:49	08:11	08:44	10:01
	15:29	17:02	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:25	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:31	03:25	03:58	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:49
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:07	21:32	19:47	18:06	15:33	14:49
20	09:39	08:10	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:22	04:14	05:44	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:36	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:49	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:16	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:46	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:31	06:02	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:42	21:02	19:16	16:37	15:12	14:55
29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:41	23:08	23:44	22:39	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:18	03:51	03:28	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:30	15:08	14:58
31	09:11	07:35	06:00	05:14	03:49	03:34	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:14	23:45	22:33	20:52	19:12	16:27	15:07	14:59
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

### SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T7 - T7

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum

950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:10	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:41	22:27	20:45	19:02	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:34	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:01
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:09	16:38	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:32	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:40	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:01	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:37	03:26	03:54	05:21	06:49	08:11	08:44	10:02
	15:29	17:02	18:26	20:54	22:23	23:40	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:25	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:31	03:25	03:58	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:31	20:59	22:29	23:42	23:17	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:49
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:41	23:45	23:07	21:32	19:47	18:06	15:33	14:49
20	09:39	08:10	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:22	04:14	05:45	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:17	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:46	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:45	22:42	21:02	19:16	16:37	15:12	14:55
29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:31	10:12
	16:16	17:51	19:11	21:41	23:08	23:44	22:39	20:59	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:19	03:51	03:28	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:35	06:00	05:15	03:49	03:34	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:14	23:45	22:33	20:52	19:13	16:27	15:09	14:59
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T8 - T8

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:06
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:03	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45	19:02	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:34	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:21	20:38	18:56	16:15	15:01
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:09	16:38	18:02	20:31	21:59	23:25	23:37	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:22	09:48
	15:11	16:41	18:05	20:34	22:02	23:28	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:26	09:50
	15:14	16:44	18:08	20:36	22:05	23:30	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:32	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:31	03:44	05:10	06:38	08:00	08:32	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:40	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18	18:36	15:57	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:26	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:40	03:27	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
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18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
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19	09:42	08:14	06:40	05:55	04:20	03:22	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:41	23:45	23:07	21:32	19:47	18:06	15:33	14:49
20	09:40	08:10	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:45	21:14	22:44	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:22	04:14	05:45	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:22	04:17	05:47	07:13	08:37	09:11	10:11
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23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:51
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:20	10:12
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29	09:17	07:42	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:31	10:12
	16:16	17:51	19:11	21:41	23:09	23:44	22:39	20:59	19:13	16:34	15:10	14:57
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	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:36	06:01	05:14	03:49	03:34	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:14	23:41	22:33	20:52	19:02	16:27	15:00	14:50
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	151
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_no forestWTG: T9 - T9

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

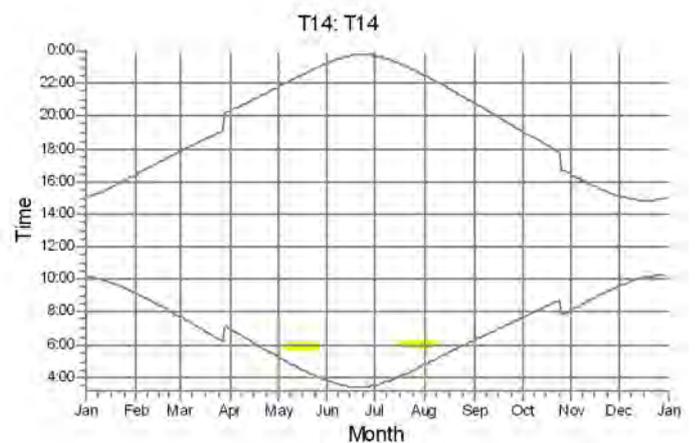
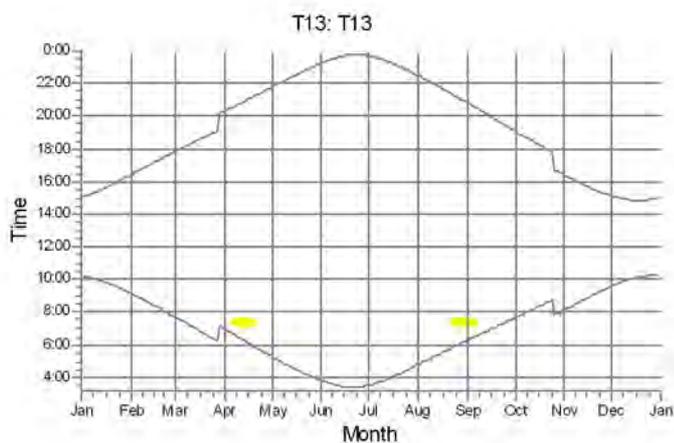
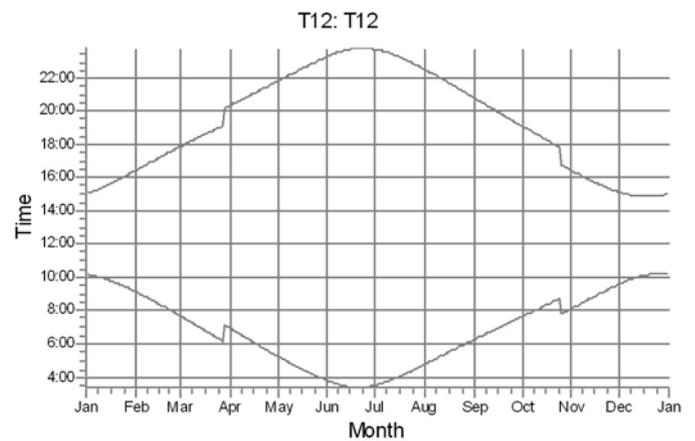
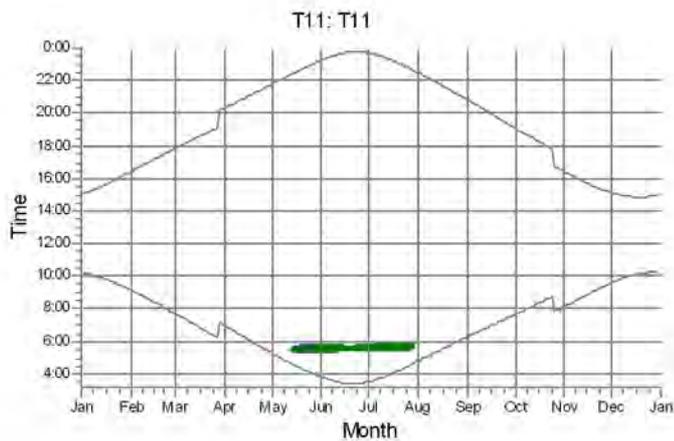
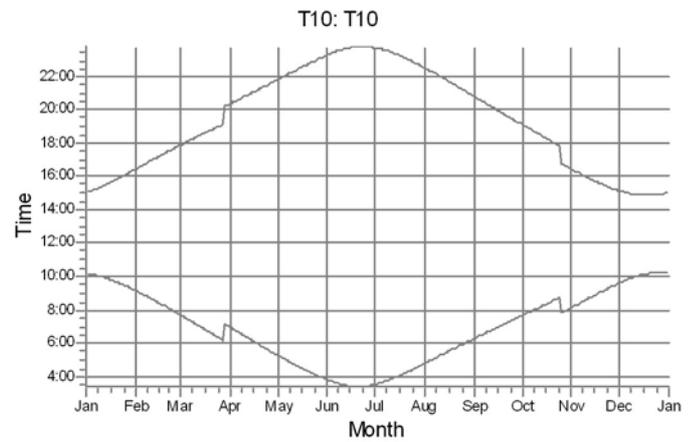
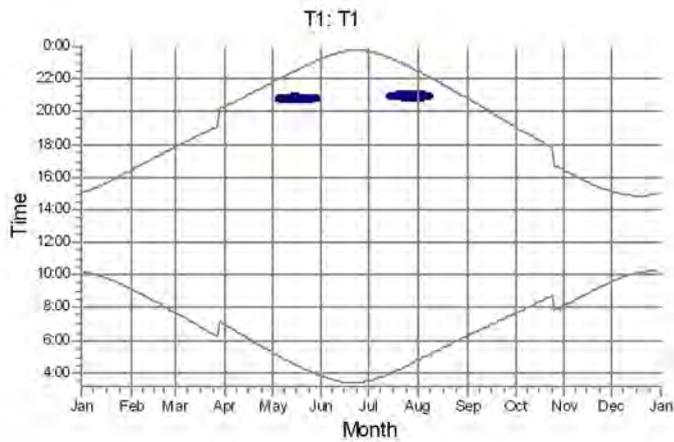
	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:41	22:27	20:45	19:02	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:10	16:38	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:32	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:38	03:27	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:26	15:49	14:51
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:07	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:46	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:42	21:02	19:16	16:37	15:12	14:56
29	09:17	07:42	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:41	23:08	23:44	22:39	20:58	19:13	16:34	15:10	14:57
30	09:14	07:39	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:36	06:01	05:16	03:49	03:29	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:14	23:41	22:33	20:52	19:01	16:27	15:00	14:52
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG, graphical

Calculation: V136 x 15 x HH172 real case\_no forest



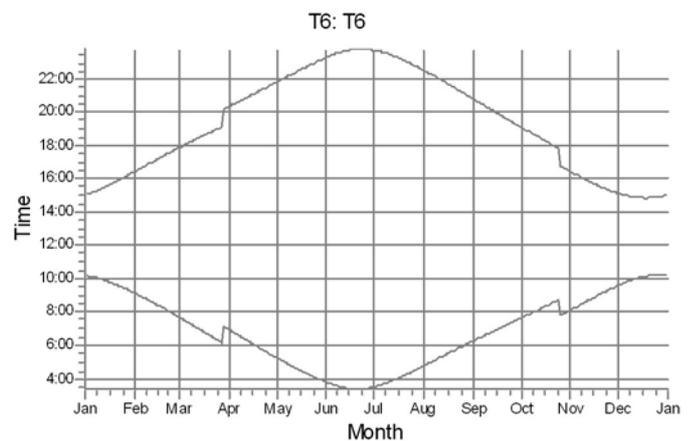
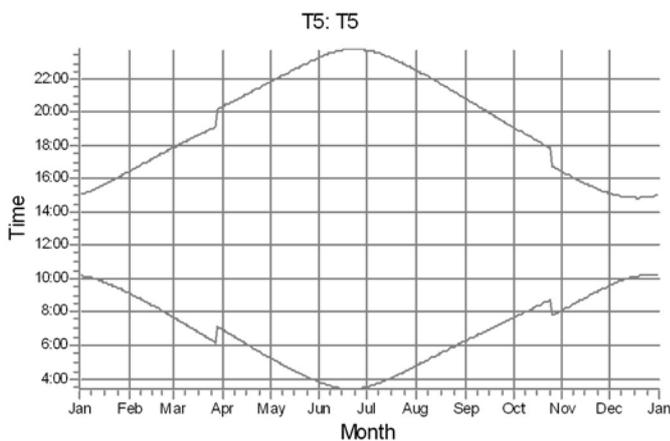
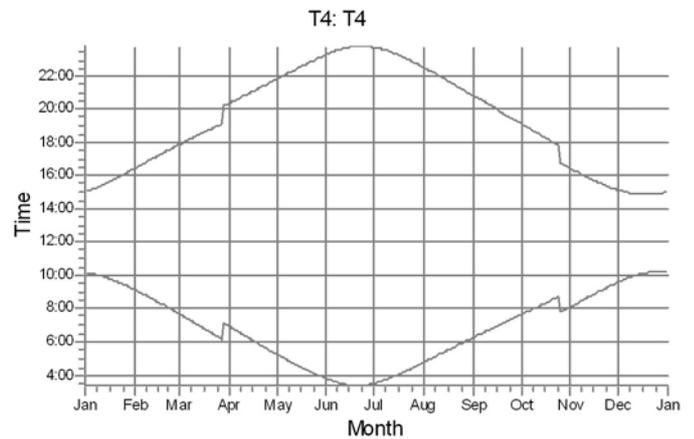
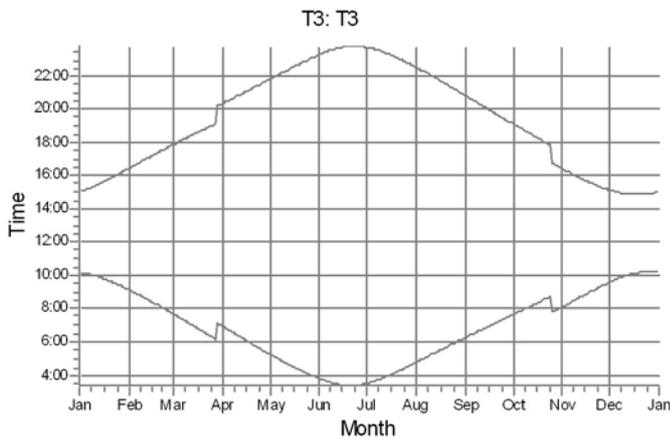
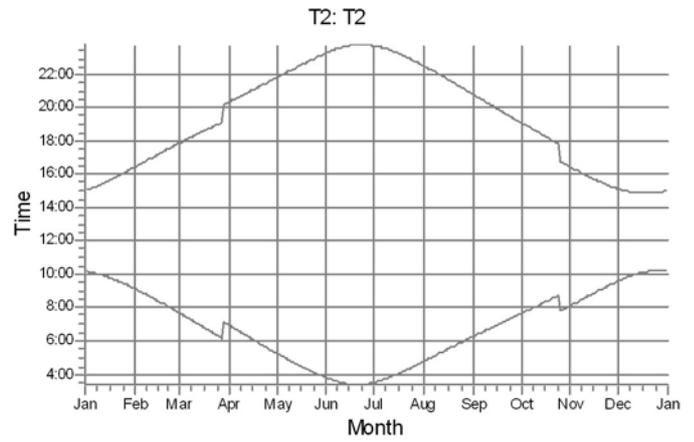
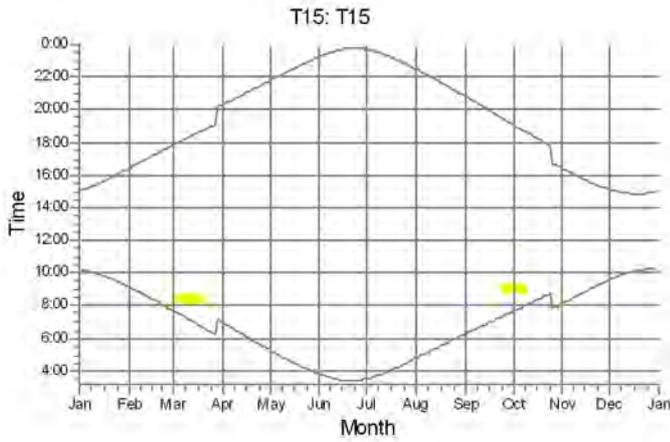
Shadow receptors

- A: Asuinrakennus (Langkujavägen 200)
- B: Lomarakennus (Voitby Långträsket)

- G: Lomarakennus/Partiomaja (Korpilahdenkuja 134)

## SHADOW - Calendar per WTG, graphical

Calculation: V136 x 15 x HH172 real case\_no forest

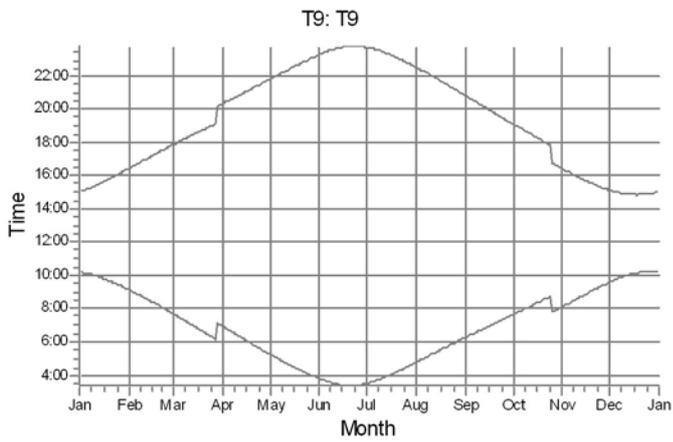
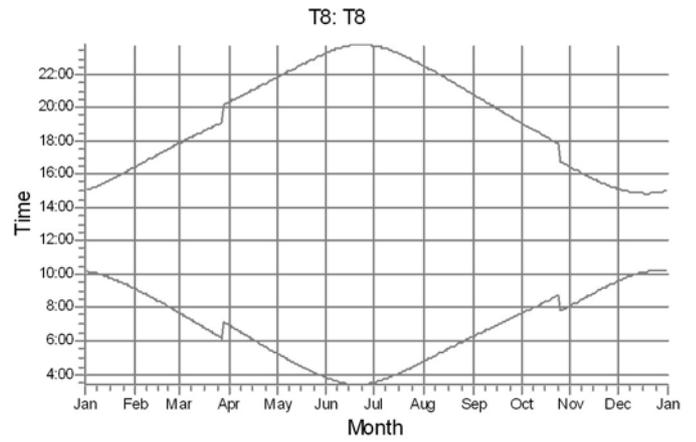
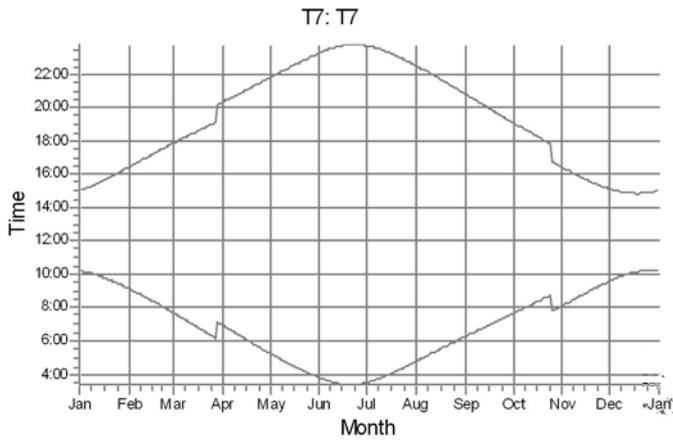


Shadow receptors

B: Lomarakennus (Voitby Långträsket)

## SHADOW - Calendar per WTG, graphical

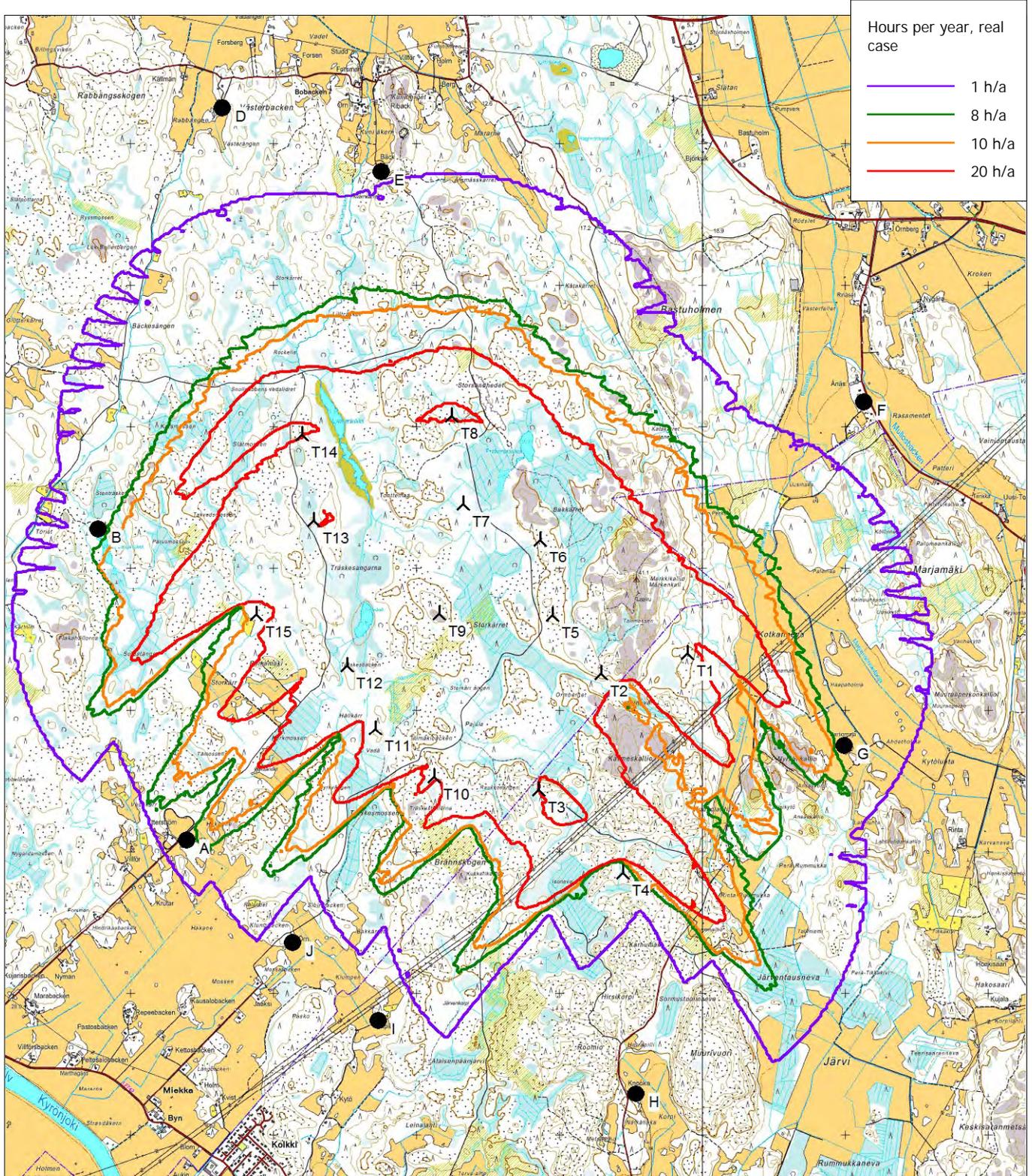
Calculation: V136 x 15 x HH172 real case\_no forest



Shadow receptors

## SHADOW - Map

Calculation: V136 x 15 x HH172 real case\_no forest



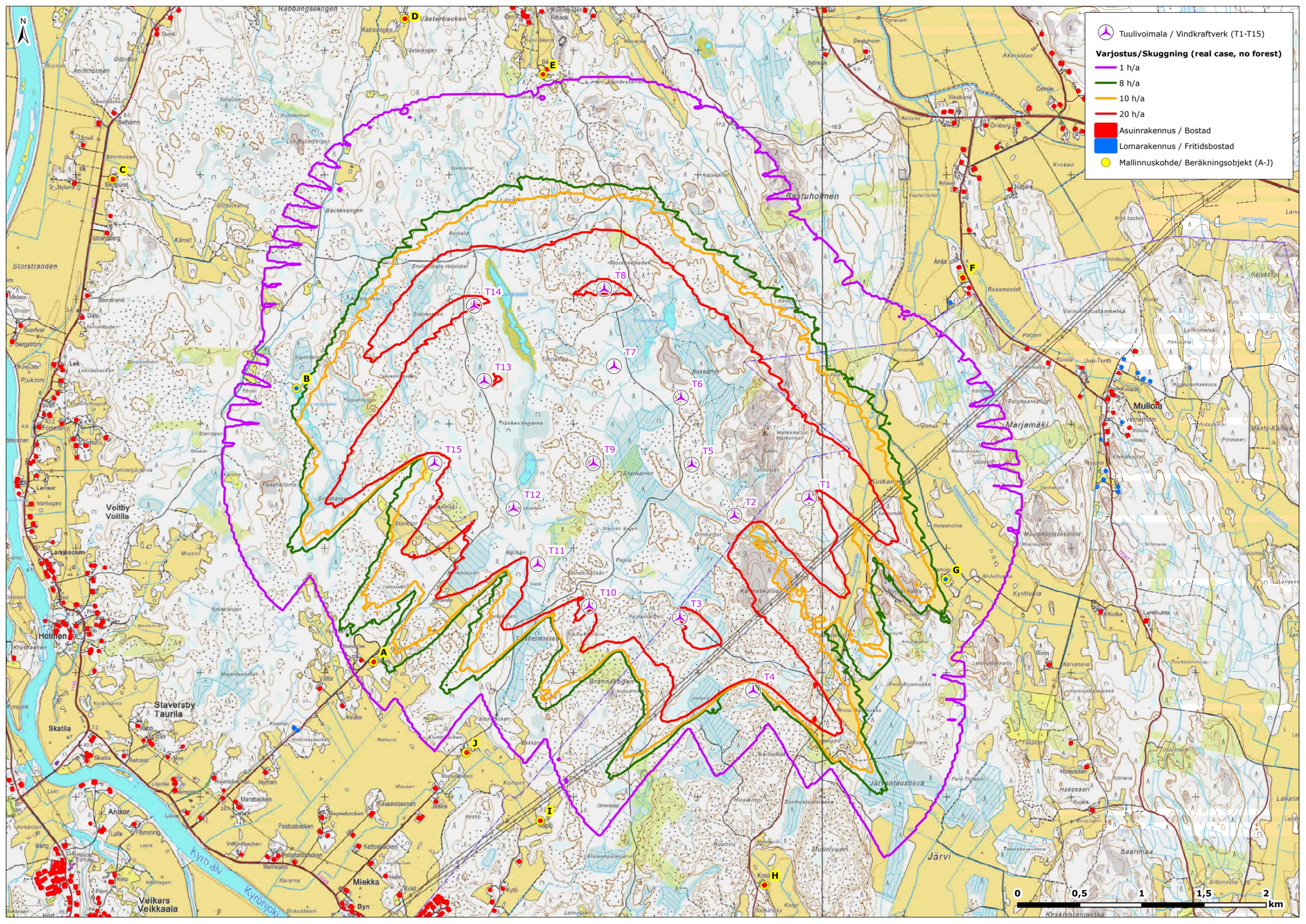
0 500 1000 1500 2000 m

Map: Peruskarttarasteri, Print scale 1:40 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 246 300 North: 7 008 480

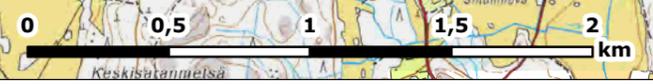
⊙ New WTG

⊙ Shadow receptor

Flicker map level: Height Contours: Merkkikallio\_height contour lines.wpo (1)



 Tuulivoimala / Vindkraftverk (T1-T15)  
**Varjostus/Skuggning (real case, no forest)**  
 1 h/a  
 8 h/a  
 10 h/a  
 20 h/a  
 Asuinrakennus / Bostad  
 Lomarakennus / Fritidsbostad  
 Mallinnuskohde/ Beräkningsobjekt (A-J)



## **Liite 4: Varjostusmallinnusten tulokset "real case, forest luke"**

## SHADOW - Main Result

Calculation: V136 x 15 x HH172 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  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational hours are calculated from WTGs in calculation and wind distribution:  
Tuuliatlas lib 30051

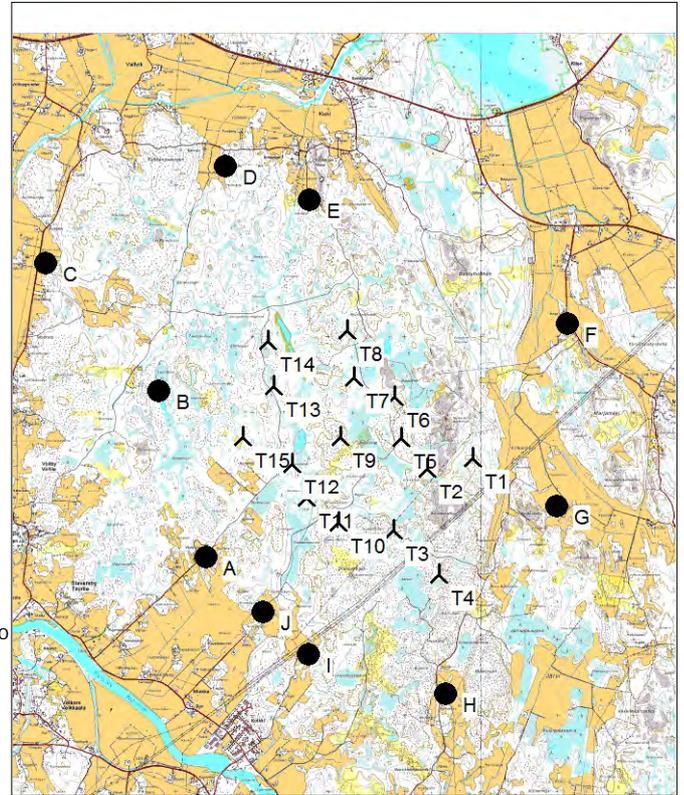
Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
Idle start wind speed: Cut in wind speed from power curve

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: Merkkikallio\_height contour lines.wpo  
Area object(s) used in calculation:  
Puuston korkeus 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	Rotor diameter	Hub height	Calculation distance	RPM
			[m]				[kW]	[m]	[m]	[m]	[RPM]	
T1	247 894	7 008 402	20,0	T1	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T10	246 126	7 007 532	23,2	T10	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T11	245 712	7 007 870	15,0	T11	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T12	245 517	7 008 318	15,0	T12	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T13	245 281	7 009 344	17,5	T13	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T14	245 200	7 009 948	17,5	T14	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T15	244 881	7 008 680	15,0	T15	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T2	247 294	7 008 259	23,6	T2	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T3	246 855	7 007 441	25,0	T3	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T4	247 445	7 006 854	26,8	T4	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T5	246 950	7 008 670	25,0	T5	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T6	246 864	7 009 208	20,3	T6	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T7	246 326	7 009 461	17,7	T7	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T8	246 247	7 010 081	21,5	T8	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	0,0
T9	246 160	7 008 681	29,6	T9	Yes	VESTAS	V136-3.45-3 450	3 450	136,0	172,0	1 712	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	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Asuinrakennus (Langkujavägen 200)	244 392	7 007 085	10,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
B	Lomarakennus (Voitby Långträsket)	243 772	7 009 284	12,8	5,0	5,0	1,0	0,0	0,0	"Green house mode"
C	Asuinrakennus (Voitbyntie 480)	242 293	7 010 963	5,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
D	Asuinrakennus (Kunintie 289)	244 642	7 012 253	5,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
E	Asuinrakennus (Sandhedsvägen 65)	245 754	7 011 805	10,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
F	Asuinrakennus (Mullontie 128)	249 130	7 010 173	7,5	5,0	5,0	1,0	0,0	0,0	"Green house mode"

To be continued on next page...

## SHADOW - Main Result

Calculation: V136 x 15 x HH172 real case\_forest luke

...continued from previous page

No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw [°]	Slope of window [°]	Direction mode
				[m]	[m]	[m]	[m]			
G	Lomarakennus/Partiomaja (Korpilahdenkuja 134)	248 995	7 007 749	10,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"
H	Asuinrakennus (Kotkannevantie 269)	247 537	7 005 291	18,5	5,0	5,0	1,0	0,0	0,0	"Green house mode"
I	Asuinrakennus (Klumpintie 171)	245 733	7 005 809	12,5	5,0	5,0	1,0	0,0	0,0	"Green house mode"
J	Asuinrakennus (Klumpvägen 170)	245 136	7 006 355	10,0	5,0	5,0	1,0	0,0	0,0	"Green house mode"

## Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Asuinrakennus (Langkujavägen 200)	6:47
B	Lomarakennus (Voitby Långträsket)	0:00
C	Asuinrakennus (Voitbyntie 480)	0:00
D	Asuinrakennus (Kunintie 289)	0:00
E	Asuinrakennus (Sandhedsvägen 65)	0:00
F	Asuinrakennus (Mullontie 128)	0:00
G	Lomarakennus/Partiomaja (Korpilahdenkuja 134)	0:00
H	Asuinrakennus (Kotkannevantie 269)	0:00
I	Asuinrakennus (Klumpintie 171)	0:00
J	Asuinrakennus (Klumpvägen 170)	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
T1	T1	0:00	0:00
T10	T10	0:00	0:00
T11	T11	21:36	6:47
T12	T12	0:00	0:00
T13	T13	0:00	0:00
T14	T14	0:00	0:00
T15	T15	0:00	0:00
T2	T2	0:00	0:00
T3	T3	0:00	0:00
T4	T4	0:00	0:00
T5	T5	0:00	0:00
T6	T6	0:00	0:00
T7	T7	0:00	0:00
T8	T8	0:00	0:00
T9	T9	0:00	0:00

Project:

Merkkikallio

Licensed user:

FCG Suunnittelu ja tekniikka Oy
Osmontie 34, PO Box 950
FI-00601 Helsinki
+358104095666
Hans Vadback / hans.vadback@fcg.fi
Calculated:
10.6.2016 9:21/3.0.619

SHADOW - Calendar

Calculation: V136 x 15 x HH172 real case\_forest lukeShadow receptor: A - Asuinrakennus (Langkujavägen 200)
Assumptions for shadow calculations

Shine probability S (Average daily sunshine hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465
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 year (1-31). Columns contain sun rise and set times, and minutes with flicker. Summary rows at the bottom show total sun hours and reduction percentages for various conditions.

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: V136 x 15 x HH172 real case\_forest lukeShadow receptor: B - Lomarakenus (Voitby Långträsket)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:20	21:47	23:16	23:42	22:30	20:49	19:06	16:25	15:07
2	10:10	09:06	07:38	06:53	05:12	03:45	03:32	04:49	06:19	07:41	08:10	09:39
	15:04	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:35	06:49	05:09	03:42	03:33	04:52	06:21	07:44	08:13	09:41
	15:06	16:32	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:17	09:43
	15:08	16:35	18:00	20:28	21:56	23:23	23:38	22:21	20:38	18:56	16:15	15:02
5	10:07	08:57	07:28	06:43	05:03	03:39	03:37	04:58	06:27	07:49	08:20	09:46
	15:10	16:38	18:03	20:31	21:59	23:25	23:37	22:18	20:35	18:53	16:12	15:00
6	10:05	08:54	07:25	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:23	09:48
	15:12	16:41	18:06	20:34	22:02	23:28	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:26	09:50
	15:14	16:44	18:08	20:37	22:05	23:30	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:58	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:32	23:32	22:08	20:25	18:42	16:04	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:32	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:30	22:05	20:21	18:39	16:01	14:55
10	10:00	08:42	07:11	06:26	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:37	23:26	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	17:00	18:23	20:51	22:20	23:38	23:24	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:12	08:44	10:02
	15:29	17:03	18:26	20:54	22:23	23:40	23:21	21:52	20:08	18:26	15:49	14:51
14	09:52	08:30	06:58	06:12	04:35	03:26	03:56	05:25	06:52	08:14	08:47	10:03
	15:32	17:06	18:29	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:47	14:51
15	09:51	08:26	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:31	21:00	22:29	23:42	23:17	21:45	20:01	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:59	04:23	03:23	04:07	05:36	07:03	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:38	23:45	23:09	21:36	19:50	18:09	15:36	14:50
19	09:42	08:14	06:41	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:46	17:21	18:43	21:11	22:41	23:45	23:07	21:32	19:47	18:06	15:33	14:50
20	09:40	08:11	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
	15:49	17:24	18:46	21:14	22:44	23:46	23:04	21:29	19:44	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:11	08:35	09:08	10:11
	15:51	17:27	18:48	21:17	22:47	23:46	23:02	21:26	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:18	05:48	07:13	08:38	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:41	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:47	22:56	21:19	19:33	17:53	15:24	14:51
24	09:30	07:58	06:24	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:01	17:36	18:57	21:26	22:55	23:46	22:53	21:16	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:22	07:46	09:20	10:13
	16:04	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:47	15:19	14:53
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:13
	16:07	17:42	19:03	21:32	23:01	23:45	22:48	21:09	19:23	16:43	15:17	14:54
27	09:22	07:48	06:13	05:29	03:59	03:25	04:32	06:02	07:27	07:52	09:25	10:13
	16:10	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:20	16:40	15:15	14:55
28	09:20	07:45	06:10	05:25	03:56	03:26	04:35	06:05	07:30	07:55	09:28	10:12
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29	09:17	07:41	06:06	05:22	03:54	03:28	04:38	06:07	07:33	07:58	09:31	10:12
	16:16	17:51	19:11	21:41	23:09	23:44	22:39	20:59	19:13	16:34	15:11	14:57
30	09:14	07:38	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:12
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31	09:11	07:35	06:00	05:15	03:49	03:27	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:44	23:14	23:45	22:33	20:52	19:06	16:28	15:00	14:50
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	152
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: V136 x 15 x HH172 real case\_forest lukeShadow receptor: C - Asuinrakennus (Voitbyntie 480)  
 Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:11	09:09	07:41	06:56	05:16	03:47	03:30	04:46	06:16	07:38	08:08	09:36
	15:02	16:25	17:51	20:20	21:47	23:17	23:42	22:30	20:49	19:06	16:25	15:07
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:19	07:41	08:11	09:39
	15:04	16:28	17:54	20:23	21:50	23:19	23:41	22:27	20:45	19:03	16:22	15:05
3	10:09	09:03	07:35	06:50	05:09	03:42	03:33	04:52	06:21	07:44	08:14	09:41
	15:06	16:32	17:57	20:25	21:53	23:21	23:40	22:24	20:42	18:59	16:18	15:03
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	15:08	16:35	18:00	20:28	21:56	23:24	23:38	22:21	20:38	18:56	16:15	15:02
5	10:07	08:57	07:28	06:43	05:03	03:38	03:36	04:58	06:27	07:49	08:20	09:46
	15:10	16:38	18:03	20:31	21:59	23:26	23:37	22:18	20:35	18:53	16:12	15:00
6	10:06	08:54	07:25	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:23	09:48
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	15:19	16:50	18:14	20:42	22:11	23:34	23:30	22:05	20:21	18:39	16:01	14:55
10	10:00	08:42	07:11	06:26	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:57
	15:21	16:53	18:17	20:45	22:14	23:36	23:28	22:02	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:44	08:06	08:38	09:59
	15:24	16:57	18:20	20:48	22:17	23:37	23:26	21:59	20:15	18:32	15:55	14:53
12	09:57	08:36	07:05	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	17:00	18:23	20:51	22:20	23:39	23:24	21:55	20:11	18:29	15:52	14:52
13	09:55	08:33	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:12	08:44	10:02
	15:29	17:03	18:26	20:54	22:23	23:40	23:22	21:52	20:08	18:26	15:49	14:51
14	09:53	08:30	06:58	06:12	04:35	03:26	03:56	05:25	06:52	08:15	08:47	10:04
	15:31	17:06	18:29	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:47	14:51
15	09:51	08:27	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:32	21:00	22:29	23:43	23:17	21:46	20:01	18:19	15:44	14:50
16	09:49	08:24	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:03	22:32	23:44	23:15	21:42	19:57	18:16	15:41	14:50
17	09:47	08:20	06:48	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:08
	15:40	17:15	18:37	21:06	22:35	23:44	23:12	21:39	19:54	18:13	15:38	14:50
18	09:44	08:17	06:44	05:59	04:23	03:23	04:07	05:36	07:03	08:26	08:59	10:09
	15:43	17:18	18:40	21:09	22:38	23:45	23:10	21:36	19:51	18:09	15:36	14:50
19	09:42	08:14	06:41	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:10
	15:46	17:21	18:43	21:11	22:41	23:46	23:07	21:32	19:47	18:06	15:33	14:50
20	09:40	08:11	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
	15:49	17:24	18:46	21:14	22:44	23:46	23:04	21:29	19:44	18:03	15:31	14:50
21	09:38	08:08	06:34	05:49	04:14	03:23	04:15	05:45	07:11	08:35	09:08	10:11
	15:51	17:27	18:49	21:17	22:47	23:47	23:02	21:26	19:40	17:59	15:28	14:50
22	09:35	08:04	06:31	05:45	04:12	03:23	04:17	05:48	07:14	08:38	09:11	10:12
	15:54	17:30	18:51	21:20	22:50	23:47	22:59	21:22	19:37	17:56	15:26	14:51
23	09:33	08:01	06:27	05:42	04:09	03:23	04:20	05:51	07:16	08:41	09:14	10:12
	15:57	17:33	18:54	21:23	22:53	23:47	22:56	21:19	19:33	17:53	15:24	14:51
24	09:30	07:58	06:24	05:39	04:06	03:23	04:23	05:53	07:19	08:44	09:17	10:13
	16:01	17:36	18:57	21:26	22:55	23:47	22:54	21:16	19:30	17:50	15:21	14:52
25	09:28	07:55	06:20	05:35	04:04	03:24	04:26	05:56	07:22	07:47	09:20	10:13
	16:04	17:39	19:00	21:29	22:58	23:47	22:51	21:12	19:27	16:47	15:19	14:53
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:50	09:23	10:13
	16:07	17:42	19:03	21:32	23:01	23:46	22:48	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:29	03:58	03:25	04:32	06:02	07:27	07:53	09:26	10:13
	16:10	17:45	19:06	21:35	23:04	23:46	22:45	21:06	19:20	16:40	15:15	14:55
28	09:20	07:45	06:10	05:25	03:56	03:26	04:35	06:05	07:30	07:56	09:28	10:13
	16:13	17:48	19:08	21:38	23:06	23:45	22:42	21:02	19:16	16:37	15:13	14:56
29	09:17	07:41	06:07	05:22	03:54	03:27	04:38	06:08	07:33	07:59	09:31	10:13
	16:16	17:51	19:11	21:41	23:09	23:44	22:39	20:59	19:13	16:34	15:11	14:57
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31	09:12	07:36	06:00	05:15	03:49	03:27	04:43	06:13	07:38	08:05	09:37	10:12
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Potential sun hours	182	242	363	447	559	605	594	502	392	308	206	151
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)	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: V136 x 15 x HH172 real case\_forest lukeShadow receptor: D - Asuinrakennus (Kunintie 289)  
 Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:11	09:09	07:41	06:56	05:15	03:46	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:20	21:47	23:17	23:42	22:30	20:49	19:06	16:24	15:06
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:11	09:39
	15:03	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:35	06:49	05:09	03:42	03:33	04:52	06:21	07:44	08:14	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:40	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:34	04:55	06:24	07:46	08:17	09:44
	15:07	16:34	18:00	20:28	21:56	23:24	23:39	22:21	20:38	18:56	16:15	15:01
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:20	09:46
	15:09	16:38	18:03	20:31	21:59	23:26	23:37	22:18	20:35	18:52	16:12	15:00
6	10:06	08:54	07:25	06:39	04:59	03:36	03:38	05:01	06:30	07:52	08:23	09:48
	15:11	16:41	18:05	20:34	22:02	23:28	23:35	22:15	20:32	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:34	03:40	05:04	06:32	07:55	08:26	09:51
	15:14	16:44	18:08	20:37	22:05	23:30	23:34	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:58	08:29	09:53
	15:16	16:47	18:11	20:39	22:08	23:32	23:32	22:08	20:25	18:42	16:03	14:56
9	10:02	08:45	07:14	06:29	04:50	03:31	03:44	05:10	06:38	08:00	08:32	09:55
	15:18	16:50	18:14	20:42	22:11	23:34	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:41	08:03	08:35	09:57
	15:21	16:53	18:17	20:45	22:14	23:36	23:28	22:02	20:18	18:36	15:57	14:54
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	15:23	16:56	18:20	20:48	22:17	23:37	23:26	21:59	20:14	18:32	15:55	14:53
12	09:57	08:36	07:04	06:19	04:40	03:27	03:51	05:18	06:46	08:09	08:41	10:00
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13	09:55	08:33	07:01	06:15	04:37	03:26	03:53	05:21	06:49	08:12	08:44	10:02
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14	09:53	08:30	06:58	06:12	04:34	03:25	03:56	05:24	06:52	08:14	08:47	10:04
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16	09:49	08:23	06:51	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:03	22:32	23:44	23:15	21:42	19:57	18:16	15:41	14:50
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18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:09
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19	09:42	08:14	06:41	05:55	04:20	03:22	04:09	05:39	07:05	08:29	09:02	10:10
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20	09:40	08:11	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:32	09:05	10:10
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22	09:35	08:04	06:30	05:45	04:11	03:22	04:17	05:47	07:13	08:38	09:11	10:12
	15:54	17:30	18:51	21:20	22:50	23:47	22:59	21:22	19:37	17:56	15:26	14:50
23	09:33	08:01	06:27	05:42	04:09	03:22	04:20	05:50	07:16	08:41	09:14	10:12
	15:57	17:33	18:54	21:23	22:53	23:47	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:58	06:24	05:38	04:06	03:23	04:23	05:53	07:19	08:44	09:17	10:13
	16:00	17:36	18:57	21:26	22:55	23:47	22:54	21:16	19:30	17:50	15:21	14:51
25	09:28	07:54	06:20	05:35	04:03	03:23	04:26	05:56	07:22	07:46	09:20	10:13
	16:03	17:39	19:00	21:29	22:58	23:47	22:51	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:17	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:23	10:13
	16:06	17:42	19:03	21:32	23:01	23:46	22:48	21:09	19:23	16:43	15:16	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:31	06:02	07:27	07:52	09:25	10:13
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28	09:20	07:45	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:13
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29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:33	07:58	09:31	10:13
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30	09:14	07:38	06:03	05:19	03:51	03:28	04:40	06:10	07:35	08:01	09:34	10:12
	16:19	17:54	19:14	21:44	23:12	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:35	06:00	05:15	03:49	03:31	04:43	06:13	07:38	08:04	09:37	10:12
	16:22	17:57	19:17	21:47	23:14	23:44	22:33	20:52	16:27	15:07	13:51	12:41
Potential sun hours	182	242	363	447	559	605	594	502	392	308	206	151
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: V136 x 15 x HH172 real case\_forest lukeShadow receptor: E - Asuinrakennus (Sandhedsvägen 65)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum

950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:11	09:09	07:41	06:56	05:15	03:46	03:29	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:06
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:39
	15:03	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:40	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:05	03:40	03:34	04:55	06:24	07:46	08:16	09:44
	15:07	16:34	18:00	20:28	21:56	23:24	23:38	22:21	20:38	18:56	16:15	15:01
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:20	09:46
	15:09	16:37	18:02	20:31	21:59	23:26	23:37	22:18	20:35	18:52	16:12	15:00
6	10:06	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:23	09:48
	15:11	16:41	18:05	20:34	22:02	23:28	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:34	03:40	05:04	06:32	07:55	08:26	09:50
	15:14	16:44	18:08	20:37	22:05	23:30	23:34	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:53
	15:16	16:47	18:11	20:39	22:08	23:32	23:32	22:08	20:25	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:31	03:44	05:10	06:38	08:00	08:32	09:55
	15:18	16:50	18:14	20:42	22:11	23:34	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:41	08:03	08:35	09:57
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18	18:36	15:57	14:53
11	09:58	08:39	07:08	06:22	04:43	03:28	03:49	05:15	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:26	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:40	03:27	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:39	23:24	21:55	20:11	18:29	15:52	14:52
13	09:55	08:33	07:01	06:15	04:37	03:26	03:53	05:21	06:49	08:12	08:44	10:02
	15:28	17:02	18:26	20:54	22:23	23:40	23:22	21:52	20:07	18:26	15:49	14:51
14	09:53	08:30	06:57	06:12	04:34	03:25	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:50
15	09:51	08:26	06:54	06:08	04:31	03:24	03:58	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:31	21:00	22:29	23:42	23:17	21:45	20:01	18:19	15:43	14:50
16	09:49	08:23	06:51	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:15	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:25	03:23	04:03	05:33	07:00	08:23	08:56	10:07
	15:39	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:49
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:09
	15:42	17:18	18:40	21:08	22:38	23:45	23:10	21:36	19:50	18:09	15:36	14:49
19	09:42	08:14	06:40	05:55	04:20	03:22	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:41	23:46	23:07	21:32	19:47	18:06	15:33	14:49
20	09:40	08:11	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:46	21:14	22:44	23:46	23:04	21:29	19:43	18:02	15:30	14:49
21	09:37	08:07	06:34	05:48	04:14	03:22	04:14	05:44	07:11	08:35	09:08	10:11
	15:51	17:27	18:48	21:17	22:47	23:47	23:02	21:26	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:22	04:17	05:47	07:13	08:38	09:11	10:12
	15:54	17:30	18:51	21:20	22:50	23:47	22:59	21:22	19:37	17:56	15:26	14:50
23	09:33	08:01	06:27	05:42	04:09	03:22	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:47	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:58	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:13
	16:00	17:36	18:57	21:26	22:55	23:47	22:53	21:16	19:30	17:49	15:21	14:51
25	09:27	07:54	06:20	05:35	04:03	03:23	04:26	05:56	07:21	07:46	09:20	10:13
	16:03	17:39	19:00	21:29	22:58	23:46	22:51	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:17	05:32	04:01	03:24	04:28	05:59	07:24	07:49	09:23	10:13
	16:06	17:42	19:02	21:32	23:01	23:46	22:48	21:09	19:23	16:43	15:16	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:31	06:02	07:27	07:52	09:25	10:13
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28	09:20	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:13
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29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:31	10:12
	16:16	17:51	19:11	21:41	23:09	23:44	22:39	20:59	19:13	16:34	15:10	14:57
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	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:30	15:08	14:58
31	09:11	07:34	06:00	05:15	03:48	03:28	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:14	23:43	22:33	20:52	19:16	16:27	15:07	14:59
Potential sun hours	182	242	363	447	559	605	594	502	392	308	206	151
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: V136 x 15 x HH172 real case\_forest lukeShadow receptor: F - Asuinrakennus (Mullontie 128)  
Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []  
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time  
N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:29	04:46	06:15	07:38	08:07	09:36
	15:01	16:25	17:51	20:19	21:46	23:16	23:42	22:30	20:48	19:06	16:24	15:06
2	10:09	09:05	07:37	06:52	05:12	03:44	03:31	04:49	06:18	07:40	08:10	09:38
	15:03	16:28	17:53	20:22	21:49	23:18	23:41	22:27	20:45	19:02	16:21	15:04
3	10:09	09:02	07:34	06:49	05:09	03:42	03:32	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:56	20:25	21:52	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:05	03:40	03:34	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	17:59	20:28	21:55	23:23	23:38	22:20	20:38	18:55	16:15	15:01
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:26	07:49	08:19	09:45
	15:09	16:37	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:22	09:48
	15:11	16:40	18:05	20:33	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:35	04:56	03:34	03:40	05:03	06:32	07:54	08:25	09:50
	15:13	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:45	16:06	14:57
8	10:02	08:48	07:17	06:32	04:53	03:33	03:42	05:06	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:49	03:31	03:44	05:09	06:38	08:00	08:31	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:54
10	09:59	08:42	07:11	06:25	04:46	03:30	03:46	05:12	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:17	18:35	15:57	14:53
11	09:58	08:39	07:07	06:22	04:43	03:28	03:48	05:15	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:54	14:52
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13	09:54	08:32	07:01	06:15	04:37	03:26	03:53	05:21	06:48	08:11	08:44	10:01
	15:28	17:02	18:25	20:53	22:23	23:40	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:25	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:05	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:50
15	09:50	08:26	06:54	06:08	04:31	03:24	03:58	05:27	06:54	08:17	08:50	10:04
	15:34	17:08	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:43	14:50
16	09:48	08:23	06:50	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:36	17:11	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:15	15:41	14:49
17	09:46	08:20	06:47	06:01	04:25	03:23	04:03	05:33	06:59	08:23	08:56	10:07
	15:39	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:53	18:12	15:38	14:49
18	09:44	08:17	06:44	05:58	04:22	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:37	23:45	23:09	21:35	19:50	18:09	15:35	14:49
19	09:42	08:13	06:40	05:55	04:20	03:22	04:09	05:39	07:05	08:28	09:02	10:09
	15:45	17:21	18:42	21:11	22:40	23:45	23:07	21:32	19:47	18:05	15:33	14:49
20	09:39	08:10	06:37	05:51	04:17	03:22	04:11	05:41	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:30	14:49
21	09:37	08:07	06:33	05:48	04:14	03:22	04:14	05:44	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:22	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:36	17:56	15:25	14:50
23	09:32	08:01	06:27	05:41	04:08	03:22	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:52	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:18	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:29	17:49	15:21	14:51
25	09:27	07:54	06:20	05:35	04:03	03:23	04:25	05:56	07:21	08:46	09:19	10:12
	16:03	17:39	18:59	21:29	22:58	23:46	22:50	21:12	19:26	17:46	15:18	14:52
26	09:24	07:51	06:16	05:31	04:00	03:24	04:28	05:59	07:24	08:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:46	22:47	21:08	19:23	17:43	15:16	14:53
27	09:22	07:47	06:13	05:28	03:58	03:25	04:31	06:01	07:27	08:52	09:25	10:12
	16:09	17:45	19:05	21:34	23:03	23:45	22:44	21:05	19:19	17:40	15:14	14:54
28	09:19	07:44	06:09	05:25	03:55	03:26	04:34	06:04	07:29	08:55	09:28	10:12
	16:12	17:48	19:08	21:37	23:06	23:44	22:42	21:02	19:16	17:37	15:12	14:55
29	09:16	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	08:58	09:30	10:12
	16:15	17:51	19:11	21:40	23:08	23:44	22:39	20:58	19:12	17:33	15:10	14:56
30	09:14	07:38	06:03	05:18	03:51	03:28	04:40	06:10	07:35	09:01	09:33	10:12
	16:18	17:54	19:14	21:43	23:11	23:43	22:36	20:55	19:09	17:30	15:08	14:58
31	09:11	07:35	06:00	05:14	03:48	03:28	04:43	06:13	07:38	09:04	09:36	10:11
	16:22	17:58	19:18	21:46	23:14	23:45	22:33	20:52	19:16	17:37	15:09	14:59
Potential sun hours	182	242	363	447	559	605	594	502	392	308	206	151
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: V136 x 15 x HH172 real case\_forest lukeShadow receptor: G - Lomarakenus/Partiomaja (Korpilahdenkuja 134)  
 Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:30	04:46	06:15	07:38	08:07	09:35
	15:02	16:25	17:51	20:19	21:46	23:16	23:41	22:29	20:48	19:06	16:24	15:06
2	10:09	09:05	07:37	06:52	05:12	03:44	03:31	04:49	06:18	07:40	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:40
	15:05	16:31	17:56	20:25	21:52	23:20	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	08:59	07:31	06:46	05:05	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	17:59	20:28	21:55	23:23	23:38	22:20	20:38	18:55	16:15	15:01
5	10:06	08:56	07:27	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:45
	15:09	16:37	18:02	20:30	21:58	23:25	23:36	22:17	20:34	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:51	08:22	09:48
	15:12	16:41	18:05	20:33	22:01	23:27	23:34	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:35	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:04	23:29	23:33	22:11	20:28	18:45	16:06	14:57
8	10:02	08:48	07:17	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:07	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:31	09:54
	15:18	16:50	18:14	20:42	22:10	23:33	23:29	22:04	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:46	05:12	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:13	23:35	23:27	22:01	20:17	18:35	15:57	14:54
11	09:57	08:38	07:07	06:22	04:43	03:29	03:49	05:15	06:43	08:06	08:37	09:58
	15:23	16:56	18:20	20:48	22:16	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:35	07:04	06:18	04:40	03:28	03:51	05:18	06:46	08:08	08:40	09:59
	15:26	16:59	18:22	20:50	22:19	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:37	03:26	03:53	05:21	06:48	08:11	08:43	10:01
	15:29	17:02	18:25	20:53	22:22	23:39	23:21	21:51	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:05	18:28	20:56	22:25	23:40	23:18	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:31	03:25	03:58	05:27	06:54	08:17	08:50	10:04
	15:34	17:08	18:31	20:59	22:28	23:42	23:16	21:45	20:00	18:19	15:43	14:50
16	09:48	08:23	06:50	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:05
	15:37	17:12	18:34	21:02	22:31	23:43	23:14	21:42	19:57	18:15	15:41	14:50
17	09:46	08:20	06:47	06:01	04:25	03:23	04:04	05:33	06:59	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:43	23:11	21:38	19:53	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:25	08:59	10:08
	15:42	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:49
19	09:41	08:13	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:28	09:02	10:09
	15:45	17:21	18:42	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:49
20	09:39	08:10	06:37	05:51	04:17	03:22	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:45	23:04	21:28	19:43	18:02	15:30	14:50
21	09:37	08:07	06:33	05:48	04:14	03:22	04:14	05:44	07:10	08:34	09:08	10:10
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:34	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:10	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:50
23	09:32	08:00	06:27	05:41	04:09	03:23	04:20	05:50	07:16	08:40	09:13	10:11
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:18	19:33	17:53	15:23	14:51
24	09:29	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:18	08:43	09:16	10:12
	16:00	17:36	18:57	21:25	22:55	23:46	22:53	21:15	19:29	17:49	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:28	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:24	07:51	06:16	05:31	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:31	23:00	23:45	22:47	21:08	19:23	16:43	15:16	14:53
27	09:22	07:47	06:13	05:28	03:58	03:25	04:31	06:01	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:34	23:03	23:45	22:44	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:29	07:55	09:27	10:12
	16:12	17:48	19:08	21:37	23:05	23:44	22:41	21:02	19:16	16:37	15:12	14:55
29	09:16	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:40	23:08	23:43	22:38	20:58	19:12	16:33	15:10	14:57
30	09:14	07:38	06:03	05:18	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:13	21:43	23:11	23:42	22:35	20:55	19:09	16:30	15:08	14:58
31	09:11	07:35	06:00	05:15	03:46	03:28	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:56	19:15	21:46	23:13	23:43	22:32	20:51	16:27	15:04	13:52	13:52
Potential sun hours	182	243	363	447	559	604	593	502	392	308	206	152
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: V136 x 15 x HH172 real case\_forest lukeShadow receptor: H - Asuinrakennus (Kotkannevantie 269)  
 Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:35
	15:02	16:25	17:51	20:19	21:46	23:15	23:41	22:29	20:48	19:06	16:24	15:07
2	10:09	09:05	07:37	06:53	05:12	03:45	03:32	04:49	06:18	07:40	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:43	03:33	04:52	06:21	07:43	08:13	09:40
	15:06	16:31	17:57	20:25	21:52	23:20	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	08:59	07:31	06:46	05:06	03:41	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:55	23:22	23:37	22:20	20:38	18:56	16:15	15:02
5	10:06	08:56	07:28	06:42	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:02	20:30	21:58	23:25	23:36	22:17	20:34	18:52	16:12	15:00
6	10:05	08:53	07:24	06:39	04:59	03:37	03:39	05:01	06:29	07:52	08:22	09:47
	15:12	16:41	18:05	20:33	22:01	23:27	23:34	22:14	20:31	18:49	16:09	14:59
7	10:03	08:51	07:21	06:36	04:56	03:35	03:41	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:04	23:29	23:32	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:17	06:32	04:53	03:34	03:43	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:07	23:31	23:31	22:07	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:10	23:33	23:29	22:04	20:21	18:39	16:01	14:55
10	09:59	08:41	07:11	06:25	04:47	03:31	03:47	05:13	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:13	23:34	23:27	22:01	20:17	18:35	15:58	14:54
11	09:57	08:38	07:07	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:37	09:57
	15:24	16:56	18:20	20:48	22:16	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:35	07:04	06:19	04:41	03:28	03:52	05:19	06:46	08:08	08:40	09:59
	15:26	16:59	18:23	20:50	22:19	23:37	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:11	08:43	10:01
	15:29	17:03	18:25	20:53	22:22	23:39	23:21	21:51	20:07	18:25	15:49	14:52
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:46	10:02
	15:32	17:06	18:28	20:56	22:25	23:40	23:18	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:49	10:04
	15:34	17:09	18:31	20:59	22:28	23:41	23:16	21:45	20:00	18:19	15:44	14:51
16	09:48	08:23	06:50	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:52	10:05
	15:37	17:12	18:34	21:02	22:31	23:42	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:06
	15:40	17:15	18:37	21:05	22:34	23:43	23:11	21:38	19:53	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:41	08:13	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:28	09:01	10:09
	15:46	17:21	18:42	21:11	22:40	23:44	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:04	10:09
	15:49	17:24	18:45	21:14	22:43	23:45	23:03	21:28	19:43	18:02	15:31	14:50
21	09:37	08:07	06:33	05:48	04:14	03:23	04:15	05:45	07:10	08:34	09:07	10:10
	15:51	17:27	18:48	21:17	22:46	23:45	23:01	21:25	19:40	17:59	15:28	14:50
22	09:34	08:04	06:30	05:45	04:12	03:23	04:18	05:47	07:13	08:37	09:10	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:51
23	09:32	08:00	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:13	10:11
	15:57	17:33	18:54	21:22	22:52	23:46	22:55	21:18	19:33	17:53	15:24	14:51
24	09:29	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
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	16:04	17:39	18:59	21:28	22:57	23:45	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:16	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:07	17:42	19:02	21:31	23:00	23:45	22:47	21:08	19:23	16:43	15:17	14:54
27	09:22	07:47	06:13	05:28	03:59	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:34	23:03	23:44	22:44	21:05	19:19	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:27	04:35	06:04	07:29	07:55	09:27	10:12
	16:13	17:48	19:08	21:37	23:05	23:44	22:41	21:02	19:16	16:37	15:13	14:56
29	09:16		07:06	05:22	03:54	03:28	04:38	06:07	07:32	07:58	09:30	10:11
	16:16		20:11	21:40	23:08	23:43	22:38	20:58	19:13	16:34	15:11	14:57
30	09:13		07:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19		20:14	21:43	23:10	23:42	22:35	20:55	19:09	16:31	15:09	14:59
31	09:11		06:59		03:49		04:43	06:13		08:04		10:10
	16:22		20:16		23:13		22:32	20:51		16:27		15:00
Potential sun hours	183	243	363	447	558	604	593	502	392	308	207	152
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: V136 x 15 x HH172 real case\_forest lukeShadow receptor: I - Asuinrakennus (Klumpintie 171)  
 Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:35
	15:02	16:25	17:51	20:19	21:46	23:16	23:41	22:29	20:48	19:06	16:25	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:19	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:03	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:43	03:33	04:52	06:21	07:43	08:13	09:40
	15:06	16:32	17:57	20:25	21:52	23:20	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:41	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:55	23:23	23:37	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:03	20:31	21:58	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:39	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:01	23:27	23:34	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:41	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:04	23:29	23:33	22:11	20:28	18:46	16:06	14:58
8	10:02	08:48	07:18	06:32	04:53	03:34	03:43	05:07	06:35	07:57	08:28	09:52
	15:17	16:47	18:11	20:39	22:07	23:31	23:31	22:08	20:24	18:42	16:04	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:10	23:33	23:29	22:04	20:21	18:39	16:01	14:55
10	09:59	08:42	07:11	06:25	04:47	03:31	03:47	05:13	06:41	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:13	23:34	23:27	22:01	20:18	18:36	15:58	14:54
11	09:57	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:37	09:58
	15:24	16:56	18:20	20:48	22:16	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:52	05:19	06:46	08:09	08:41	09:59
	15:26	17:00	18:23	20:51	22:19	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:22	23:39	23:21	21:52	20:07	18:26	15:49	14:52
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:25	06:51	08:14	08:47	10:03
	15:32	17:06	18:28	20:56	22:25	23:40	23:18	21:48	20:04	18:22	15:47	14:51
15	09:50	08:26	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:28	23:41	23:16	21:45	20:00	18:19	15:44	14:51
16	09:48	08:23	06:51	06:05	04:29	03:25	04:02	05:30	06:57	08:20	08:53	10:05
	15:37	17:12	18:34	21:02	22:31	23:42	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:43	23:11	21:39	19:54	18:12	15:39	14:50
18	09:44	08:17	06:44	05:58	04:23	03:24	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:41	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:46	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:49	17:24	18:45	21:14	22:43	23:45	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:15	03:23	04:15	05:45	07:11	08:34	09:08	10:10
	15:52	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:34	08:04	06:30	05:45	04:12	03:23	04:18	05:48	07:13	08:37	09:11	10:11
	15:55	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:37	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:13	10:11
	15:58	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:24	14:51
24	09:30	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
	16:01	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:04	17:39	19:00	21:29	22:57	23:45	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:07	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:54
27	09:22	07:48	06:13	05:29	03:59	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:34	23:03	23:45	22:44	21:05	19:19	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:27	04:35	06:05	07:30	07:55	09:27	10:12
	16:13	17:48	19:08	21:37	23:05	23:44	22:41	21:02	19:16	16:37	15:13	14:56
29	09:16		07:06	05:22	03:54	03:28	04:38	06:07	07:32	07:58	09:30	10:12
	16:16		20:11	21:40	23:08	23:43	22:38	20:58	19:13	16:34	15:11	14:57
30	09:14		07:03	05:19	03:51	03:29	04:41	06:10	07:35	08:01	09:33	10:11
	16:19		20:14	21:43	23:11	23:42	22:35	20:55	19:09	16:31	15:09	14:59
31	09:11		07:00		03:49		04:44	06:13		08:04		10:11
	16:22		20:16		23:13		22:32	20:52		16:28		15:00
Potential sun hours	183	243	363	447	558	604	593	502	392	308	207	152
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: V136 x 15 x HH172 real case\_forest lukeShadow receptor: J - Asuinrakennus (Klumpvägen 170)

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:16	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:41	22:30	20:48	19:06	16:25	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:19	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:40	22:26	20:45	19:03	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:43	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:32	17:57	20:25	21:53	23:20	23:39	22:23	20:42	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:41	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:43	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:03	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	05:00	03:37	03:39	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:06	20:34	22:02	23:27	23:34	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:41	05:04	06:32	07:55	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:58
8	10:02	08:48	07:18	06:32	04:53	03:34	03:43	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:04	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:01	14:55
10	09:59	08:42	07:11	06:26	04:47	03:31	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:57	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:52	05:19	06:46	08:09	08:41	10:00
	15:26	17:00	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:26	15:49	14:52
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:25	06:52	08:14	08:47	10:03
	15:32	17:06	18:28	20:56	22:26	23:40	23:19	21:48	20:04	18:22	15:47	14:51
15	09:50	08:26	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:01	18:19	15:44	14:51
16	09:48	08:23	06:51	06:05	04:29	03:25	04:02	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:43	23:11	21:39	19:54	18:12	15:39	14:50
18	09:44	08:17	06:44	05:58	04:23	03:24	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:46	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
	15:49	17:24	18:46	21:14	22:43	23:45	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:15	03:23	04:15	05:45	07:11	08:34	09:08	10:10
	15:52	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:18	05:48	07:13	08:37	09:11	10:11
	15:55	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:37	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:11
	15:58	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:24	14:51
24	09:30	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
	16:01	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:04	17:39	19:00	21:29	22:57	23:46	22:50	21:12	19:26	16:47	15:19	14:53
26	09:24	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:07	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:54
27	09:22	07:48	06:13	05:29	03:59	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:35	23:03	23:45	22:44	21:05	19:20	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:27	04:35	06:05	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:41	21:02	19:16	16:37	15:13	14:56
29	09:16	07:41	06:06	05:22	03:54	03:28	04:38	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:41	23:08	23:43	22:39	20:58	19:13	16:34	15:11	14:57
30	09:14	07:38	06:03	05:19	03:51	03:29	04:41	06:10	07:35	08:01	09:33	10:11
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31	09:11	07:35	06:00	05:15	03:49	03:27	04:44	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:13	23:43	22:33	20:52	19:16	16:28	15:00	14:50
Potential sun hours	183	243	363	447	558	604	593	502	392	308	207	152
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

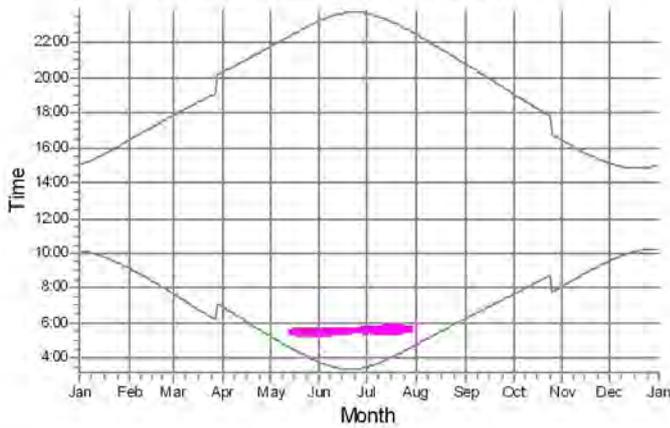
Table layout: For each day in each month the following matrix apply

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)

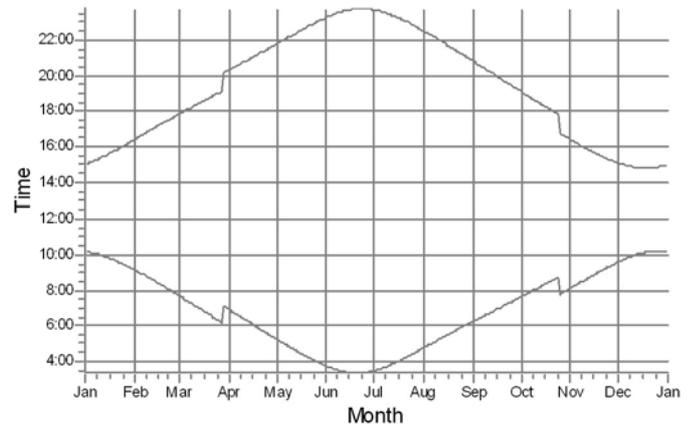
## SHADOW - Calendar, graphical

Calculation: V136 x 15 x HH172 real case\_forest luke

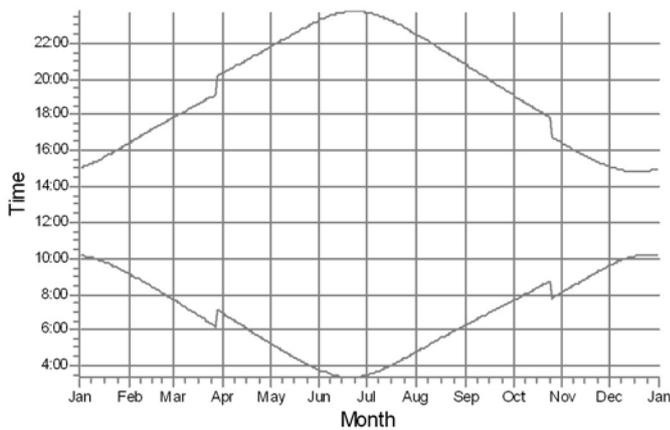
A: Asuinrakennus (Langkujavägen 200)



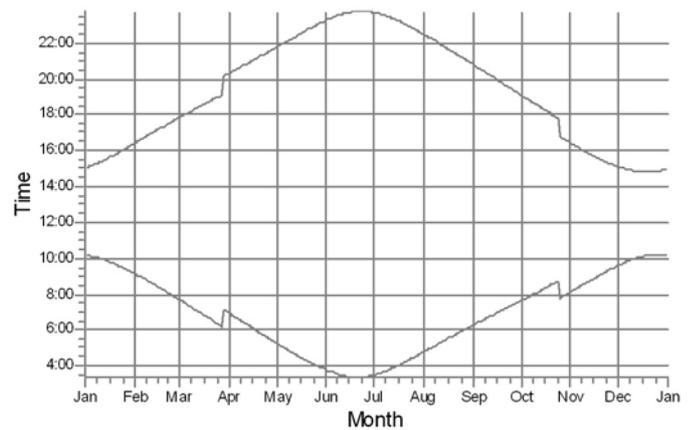
B: Lomarakennus (Voitby Långträsket)



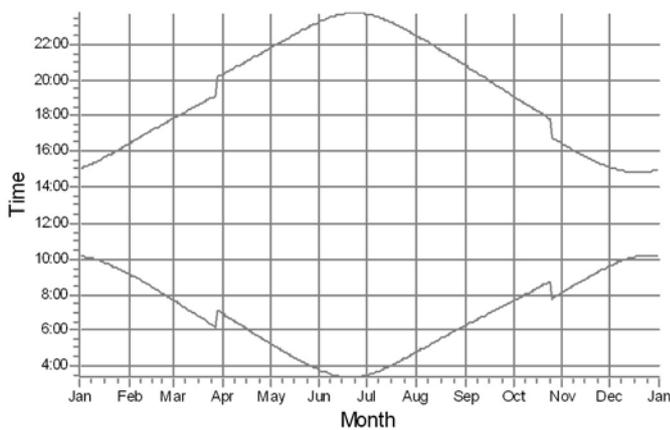
C: Asuinrakennus (Voitbyntie 480)



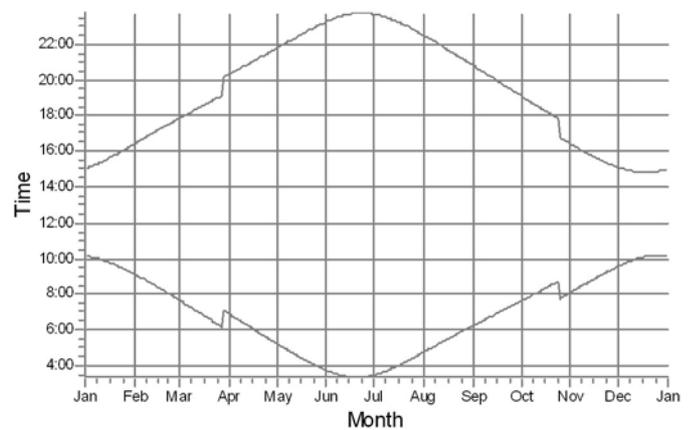
D: Asuinrakennus (Kunintie 289)



E: Asuinrakennus (Sandhedsvägen 65)



F: Asuinrakennus (Mullontie 128)

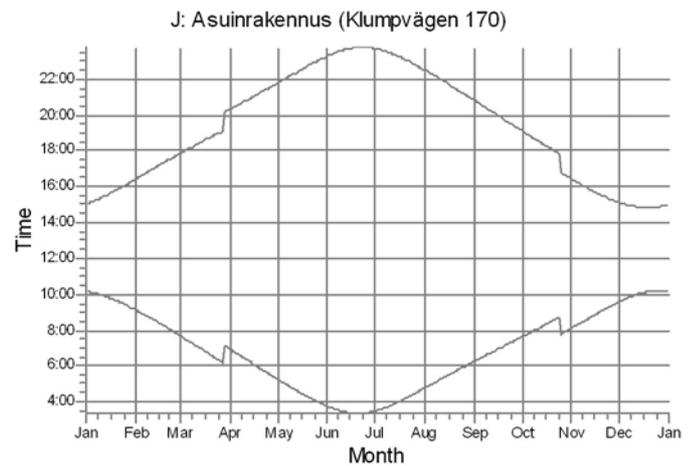
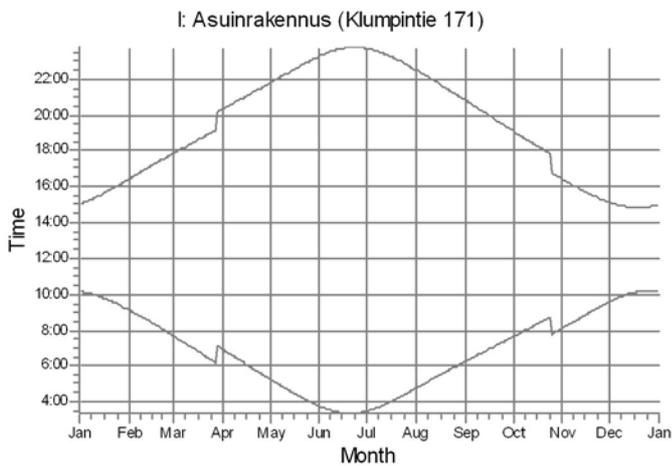
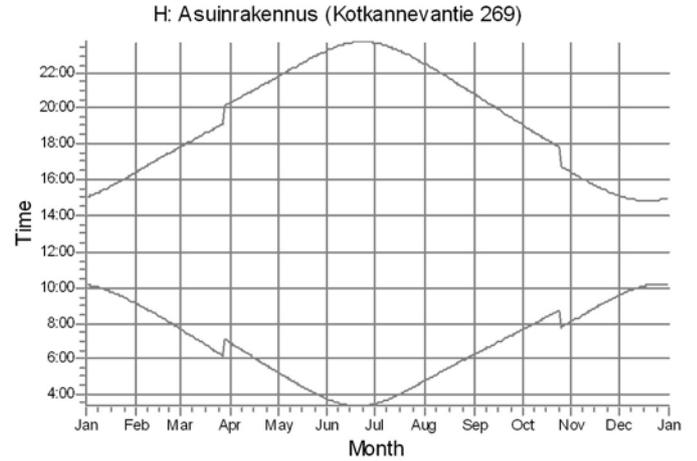
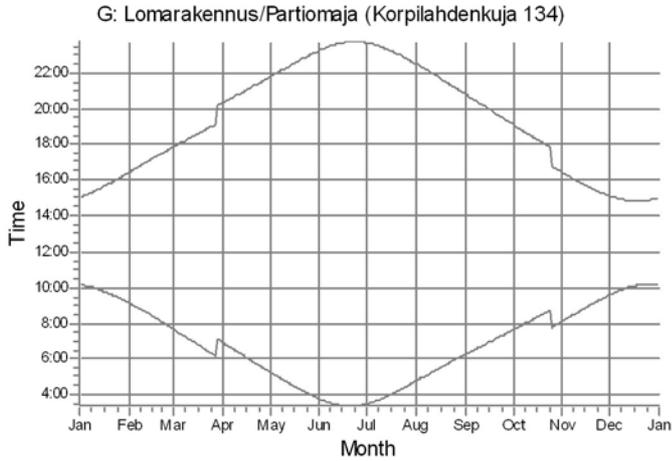


WTGs

T11: T11

## SHADOW - Calendar, graphical

Calculation: V136 x 15 x HH172 real case\_forest luke



WTGs

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T1 - T1

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:46	23:16	23:42	22:29	20:48	19:06	16:24	15:06
2	10:09	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:40	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:52	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	17:59	20:28	21:55	23:23	23:38	22:20	20:38	18:56	16:15	15:01
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:45
	15:09	16:37	18:02	20:31	21:58	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:01	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:35	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:04	23:29	23:33	22:11	20:28	18:45	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:31	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:17	18:35	15:57	14:54
11	09:58	08:39	07:07	06:22	04:44	03:29	03:49	05:15	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:35	07:04	06:18	04:40	03:28	03:51	05:18	06:46	08:08	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:37	03:26	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:02	18:25	20:53	22:23	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:05	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:31	03:25	03:58	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:50	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:15	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	06:59	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:44	23:11	21:38	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:49
19	09:42	08:13	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:28	09:02	10:09
	15:45	17:21	18:42	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:49
20	09:39	08:10	06:37	05:51	04:17	03:22	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:33	05:48	04:14	03:22	04:14	05:44	07:10	08:34	09:08	10:10
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:50
23	09:32	08:01	06:27	05:41	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:49	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:29	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:24	07:51	06:16	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:45	22:47	21:08	19:23	16:43	15:16	14:53
27	09:22	07:47	06:13	05:28	03:58	03:25	04:31	06:01	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:34	23:03	23:45	22:44	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:29	07:55	09:28	10:12
	16:12	17:48	19:08	21:37	23:06	23:44	22:41	21:02	19:16	16:37	15:12	14:55
29	09:16	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:52	19:11	21:40	23:08	23:43	22:39	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:18	03:51	03:28	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:55	19:14	21:43	23:11	23:43	22:36	20:55	19:09	16:30	15:08	14:58
31	09:11	07:34	06:00	05:14	03:49	03:31	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:58	19:17	21:46	23:13	23:45	22:33	20:52	19:12	16:27	15:00	14:59
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T10 - T10

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:41	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:43	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:41	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:03	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:01	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:26	15:49	14:51
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:11	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:46	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:45	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:10	08:34	09:08	10:10
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:37	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:07	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:54
27	09:22	07:48	06:13	05:28	03:58	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:35	23:03	23:45	22:44	21:05	19:19	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:27	04:35	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:41	21:02	19:16	16:37	15:13	14:56
29	09:16	07:41	06:06	05:22	03:54	03:28	04:38	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:41	23:08	23:43	22:39	20:58	19:13	16:34	15:11	14:57
30	09:14	07:38	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:09	14:58
31	09:11	07:35	06:00	05:15	03:49	03:27	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:13	23:45	22:33	20:52	19:12	16:28	15:05	14:59
Potential sun hours	183	243	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T11 - T11

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
 950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
 Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10 15:02	09:08 16:25	07:41 17:51	06:56 20:19	05:15 21:47	03:47 23:16	05:21-05:42/21 23:42	03:30 22:30	05:29-05:44/15 20:48	04:46 19:06	06:16 16:24	07:38 15:07
2	10:09 15:04	09:05 16:28	07:38 17:54	06:53 20:22	05:12 21:50	03:45 23:18	05:20-05:41/21 23:40	03:32 22:27	05:30-05:45/15 20:45	04:49 19:03	06:18 16:21	07:41 15:05
3	10:08 15:06	09:03 16:31	07:34 17:57	06:49 20:25	05:09 21:53	03:42 23:21	05:21-05:41/20 23:39	03:33 22:23	05:30-05:45/15 20:42	04:52 18:59	06:21 16:18	07:43 15:03
4	10:07 15:08	09:00 16:35	07:31 18:00	06:46 20:28	05:06 21:56	03:40 23:23	05:22-05:42/20 23:38	03:35 22:20	05:29-05:46/17 20:38	04:55 18:56	06:24 16:15	07:46 15:02
5	10:06 15:10	08:57 16:38	07:28 18:03	06:42 20:31	05:03 21:59	03:39 23:25	05:22-05:41/19 23:36	03:37 22:17	05:29-05:46/17 20:35	04:58 18:52	06:27 16:12	07:49 15:00
6	10:05 15:12	08:54 16:41	07:24 18:05	06:39 20:34	04:59 22:02	03:37 23:27	05:22-05:41/19 23:35	03:38 22:14	05:29-05:47/18 20:31	05:01 18:49	06:30 16:09	07:52 14:59
7	10:04 15:14	08:51 16:44	07:21 18:08	06:36 20:36	04:56 22:05	03:35 23:29	05:23-05:41/18 23:33	03:40 22:11	05:28-05:47/19 20:28	05:04 18:46	06:32 16:06	07:55 14:57
8	10:02 15:16	08:48 16:47	07:18 18:11	06:32 20:39	04:53 22:08	03:33 23:31	05:23-05:40/17 23:31	03:42 22:08	05:29-05:48/19 20:24	05:07 18:42	06:35 16:03	07:57 14:56
9	10:01 15:19	08:45 16:50	07:14 18:14	06:29 20:42	04:50 22:11	03:32 23:33	05:24-05:40/16 23:33	03:45 22:05	05:28-05:48/20 20:21	05:10 18:39	06:38 16:01	08:00 14:55
10	09:59 15:21	08:42 16:53	07:11 18:17	06:25 20:45	04:47 22:14	03:30 23:35	05:24-05:40/16 23:27	03:47 22:03	05:28-05:49/21 20:18	05:13 18:36	06:41 15:58	08:03 14:54
11	09:58 15:24	08:39 16:56	07:08 18:20	06:22 20:48	04:44 22:17	03:29 23:36	05:26-05:40/14 23:49	03:49 21:58	05:29-05:49/20 20:14	05:16 18:32	06:43 15:55	08:06 14:53
12	09:56 15:26	08:36 16:59	07:04 18:23	06:19 20:51	04:41 22:20	03:28 23:38	05:26-05:40/14 23:51	03:51 21:55	05:29-05:50/21 20:11	05:19 18:29	06:46 15:52	08:09 14:52
13	09:54 15:29	08:33 17:03	07:01 18:26	06:15 20:54	04:38 22:23	03:27 23:39	05:26-05:39/13 23:39	03:54 21:52	05:28-05:49/21 20:07	05:22 18:26	06:49 15:49	08:11 14:51
14	09:52 15:31	08:29 17:06	06:57 18:28	06:12 20:56	04:35 22:26	03:26 23:41	05:27-05:40/13 23:41	03:56 21:48	05:28-05:50/22 20:04	05:24 18:22	06:51 15:46	08:14 14:51
15	09:50 15:34	08:26 17:09	06:54 18:31	06:09 20:59	04:32 22:29	03:25 23:42	05:27-05:39/12 23:42	03:59 21:45	05:28-05:50/22 20:01	05:27 18:19	06:54 15:44	08:17 14:50
16	09:48 15:37	08:23 17:12	06:51 18:34	06:05 21:02	04:29 22:32	03:24 23:43	05:28-05:39/11 23:43	04:01 21:42	05:28-05:50/22 19:57	05:30 18:16	06:57 15:41	08:20 14:50
17	09:46 15:40	08:20 17:15	06:47 18:37	06:02 21:05	04:26 22:35	03:23 23:44	05:28-05:39/11 23:44	04:04 21:39	05:28-05:50/22 19:54	05:33 18:12	07:00 15:38	08:23 14:50
18	09:44 15:43	08:17 17:18	06:44 18:40	05:58 21:08	04:23 22:38	03:23 23:44	05:29-05:39/10 23:44	04:07 21:35	05:28-05:50/22 19:50	05:36 18:09	07:02 15:36	08:26 14:50
19	09:42 15:46	08:14 17:21	06:40 18:43	05:55 21:11	04:20 22:40	03:23 23:45	05:29-05:39/10 23:45	04:09 21:32	05:29-05:51/22 19:47	05:39 18:06	07:05 15:33	08:29 14:50
20	09:39 15:48	08:10 17:24	06:37 18:45	05:52 21:14	04:17 22:43	03:23 23:46	05:29-05:39/10 23:46	04:12 21:29	05:29-05:51/22 19:43	05:42 18:03	07:08 15:31	08:32 14:50
21	09:37 15:51	08:07 17:27	06:34 18:48	05:48 21:17	04:14 22:46	03:23 23:46	05:30-05:39/9 23:46	04:15 21:25	05:29-05:51/22 19:40	05:45 17:59	07:11 15:28	08:34 14:50
22	09:35 15:54	08:04 17:30	06:30 18:51	05:45 21:20	04:12 22:49	03:23 23:46	05:30-05:39/9 23:46	04:17 21:22	05:29-05:50/21 19:37	05:48 17:56	07:13 15:26	08:37 14:51
23	09:32 15:57	08:01 17:33	06:27 18:54	05:42 21:23	04:09 22:52	03:23 23:46	05:30-05:40/10 23:46	04:20 21:19	05:30-05:50/20 19:33	05:50 17:53	07:16 15:23	08:40 14:51
24	09:30 16:00	07:57 17:36	06:23 18:57	05:38 21:26	04:06 22:55	03:24 23:46	05:30-05:40/10 23:46	04:23 21:15	05:31-05:50/19 19:30	05:53 17:50	07:19 15:21	08:43 14:52
25	09:27 16:03	07:54 17:39	06:20 19:00	05:35 21:29	04:04 22:58	03:24 23:46	05:31-05:41/10 23:46	04:26 21:12	05:31-05:49/18 19:26	05:56 16:46	07:21 15:19	07:46 14:53
26	09:25 16:07	07:51 17:42	06:17 19:02	05:32 21:32	04:01 23:00	03:25 23:45	05:30-05:41/11 23:45	04:29 22:47	05:32-05:48/16 19:23	05:59 16:43	07:24 15:17	07:49 14:54
27	09:22 16:10	07:48 17:45	06:13 19:05	05:28 21:35	03:58 23:03	03:26 23:45	05:30-05:42/12 23:45	04:32 22:44	05:33-05:48/15 19:20	06:02 16:40	07:27 15:15	07:52 14:55
28	09:19 16:13	07:44 17:48	06:10 19:08	05:25 21:38	03:56 23:06	03:26 23:44	05:30-05:43/13 23:44	04:35 22:42	05:34-05:46/12 19:16	06:05 16:37	07:30 15:13	07:55 14:56
29	09:17 16:16	07:42 17:48	06:06 19:06	05:22 21:41	03:54 23:08	03:28 23:43	05:29-05:42/13 23:43	04:38 22:39	05:37-05:45/8 19:13	06:07 16:34	07:32 15:11	07:58 14:57
30	09:14 16:19	07:43 17:49	06:03 19:07	05:19 21:44	03:51 23:11	03:29 23:43	05:29-05:43/14 23:43	04:40 22:36	06:10 20:55	07:35 19:09	08:01 16:31	09:33 15:09
31	09:11 16:22	07:41 17:54	06:00 19:08	05:17 21:47	03:49 23:13	03:28 23:43	05:20-05:41/21 23:43	04:43 22:33	06:13 20:52	08:04 16:28	08:04 15:00	09:04 14:50
Potential sun hours	183	243	363	447	559	604	604	593	502	392	308	206
Sum of minutes with flicker	0	0	0	0	337	416	543	0	0	0	0	152

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
 Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T12 - T12

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:19	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:40	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:46
	15:10	16:38	18:03	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:32	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:01	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:26	15:49	14:51
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:01	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:46	17:21	18:43	21:11	22:40	23:45	23:07	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:11	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:53
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:07	17:42	19:02	21:32	23:00	23:46	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:20	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:26	04:35	06:05	07:30	07:55	09:28	10:12
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29	09:17	07:41	06:06	05:22	03:54	03:28	04:37	06:07	07:32	07:58	09:30	10:12
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30	09:14	07:38	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:09	14:58
31	09:11	07:35	06:00	05:15	03:49	03:27	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:13	23:45	22:33	20:52	19:13	16:28	15:06	14:59
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T13 - T13

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:35	18:00	20:28	21:56	23:23	23:38	22:21	20:38	18:56	16:15	15:02
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:10	16:38	18:03	20:31	21:59	23:25	23:37	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:26	09:50
	15:14	16:44	18:08	20:36	22:05	23:30	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:25	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:32	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:37	23:26	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:38	03:27	03:54	05:21	06:49	08:12	08:44	10:02
	15:29	17:03	18:26	20:54	22:23	23:40	23:21	21:52	20:07	18:26	15:49	14:51
14	09:52	08:30	06:57	06:12	04:35	03:26	03:56	05:24	06:52	08:14	08:47	10:03
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:31	20:59	22:29	23:42	23:17	21:45	20:01	18:19	15:44	14:50
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	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
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	15:43	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:41	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
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20	09:40	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:46	21:14	22:44	23:46	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:11	08:35	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:58	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:20	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:13
	16:06	17:42	19:02	21:32	23:01	23:46	22:48	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:13
	16:10	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:20	16:40	15:14	14:54
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	16:13	17:48	19:08	21:38	23:06	23:45	22:42	21:02	19:16	16:37	15:12	14:56
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	16:16	17:51	19:11	21:41	23:09	23:44	22:39	20:59	19:13	16:34	15:10	14:57
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	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:36	06:00	05:15	03:49	03:28	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:14	23:41	22:33	20:52	19:02	16:28	15:04	14:59
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T14 - T14

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:40	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:21	20:38	18:56	16:15	15:01
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:09	16:38	18:03	20:31	21:59	23:25	23:37	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:23	09:48
	15:12	16:41	18:05	20:34	22:02	23:28	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:26	09:50
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8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:32	23:32	22:08	20:25	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:32	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:26	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:24	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:38	03:26	03:54	05:21	06:49	08:12	08:44	10:02
	15:29	17:03	18:26	20:54	22:23	23:40	23:21	21:52	20:07	18:26	15:49	14:51
14	09:52	08:30	06:58	06:12	04:35	03:26	03:56	05:24	06:52	08:14	08:47	10:03
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:31	21:00	22:29	23:42	23:17	21:45	20:01	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:41	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:41	23:45	23:07	21:32	19:47	18:06	15:33	14:50
20	09:40	08:11	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:46	21:14	22:44	23:46	23:04	21:29	19:43	18:03	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:22	04:15	05:45	07:11	08:35	09:08	10:11
	15:51	17:27	18:48	21:17	22:47	23:46	23:02	21:26	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:47	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:58	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:20	10:13
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:17	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:13
	16:06	17:42	19:02	21:32	23:01	23:46	22:48	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:13
	16:10	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:20	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
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29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:31	10:12
	16:16	17:51	19:11	21:41	23:09	23:44	22:39	20:59	19:13	16:34	15:10	14:57
30	09:14	07:37	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:30	06:00	05:17	03:49	03:34	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:50	23:14	23:41	22:33	20:52	19:06	16:27	15:03	14:59
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	151
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T15 - T15

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:10	09:06	07:38	06:53	05:12	03:45	03:32	04:49	06:19	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:41	22:27	20:45	19:03	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:44	08:13	09:41
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:35	18:00	20:28	21:56	23:23	23:38	22:21	20:38	18:56	16:15	15:02
5	10:07	08:57	07:28	06:43	05:03	03:39	03:37	04:58	06:27	07:49	08:19	09:46
	15:10	16:38	18:03	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:06	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:26	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:25	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:32	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:01	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:41	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:09	08:41	10:00
	15:26	17:00	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:38	03:27	03:54	05:22	06:49	08:12	08:44	10:02
	15:29	17:03	18:26	20:54	22:23	23:40	23:21	21:52	20:07	18:26	15:49	14:51
14	09:52	08:30	06:58	06:12	04:35	03:26	03:56	05:24	06:52	08:14	08:47	10:03
	15:31	17:06	18:29	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:09	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:05
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16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:41	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
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20	09:40	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:32	09:05	10:10
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22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:48	07:13	08:37	09:11	10:11
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23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:58	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:22	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:53
26	09:25	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:07	17:42	19:02	21:32	23:00	23:46	22:47	21:09	19:23	16:43	15:17	14:54
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:20	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:26	04:35	06:05	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:42	21:02	19:16	16:37	15:13	14:56
29	09:17	07:41	06:06	05:22	03:54	03:28	04:38	06:07	07:32	07:58	09:31	10:12
	16:16	17:51	19:11	21:41	23:08	23:44	22:39	20:59	19:13	16:34	15:11	14:57
30	09:14	07:37	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:09	14:58
31	09:11	07:30	06:00	05:17	03:49	03:31	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:14	23:45	22:33	20:52	19:13	16:28	15:06	14:59
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T2 - T2

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:46	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:52	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	17:59	20:28	21:55	23:23	23:38	22:20	20:38	18:56	16:15	15:01
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:45
	15:09	16:38	18:02	20:31	21:58	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:31	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:35	15:57	14:54
11	09:58	08:39	07:07	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:18	06:46	08:08	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:37	03:27	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:02	18:25	20:54	22:23	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:31	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:13	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:44	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:49	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:29	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:24	07:51	06:16	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:47	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:35	23:03	23:45	22:44	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:37	23:06	23:44	22:41	21:02	19:16	16:37	15:12	14:56
29	09:16	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:40	23:08	23:43	22:39	20:58	19:13	16:34	15:10	14:57
30	09:14	07:39	06:03	05:18	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:43	23:11	23:43	22:36	20:55	19:09	16:30	15:08	14:58
31	09:11	07:36	06:01	05:13	03:49	03:31	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:46	23:13	23:43	22:33	20:52	19:02	16:27	15:05	14:59
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T3 - T3

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465  
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:46	23:16	23:41	22:29	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:31	17:57	20:25	21:52	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:34	18:00	20:28	21:55	23:23	23:38	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:02	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:02	20:31	21:58	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:01	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:04	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:35	15:58	14:54
11	09:58	08:39	07:07	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:24	16:56	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:08	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:03	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:40	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:31	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:24	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:44	23:11	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:13	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:45	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:10	08:34	09:08	10:10
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:13	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:29	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:17	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:34	23:03	23:45	22:44	21:05	19:19	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:26	04:35	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:37	23:06	23:44	22:41	21:02	19:16	16:37	15:12	14:56
29	09:16	07:41	06:06	05:22	03:54	03:28	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:40	23:08	23:43	22:38	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:43	23:11	23:42	22:36	20:55	19:09	16:31	15:09	14:58
31	09:11	07:34	06:05	05:19	03:49	03:28	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:46	23:13	23:44	22:33	20:52	19:12	16:27	15:07	14:59
Potential sun hours	183	243	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T4 - T4

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:35
	15:02	16:25	17:51	20:19	21:46	23:16	23:41	22:29	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:45	03:32	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:49	23:18	23:40	22:26	20:45	19:02	16:21	15:05
3	10:08	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:40
	15:06	16:31	17:57	20:25	21:52	23:20	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	08:59	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:08	16:34	17:59	20:28	21:55	23:23	23:37	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:02	03:39	03:37	04:58	06:27	07:49	08:19	09:45
	15:10	16:38	18:02	20:31	21:58	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:01	23:27	23:34	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:04	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:07	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:45	05:10	06:38	08:00	08:31	09:54
	15:19	16:50	18:14	20:42	22:10	23:33	23:29	22:04	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:40	08:03	08:34	09:56
	15:21	16:53	18:17	20:45	22:13	23:35	23:27	22:01	20:17	18:35	15:58	14:54
11	09:57	08:39	07:07	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:37	09:58
	15:24	16:56	18:20	20:48	22:16	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:35	07:04	06:19	04:41	03:28	03:51	05:19	06:46	08:08	08:40	09:59
	15:26	16:59	18:23	20:51	22:19	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:38	03:27	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:02	18:25	20:53	22:22	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:35	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:25	23:40	23:18	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:32	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:28	23:41	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:05
	15:37	17:12	18:34	21:02	22:31	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:34	23:43	23:11	21:38	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:07	05:36	07:02	08:26	08:59	10:08
	15:43	17:18	18:40	21:08	22:37	23:44	23:09	21:35	19:50	18:09	15:36	14:50
19	09:41	08:13	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:28	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:06	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:23	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:45	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:23	04:15	05:45	07:10	08:34	09:08	10:10
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:34	08:04	06:30	05:45	04:12	03:23	04:17	05:47	07:13	08:37	09:10	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:58	21:22	19:36	17:56	15:26	14:51
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:13	10:11
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:29	07:57	06:23	05:38	04:06	03:24	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:04	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:28	22:57	23:46	22:50	21:12	19:26	16:46	15:19	14:53
26	09:24	07:51	06:16	05:32	04:01	03:25	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:31	23:00	23:45	22:47	21:08	19:23	16:43	15:17	14:53
27	09:22	07:47	06:13	05:28	03:58	03:26	04:32	06:02	07:27	07:52	09:25	10:12
	16:10	17:45	19:05	21:34	23:03	23:45	22:44	21:05	19:19	16:40	15:15	14:55
28	09:19	07:44	06:10	05:25	03:56	03:26	04:35	06:04	07:30	07:55	09:27	10:12
	16:13	17:48	19:08	21:37	23:05	23:44	22:41	21:02	19:16	16:37	15:12	14:56
29	09:16	07:41	06:06	05:22	03:54	03:28	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:40	23:08	23:43	22:38	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:19	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:43	23:11	23:42	22:35	20:55	19:09	16:31	15:09	14:58
31	09:11	07:34	06:00	05:15	03:49	03:28	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:46	23:13	23:44	22:32	20:52	19:02	16:27	15:00	14:59
Potential sun hours	183	243	363	447	559	604	593	502	392	308	207	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T5 - T5

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:40	22:27	20:45	19:02	16:21	15:05
3	10:09	09:02	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:39	22:23	20:41	18:59	16:18	15:03
4	10:07	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:01
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:45
	15:09	16:38	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:33	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:02	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:31	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:47	05:13	06:40	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:35	15:57	14:54
11	09:58	08:39	07:07	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:36	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:32	07:01	06:15	04:37	03:27	03:54	05:21	06:49	08:11	08:44	10:01
	15:29	17:02	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:26	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:31	03:25	03:59	05:27	06:54	08:17	08:50	10:04
	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:50
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:07	21:32	19:47	18:06	15:33	14:50
20	09:39	08:10	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:22	04:15	05:45	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:36	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:16	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:49	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	18:59	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:16	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:45	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:35	23:03	23:45	22:44	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:42	21:02	19:16	16:37	15:12	14:56
29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:41	23:08	23:44	22:39	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:18	03:51	03:29	04:40	06:10	07:35	08:01	09:33	10:11
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:35	06:00	05:14	03:49	03:31	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:13	23:45	22:33	20:52	19:12	16:27	15:03	14:59
Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T6 - T6

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:41	22:27	20:45	19:02	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:41	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:34	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:01
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:09	16:38	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:54	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:28	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:32	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
10	09:59	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:40	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:35	15:57	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:40	03:28	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:37	03:26	03:53	05:21	06:49	08:11	08:44	10:01
	15:29	17:02	18:26	20:54	22:23	23:39	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:25	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:56	22:26	23:41	23:19	21:48	20:04	18:22	15:46	14:51
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	15:34	17:09	18:31	20:59	22:29	23:42	23:16	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:49
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:40	23:45	23:07	21:32	19:47	18:06	15:33	14:49
20	09:39	08:10	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:31	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
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	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:36	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:49	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:16	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:46	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:31	06:02	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
	16:13	17:48	19:08	21:38	23:06	23:44	22:42	21:02	19:16	16:37	15:12	14:55
29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:30	10:12
	16:16	17:51	19:11	21:41	23:08	23:44	22:39	20:58	19:13	16:34	15:10	14:57
30	09:14	07:38	06:03	05:18	03:51	03:28	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:30	15:08	14:58
31	09:11	07:35	06:00	05:14	03:49	03:34	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:14	23:45	22:33	20:52	19:02	16:27	15:00	14:59
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T7 - T7

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:10	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:41	22:27	20:45	19:02	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:34	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:01
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:09	16:38	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:25	09:50
	15:14	16:44	18:08	20:36	22:05	23:29	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52
	15:16	16:47	18:11	20:39	22:08	23:31	23:31	22:08	20:24	18:42	16:03	14:56
9	10:01	08:45	07:14	06:29	04:50	03:32	03:44	05:10	06:38	08:00	08:32	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:40	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:01	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:25	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:41	03:28	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:37	03:26	03:54	05:21	06:49	08:11	08:44	10:02
	15:29	17:02	18:26	20:54	22:23	23:40	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:25	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:31	03:25	03:58	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:31	20:59	22:29	23:42	23:17	21:45	20:00	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:29	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:50
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:49
19	09:42	08:14	06:40	05:55	04:20	03:23	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:41	23:45	23:07	21:32	19:47	18:06	15:33	14:49
20	09:39	08:10	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:22	04:14	05:45	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:23	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
24	09:30	07:57	06:23	05:38	04:06	03:23	04:23	05:53	07:19	08:43	09:17	10:12
	16:00	17:36	18:57	21:26	22:55	23:46	22:53	21:15	19:30	17:50	15:21	14:52
25	09:27	07:54	06:20	05:35	04:03	03:24	04:26	05:56	07:21	07:46	09:19	10:12
	16:03	17:39	19:00	21:29	22:58	23:46	22:50	21:12	19:26	16:46	15:19	14:52
26	09:25	07:51	06:17	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:12
	16:06	17:42	19:02	21:32	23:00	23:46	22:47	21:09	19:23	16:43	15:17	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:32	06:02	07:27	07:52	09:25	10:12
	16:09	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:19	16:40	15:14	14:54
28	09:19	07:44	06:10	05:25	03:56	03:26	04:34	06:04	07:30	07:55	09:28	10:12
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29	09:17	07:41	06:06	05:22	03:53	03:27	04:37	06:07	07:32	07:58	09:31	10:12
	16:16	17:51	19:11	21:41	23:08	23:44	22:39	20:59	19:13	16:34	15:10	14:57
30	09:14	07:37	06:03	05:19	03:51	03:28	04:40	06:10	07:35	08:01	09:33	10:12
	16:19	17:54	19:14	21:44	23:11	23:43	22:36	20:55	19:09	16:31	15:08	14:58
31	09:11	07:30	06:05	05:19	03:49	03:28	04:43	06:13	07:38	08:04	09:36	10:11
	16:22	17:57	19:17	21:47	23:14	23:41	22:33	20:52	19:02	16:27	15:03	14:59
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T8 - T8

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
1,03 2,53 3,97 6,77 9,62 10,20 9,62 7,58 5,07 2,64 1,20 0,65

Operational time

N NNE ENE E ESE SSE S SSW WSW W WNW NNW Sum  
950 485 257 338 655 682 961 1 447 1 196 618 441 434 8 465

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

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:46	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:06
2	10:10	09:06	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:03	16:28	17:54	20:22	21:50	23:19	23:41	22:27	20:45	19:02	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:05	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:34	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:21	20:38	18:56	16:15	15:01
5	10:07	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:09	16:38	18:02	20:31	21:59	23:25	23:37	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:36	03:38	05:01	06:29	07:52	08:22	09:48
	15:11	16:41	18:05	20:34	22:02	23:28	23:35	22:14	20:31	18:49	16:09	14:58
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:26	09:50
	15:14	16:44	18:08	20:36	22:05	23:30	23:33	22:11	20:28	18:46	16:06	14:57
8	10:03	08:48	07:18	06:32	04:53	03:33	03:42	05:07	06:35	07:57	08:29	09:52
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9	10:01	08:45	07:14	06:29	04:50	03:31	03:44	05:10	06:38	08:00	08:32	09:54
	15:18	16:50	18:14	20:42	22:11	23:33	23:30	22:05	20:21	18:39	16:00	14:55
10	10:00	08:42	07:11	06:25	04:47	03:30	03:46	05:13	06:40	08:03	08:35	09:56
	15:21	16:53	18:17	20:45	22:14	23:35	23:28	22:02	20:18	18:36	15:57	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
	15:23	16:56	18:20	20:48	22:17	23:37	23:26	21:58	20:14	18:32	15:55	14:53
12	09:56	08:36	07:04	06:19	04:40	03:27	03:51	05:18	06:46	08:09	08:41	10:00
	15:26	16:59	18:23	20:51	22:20	23:38	23:23	21:55	20:11	18:29	15:52	14:52
13	09:54	08:33	07:01	06:15	04:37	03:26	03:53	05:21	06:49	08:11	08:44	10:02
	15:29	17:02	18:26	20:54	22:23	23:40	23:21	21:52	20:07	18:25	15:49	14:51
14	09:52	08:29	06:57	06:12	04:34	03:25	03:56	05:24	06:51	08:14	08:47	10:03
	15:31	17:06	18:28	20:57	22:26	23:41	23:19	21:49	20:04	18:22	15:46	14:51
15	09:50	08:26	06:54	06:08	04:31	03:25	03:58	05:27	06:54	08:17	08:50	10:05
	15:34	17:09	18:31	20:59	22:29	23:42	23:17	21:45	20:01	18:19	15:44	14:50
16	09:48	08:23	06:51	06:05	04:28	03:24	04:01	05:30	06:57	08:20	08:53	10:06
	15:37	17:12	18:34	21:02	22:32	23:43	23:14	21:42	19:57	18:16	15:41	14:50
17	09:46	08:20	06:47	06:02	04:26	03:23	04:04	05:33	07:00	08:23	08:56	10:07
	15:40	17:15	18:37	21:05	22:35	23:44	23:12	21:39	19:54	18:12	15:38	14:49
18	09:44	08:17	06:44	05:58	04:23	03:23	04:06	05:36	07:02	08:26	08:59	10:08
	15:42	17:18	18:40	21:08	22:38	23:45	23:09	21:35	19:50	18:09	15:36	14:49
19	09:42	08:14	06:40	05:55	04:20	03:22	04:09	05:39	07:05	08:29	09:02	10:09
	15:45	17:21	18:43	21:11	22:41	23:45	23:07	21:32	19:47	18:06	15:33	14:49
20	09:40	08:10	06:37	05:52	04:17	03:22	04:12	05:42	07:08	08:32	09:05	10:10
	15:48	17:24	18:45	21:14	22:44	23:46	23:04	21:29	19:43	18:02	15:31	14:50
21	09:37	08:07	06:34	05:48	04:14	03:22	04:14	05:45	07:10	08:34	09:08	10:11
	15:51	17:27	18:48	21:17	22:46	23:46	23:01	21:25	19:40	17:59	15:28	14:50
22	09:35	08:04	06:30	05:45	04:11	03:22	04:17	05:47	07:13	08:37	09:11	10:11
	15:54	17:30	18:51	21:20	22:49	23:46	22:59	21:22	19:37	17:56	15:26	14:50
23	09:32	08:01	06:27	05:42	04:09	03:23	04:20	05:50	07:16	08:40	09:14	10:12
	15:57	17:33	18:54	21:23	22:52	23:46	22:56	21:19	19:33	17:53	15:23	14:51
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26	09:25	07:51	06:17	05:32	04:01	03:24	04:29	05:59	07:24	07:49	09:22	10:13
	16:06	17:42	19:02	21:32	23:01	23:46	22:48	21:09	19:23	16:43	15:16	14:53
27	09:22	07:48	06:13	05:28	03:58	03:25	04:31	06:02	07:27	07:52	09:25	10:13
	16:09	17:45	19:05	21:35	23:03	23:45	22:45	21:05	19:19	16:40	15:14	14:54
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	16:22	17:57	19:17	21:47	23:14	23:41	22:33	20:52	19:02	16:27	15:00	14:50
Potential sun hours	182	242	363	447	559	604	594	502	392	308	206	151
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker  
Sun set (hh:mm) First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

## SHADOW - Calendar per WTG

Calculation: V136 x 15 x HH172 real case\_forest lukeWTG: T9 - T9

Assumptions for shadow calculations

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,03	2,53	3,97	6,77	9,62	10,20	9,62	7,58	5,07	2,64	1,20	0,65

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
950	485	257	338	655	682	961	1 447	1 196	618	441	434	8 465

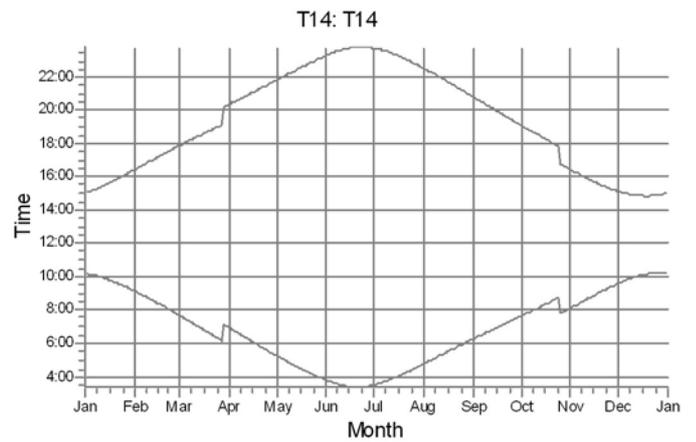
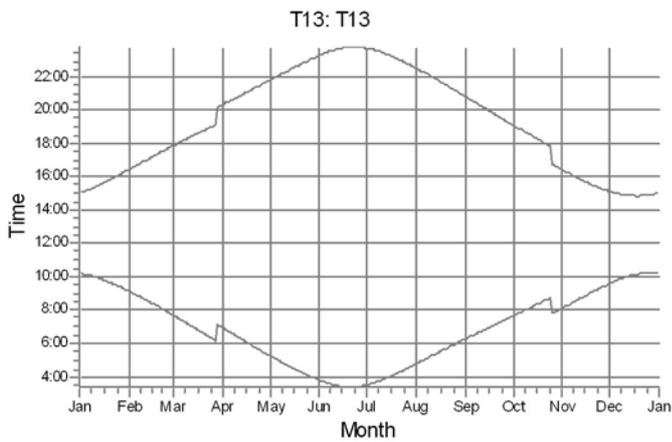
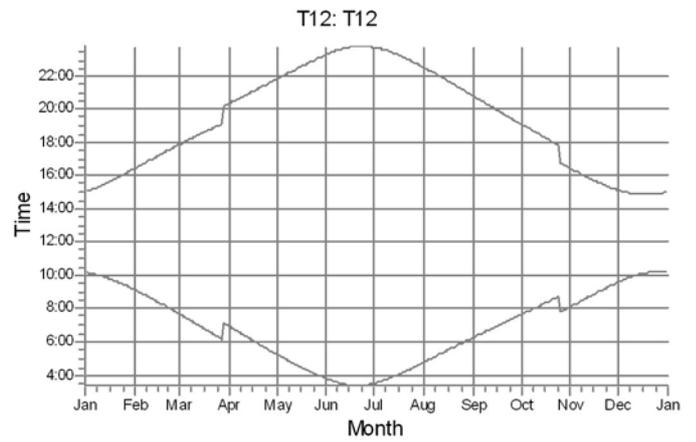
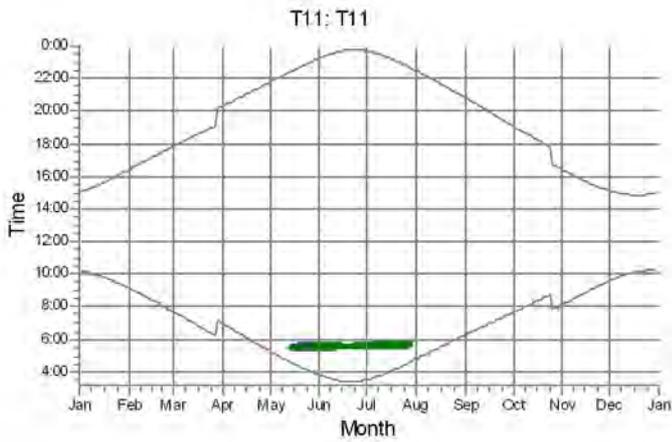
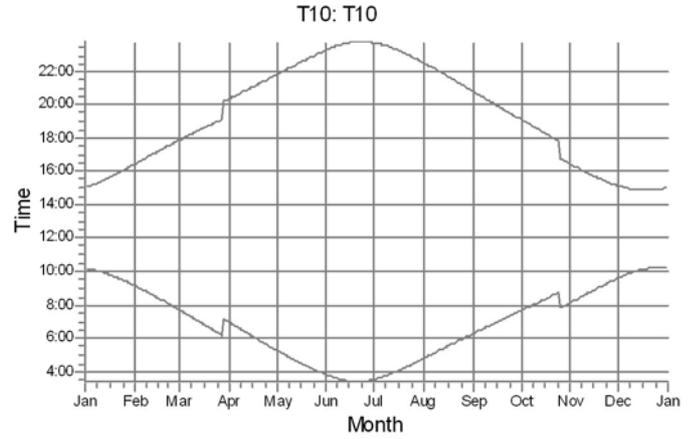
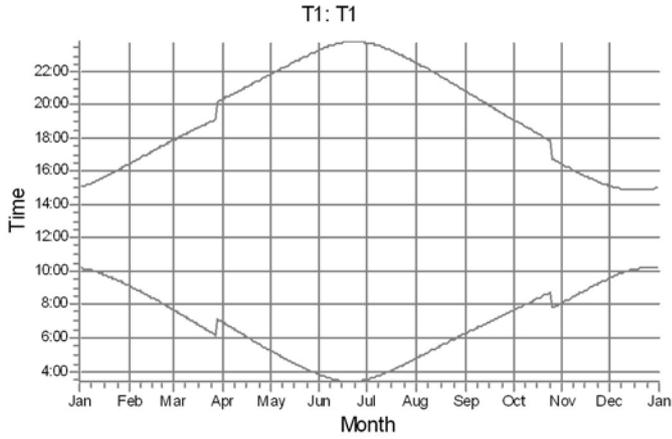
Idle start wind speed: Cut in wind speed from power curve

	January	February	March	April	May	June	July	August	September	October	November	December
1	10:10	09:08	07:41	06:56	05:15	03:47	03:30	04:46	06:16	07:38	08:07	09:36
	15:02	16:25	17:51	20:19	21:47	23:16	23:42	22:30	20:48	19:06	16:24	15:07
2	10:09	09:05	07:38	06:53	05:12	03:44	03:31	04:49	06:18	07:41	08:10	09:38
	15:04	16:28	17:54	20:22	21:50	23:18	23:41	22:27	20:45	19:02	16:21	15:05
3	10:09	09:03	07:34	06:49	05:09	03:42	03:33	04:52	06:21	07:43	08:13	09:41
	15:06	16:31	17:57	20:25	21:53	23:21	23:39	22:24	20:42	18:59	16:18	15:03
4	10:08	09:00	07:31	06:46	05:06	03:40	03:35	04:55	06:24	07:46	08:16	09:43
	15:07	16:34	18:00	20:28	21:56	23:23	23:38	22:20	20:38	18:56	16:15	15:02
5	10:06	08:57	07:28	06:42	05:02	03:38	03:36	04:58	06:27	07:49	08:19	09:46
	15:10	16:38	18:02	20:31	21:59	23:25	23:36	22:17	20:35	18:52	16:12	15:00
6	10:05	08:54	07:24	06:39	04:59	03:37	03:38	05:01	06:30	07:52	08:22	09:48
	15:12	16:41	18:05	20:34	22:02	23:27	23:35	22:14	20:31	18:49	16:09	14:59
7	10:04	08:51	07:21	06:36	04:56	03:35	03:40	05:04	06:32	07:55	08:25	09:50
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	15:19	16:50	18:14	20:42	22:11	23:33	23:29	22:05	20:21	18:39	16:00	14:55
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	15:21	16:53	18:17	20:45	22:14	23:35	23:27	22:01	20:18	18:36	15:58	14:54
11	09:58	08:39	07:08	06:22	04:44	03:29	03:49	05:16	06:43	08:06	08:38	09:58
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	15:48	17:24	18:45	21:14	22:43	23:46	23:04	21:29	19:43	18:02	15:31	14:50
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Potential sun hours	182	242	363	447	559	604	593	502	392	308	206	152
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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

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

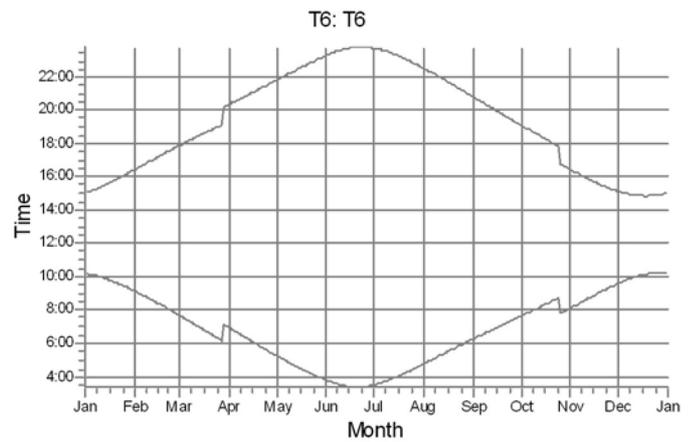
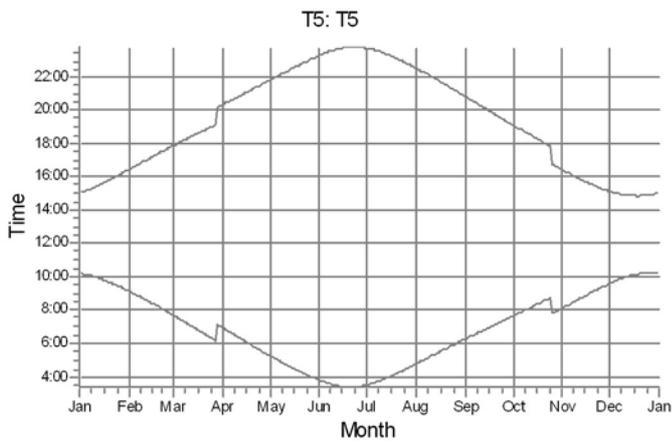
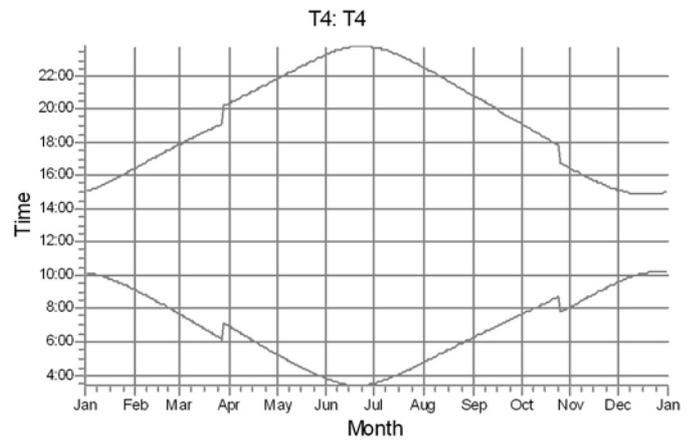
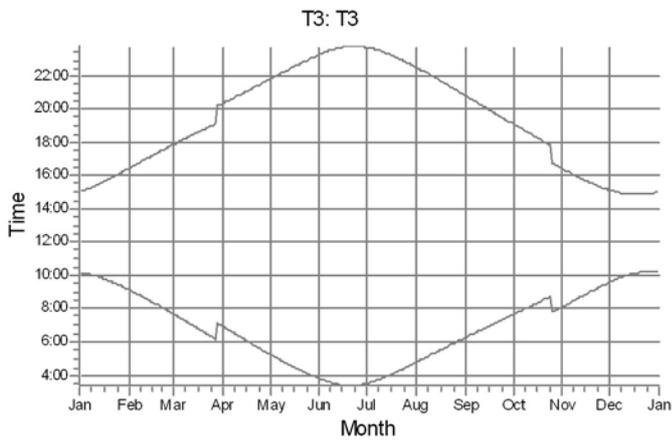
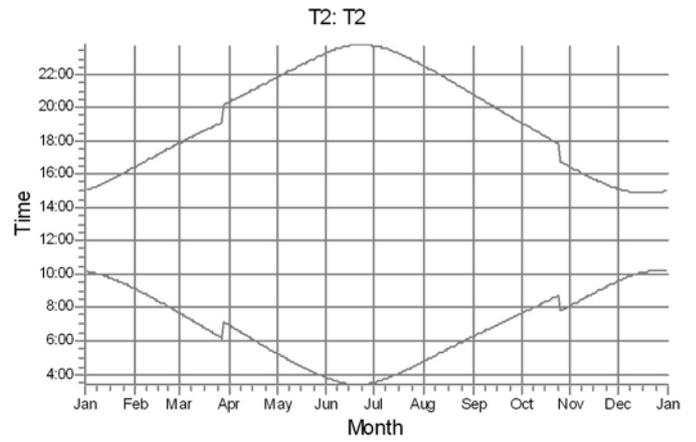
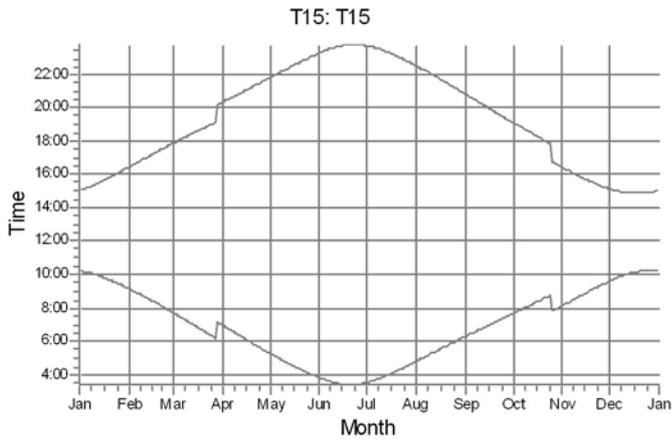
SHADOW - Calendar per WTG, graphical  
Calculation: V136 x 15 x HH172 real case\_forest luke



Shadow receptors

A: Asuinrakennus (Langkujavägen 200)

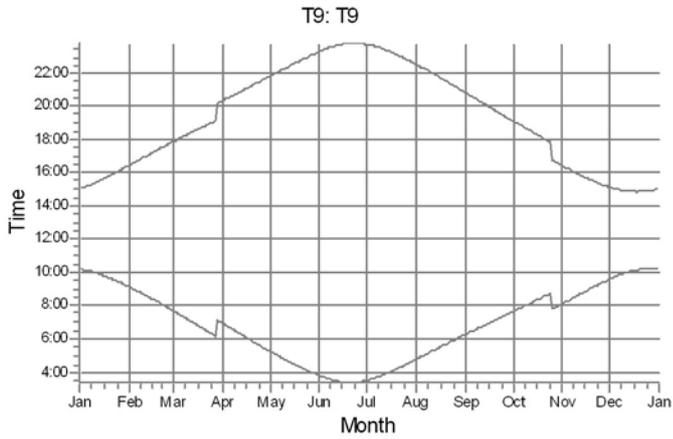
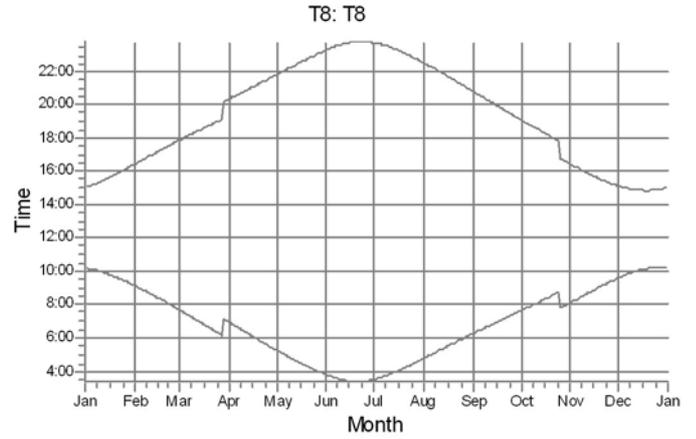
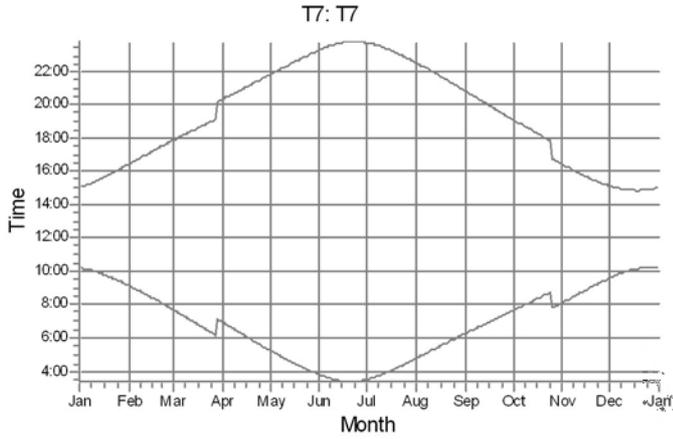
SHADOW - Calendar per WTG, graphical  
Calculation: V136 x 15 x HH172 real case\_forest luke



Shadow receptors

## SHADOW - Calendar per WTG, graphical

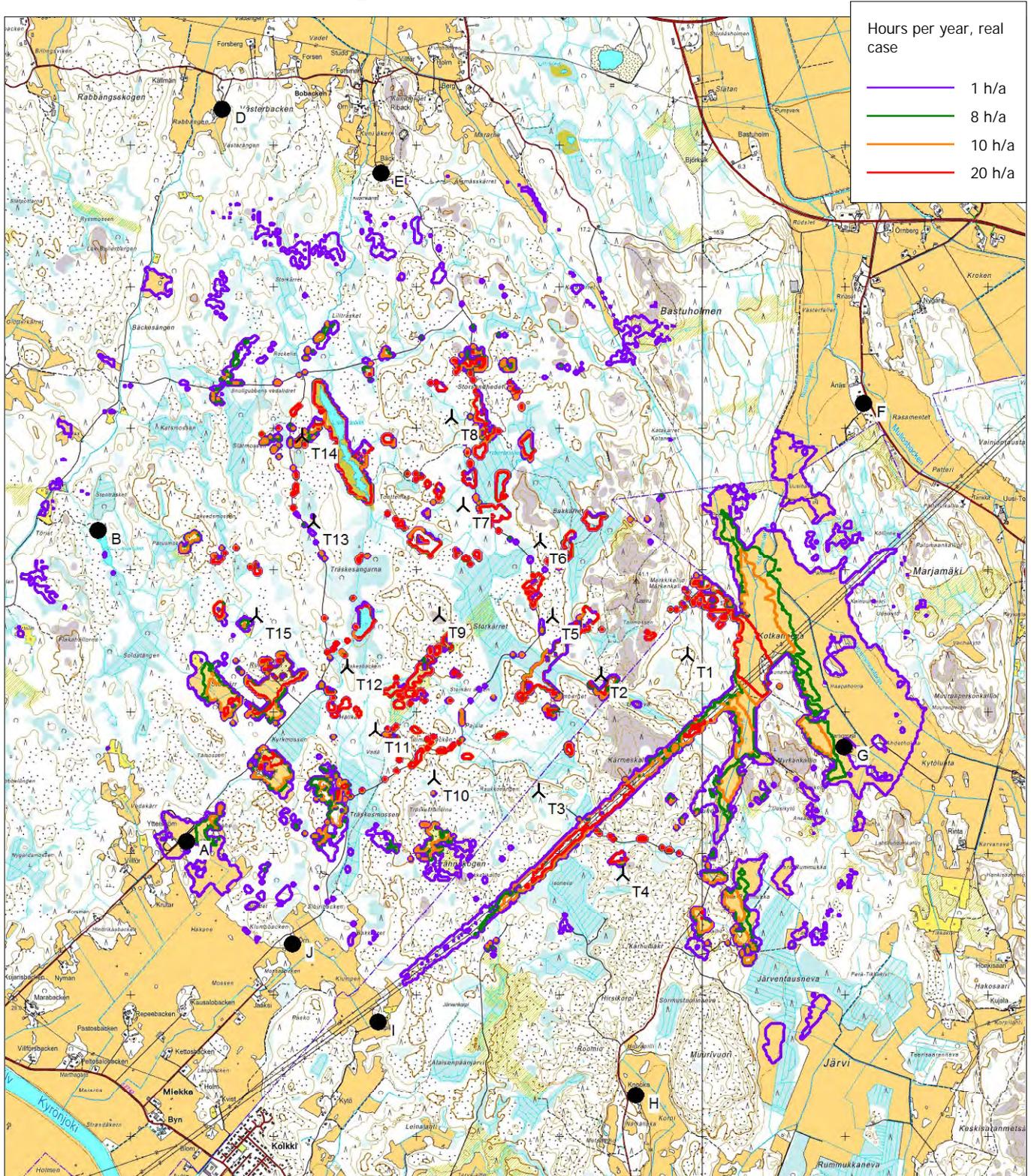
Calculation: V136 x 15 x HH172 real case\_forest luke



Shadow receptors

## SHADOW - Map

Calculation: V136 x 15 x HH172 real case\_forest luke



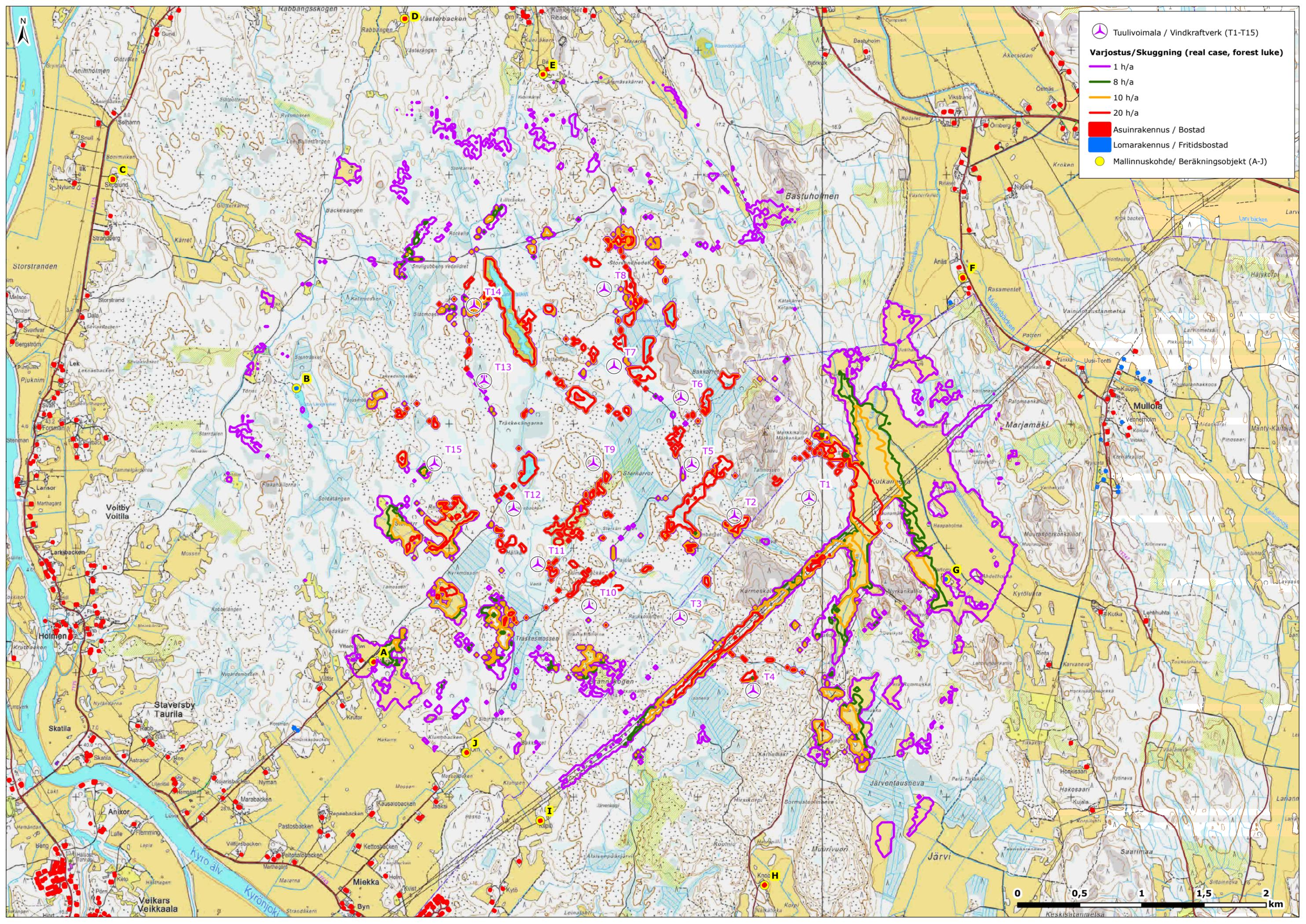
0 500 1000 1500 2000 m

Map: Peruskarttarasteri, Print scale 1:40 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 246 300 North: 7 008 480

🚧 New WTG

📍 Shadow receptor

Flicker map level: Height Contours: Merkkikallio\_height contour lines.wpo (1)



Tuulivoimala / Vindkraftverk (T1-T15)

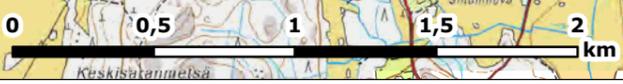
**Varjostus/Skuggning (real case, forest luke)**

- 1 h/a
- 8 h/a
- 10 h/a
- 20 h/a

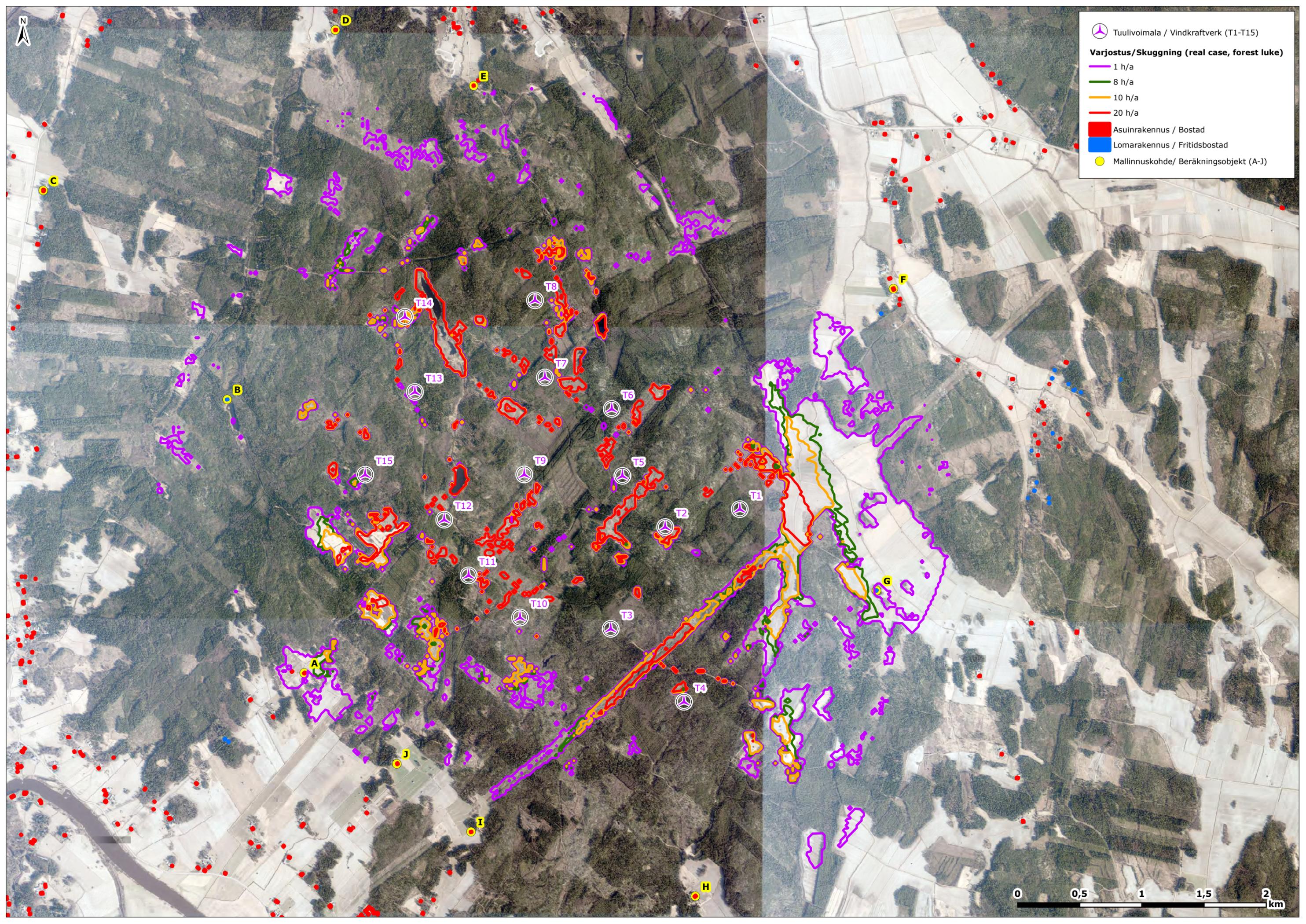
Asuinrakennus / Bostad

Lomarakennus / Fritidsbostad

Mallinuskohde/ Beräkningsobjekt (A-J)







Tuulivoimala / Vindkraftverk (T1-T15)

**Varjostus/Skuggning (real case, forest luke)**

- 1 h/a
- 8 h/a
- 10 h/a
- 20 h/a

Asuinrakennus / Bostad

Lomarakennus / Fritidsbostad

Mallinuskohde/ Beräkningsobjekt (A-J)

