FORTUM POWER AND HEAT OY

Katajamäen tuulivoimahanke

Melu- ja varjostusmallinnusraportti

Sisällysluettelo

Katajamäen tuulivoimahanke

1 MELU- JA VARJOSTUSMALLINNUKSEN TAVOITTEET

Katajamäen tuulivoimahankkeen hankeomistaja Fortum suunnittelee vaihtoehdossa 1 (VE1) 51 voimalan rakentamista ja vaihtoehdossa 2 (VE2) 46 voimalan rakentamista Kajaaniin. Raportissa tarkastellaan yhteisvaikutuksia hankkeen lähellä sijaitsevan Kivikankaan tuulivoimahankkeen kanssa. Tämä melu- ja varjostusmallinnusraportti on laadittu Katajamäen hankkeen YVA-menettelyvaiheen sijoitussuunnitelmien perusteella.

Tuulivoimaloiden aiheuttamia meluvaikutuksia on arvioitu WindPRO-ohjelman DECIBEL-moduulilla. Tuulivoimaloiden aiheuttamat varjostusvaikutukset on mallinnettu WindPro-ohjelman SHADOW-moduulilla. Melu- ja varjostusmallinnukset on laatinut Henna-Riikka Rintamäki ja laaduntarkastuksen on tehnyt Johanna Harju FCG Finnish Consulting Group Oy:stä

2 LÄHTÖTIEDOT JA MENETELMÄT

2.1 Melu

2.1.1 Melumallinnus ISO 9613-2

Tuulivoimaloiden aiheuttamat äänenpainetasot on mallinnettu WindPRO-laskentaohjelman Decibel-moduulilla ISO 9613-2 standardin mukaisesti. Ympäristöhallinnon tuulivoimaloiden melun mallintamista koskevan ohjeen 2/2014 mukaisesti tuulen nopeutena käytettiin 10 m korkeudella mitattuna 8 m/s, ilman lämpötilana 15 °C, ilmanpaineena 101,325 kPa, ilman suhteellisena kosteutena 70 % ja maanpinnan kovuutena arvoa 0,4. Laskenta on tehty 4,0 m maan pinnan tasosta.

Katajamäen tuulivoimaloiden äänenpainetasot on mallinnettu molemmissa vaihtoehdoissa voimalaitostyypillä N163-6,8MW ja 218,5 metriä korkealla tornilla. Voimaloiden kokonaiskorkeus on näin ollen 300 m.

Voimalaitoksen N163-6,8MW lähtömelutaso on 106,4 dB(A). Voimalaitosvalmistajan mukaan N163-6,8MW melutaso vastaa ylempää luottamusväliä 95 % ja on valmistajan mukaan melun takuuarvo, kun siihen lisätään 1,5 dB(A).

Hankkeiden yhteisvaikutuksia tarkastellessa Kivikankaan tuulivoimaloiden äänenpainetasot on mallinnettu luodulla voimalaitostyypillä RD200 - 10MW ja 200 metriä korkealla tornilla. Voimaloiden kokonaiskorkeus on 300 metriä. Lähtömelutaso Kivikankaan voimaloissa on 107,1 dB(A). Voimaloiden melutaso vastaa keskiäänitasoa ja lähtömelutasoon lisätään mallinnuksissa epävarmuus 2 dB(A) että saadaan äänitehotaso vastaamaan takuuarvoa.

Melumallinnusten laskentatuloksia on havainnollistettu ns. keskiäänitasokarttojen avulla. Keskiäänitasokartoissa on melun keskiäänitaso- eli ekvivalenttiäänitasokäyrät (LAeq) 5 dB välein.

Taulukko 1. Katajamäen tuulivoimahankkeen mallinnusohjelma ja tuulivoimaloiden äänitehotasot voimalaitoksella N163-6,8 MW sekä melun erityispiirteet.

MALLINNUSOHJELMAN TIEDOT							
Mallinnusohjelma ja versio: WindPRO version 3.5.576				Mallinnusmenetelmä: ISO 9613-2			
TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)							
Tuulivoimalan valmistaja: Nordex				Tyyppi: N163-6,8 MW		Sarjanumero/t:-	
Nimellisteho: 6,8 MW		Napakorkeus: 218,5 m		Roottorin halkaisija:163 m		Tornin tyyppi: teräs/hybridi	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä			
Kyllä	- dB	Kyllä	- dB	Noise mode säätö: Mode 1, STE			
~~Ei~~		~~Ei~~		Noise mode, lähtömelutaso		106,4 dB	

AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT
Third octave sound power levels F008_277_A17_EN_R02, revision 02, 2021–11-08
Valmistajan ilmoittama tuulivoimalan tuottama äänitehotaso vastaa keskitäänitasoa ja lisäämällä epävarmuus 1,5 dB(A) saadaan äänitehotaso vastaamaan takuuarvoa.
Nordexin mukaan:
The warranted sound power levels are calculated expected mean values. This is common practise in the industry and also other OEMs are following the same approach. Within the Noise Emission Warranty Nordex warrants that a single measurement will be within the confidence interval according to IEC 61400-14.
Please further be advised, that we limit the Confidence Interval according to the Noise Emission Warranty to a maximum value of 1.5dB(A).
If you experience challenges in your noise emission calculations, please let us know and we could investigate further.
Kind regards,
Chris

Oktaaveittain [Hz],dB(A)		1/3-oktaaveittain [Hz] LWA dB					
		20	79,2	200	96,0	1600	95,1
63	93,9	25	81,1	250	96,8	2000	91,9
125	98,6	31,5	82,3	315	96,7	2500	88,6
250	100,9	40	83,3	400	96,5	3150	83,8
500	101,4	50	89,6	500	96,8	4000	78,7
1000	101,8	63	91,3	630	97,0	5000	70,6
2000	99,7	80	91,9	800	97,0	6300	61,9
4000	90,2	100	94,5	1000	97,2	8000	56,5
8000	71,3	125	94,5	1250	96,5	10000	91,9
107,9 dB(A)		160	95,5				

Melun erityispiirteiden mittaus ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudi-modulaatio)		Muu, Mikä:	
~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei

Taulukko 2. Katajamäen tuulivoimahankkeen mallinnusohjelma ja tuulivoimaloiden äänitehotasot voimalaitoksella Generic RD200 - 10 MW sekä melun erityispiirteet.

MALLINNUSOHJELMAN TIEDOT							
Mallinnusohjelma ja versio: WindPRO version 3.5.576				Mallinnusmenetelmä: ISO 9613-2			
TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)							
Tuulivoimalan valmistaja: Generic				Tyyppi: RD200-10 MW		Sarjanumero/t:-	
Nimellisteho: 10 MW		Napakorkeus: 200,0 m		Roottorin halkaisija: 200 m		Tornin tyyppi: teräs/hybridi	
Mahdollisuudet vaikuttaa tuulivoimalan melupäästöön käytön aikana ja sen vaikutus meluun							
Lapakulman säätö		Pyörimisnopeus		Muu, mikä			
Kyllä	- dB	Kyllä	- dB	Noise mode säätö:			
~~Ei~~		~~Ei~~		Noise mode, lähtömelutaso		107,1 dB	
AKUSTISET TIEDOT/LASKENNAN LÄHTÖTIEDOT							
Voimaloiden melutaso vastaa keskiäänitasoa. Äänitehotasoon lisättiin 2 dB(A) että saadaan se vastaamaan takuuarvoa.							

Oktaaveittain [Hz],dB(A)		1/3-oktaaveittain [Hz] LWA dB					
		20	60,0	200	95,0	1600	96,0
63	87,3	25	65	250	97	2000	95
125	95,7	31,5	70	315	98	2500	93
250	101,6	40	75	400	99	3150	90
500	104,5	50	77,5	500	100	4000	87,5
1000	103,8	63	82	630	100	5000	84
2000	99,6	80	85	800	100	6300	81
4000	92,6	100	87	1000	99	8000	77
8000	82,9	125	91	1250	98	10000	73
109,1 dB(A)		160	93,0				

Melun erityispiirteiden mittaus ja havainnot:							
Kapeakaistaisuus / Tonaalisuus		Impulssimaisuus		Merkityksellinen sykintä (amplitudi-modulaatio)		Muu, Mikä:	
~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei	~~kyllä~~	ei

2.1.2 Matalataajuinen melu

Matalataajuinen melu laskettiin Ympäristöministeriön ohjeen 2/2014 mukaisin menetelmin käyttäen voimalavalmistajilta saatuja arvioita niiden äänitehotasoista.

Ohje 2/2014 antaa menetelmän matalataajuisen melun laskentaan rakennusten ulkopuolelle. Sosiaali- ja terveysministeriön Asumisterveysasetus 2015 antaa matalataajuiselle melulle toimenpiderajat asuinhuoneissa. Rakennusten sisälle kantautuva äänitaso arvioitiin Turun AMK:n (Keränen, Hakala

ja Hongisto, 2018) julkistamien Anojanssi projektin tulosten mukaisten ääneneristävyysarvoin ja tuloksia verrattiin toimenpiderajoihin.

Taulukko 3. Suomalaisen pientalon julkisivun äänitasoeron alalikiarvo Anojanssi projektin tulosten mukaisesti.

f [Hz]	20	25	31.5	40	50	63	80	100	125	160	200
DLσ [dB]	7.6	8.3	9.2	10.3	11.5	13.0	14.8	16.8	18.8	21.1	22.8

Matalataajuisen melun laskelmassa huomioitiin maanpinnan muodon vaikutus ohjeen 4/2014 mukaisesti. Tulokset on esitetty taajuuskohtaisena taulukkona hankealuetta ympäröiville asuin- ja lomarakennuksille.

Taulukko 4. 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	Pystyresoluutio:0,5
Maan- ja vedenpinnan absorption 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°		Tuulen nopeus: 10 metrin korkeudella mitattuna 8 m/s	
Voimalan äänen suuntaavuus ja vaimentuminen			
Vapaa avaruus: kyllä		Muu, mikä, miksi:	

2.2 Varjostusmallinnus

Taulukko 5. Katajamäen ja Kivikankaan tuulivoimahankkeen mallinnusohjelma ja tuulivoimaloiden koko varjostusmallinnuksissa.

MALLINNUSOHJELMAN TIEDOT			
Mallinnusohjelma ja versio: WindPRO version 3.5.576		Mallinnusmenetelmä: ISO 9613-2	
TUULIVOIMALAN (TUULIVOIMALOIDEN TIEDOT)			
Tuulivoimalan valmistaja: Generic		Tyyppi: RD200	Sarjanumero/t:-
Nimellisteho:	Napakorkeus: 200 m	Roottorin halkaisija: 200 m	Tornin tyyppi: teräs/hybridi

Tuulivoimaloiden varjostusvaikutukset on mallinnettu käyttäen roottorinhalkaisijaltaan 200 metristä voimalaitosta 200 metriä korkealla tornilla. Kokonaiskorkeudeltaan voimala on mallinnuksissa 300 metriä.

Varjostusvaikutuksia mallinnettiin WindPRO-ohjelman Shadow-moduulilla. Laskennassa varjot huomioidaan, kun aurinko on yli 3 astetta horisontin yläpuolella. Varjoksi lasketaan tilanne, jossa siipi peittää vähintään 20 % auringosta.

Varjostusmallinnuksessa huomioidaan siiven lavan maksimileveys sekä siiven kärjen leveys 90 % etäisyydellä turbiinista. Mallinnuksessa siiven oletetaan kapenevan lineaarisesti kohti kärjen leveysarvoa. Katajamäen varjostusmallinnuksessa on käytetty siiven lavan maksimileveytenä 4,32 metriä ja siiven kärjen leveytenä 1,69 metriä. Kivikankaan hankkeessa varjostusmallinnuksessa on käytetty siiven lavan maksimileveytenä 5,62 metriä ja siiven kärjen leveytenä 1,88 metriä.

Varjostusmallin laskennassa on huomioitu hankealueen korkeustiedot, tuulivoimaloiden sijainnit, tuulivoimalan napakorkeudet ja roottorin halkaisija sekä hankealueen aikavyöhyke. Mallinnuksessa otettiin huomioon auringon asema horisontissa eri kellon- ja vuodenaikoina, pilvisyys 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. Laskentaikkunoiden suunnat asennettiin voimaloita kohti ns. ”greenhouse mode”.

Auringon keskimääräiset paistetunnit perustuvat Jokioisen sääaseman mitattuihin säätietoihin 1969 - 1993. Laskentojen tuulen suunta ja nopeusjakaumana käytettiin NASA:n MERRA-dataa (Modern Era Retrospective-analysis for Research and Applications) hankealueen läheisyydeltä.

Puuston huomioivassa varjostusmallinnuksissa (Luke forest) on huomioitu puuston peittävyys käyttämällä Luonnonvarakeskuksen vuoden 2019 puuston keskipituus aineistoa.

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

2.3 Raja- ja ohjearvot

2.3.1 Melu

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

Taulukko 6. Valtioneuvoston asetuksen mukaiset tuulivoimaloiden melutason toimenpiderajat (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 toimenpiderajoja. Toimenpiderajat koskevat asuinhuoneita ja ne on annettu taajuuspainottamattomina yhden tunnin keskiäänitasoina tersseittäin. Toimenpiderajat koskevat yöaikaa ja päivällä sallitaan 5 dB suuremmat arvot.

Taulukko 7. 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 keski-äänitaso 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.

2.3.2 Varjostus

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

Useissa maissa on annettu raja-arvoja tai suosituksia hyväksyttävän välkevaikutuksen määrästä. Esimerkiksi Ruotsissa suositus on kahdeksan tuntia vuodessa ja 30 minuuttia päivässä.

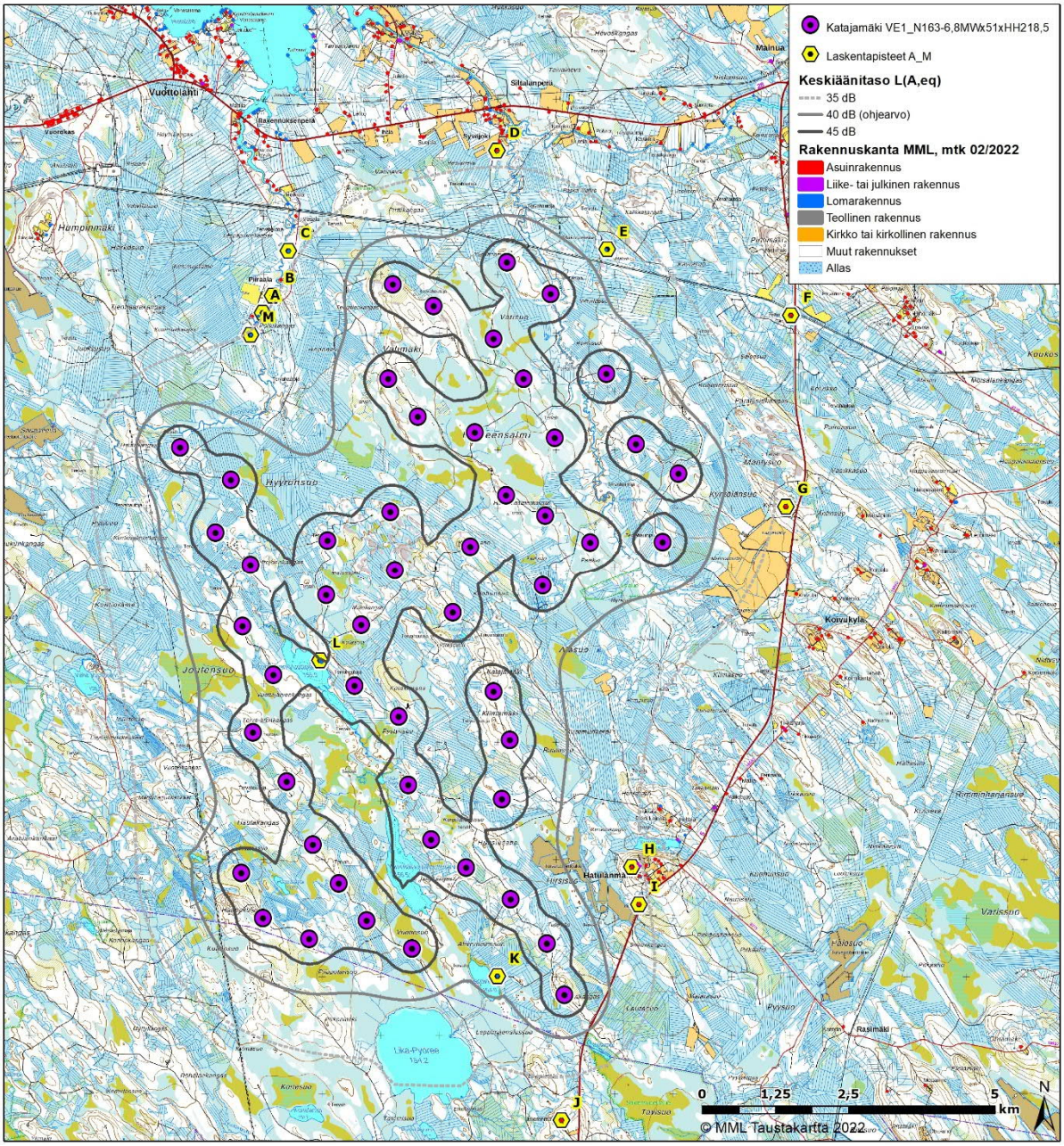
Arvioinnissa on tarkasteltu vaikutuksia alueella, jossa varjoja tai välkettä mallinnuksen mukaisessa todellisessa tilanteessa (”real case”) esiintyy vähintään kahdeksan tuntia vuodessa.

3 MELU- JA VARJOSTUSMALLINNUSTEN TULOKSET

3.1 Melu

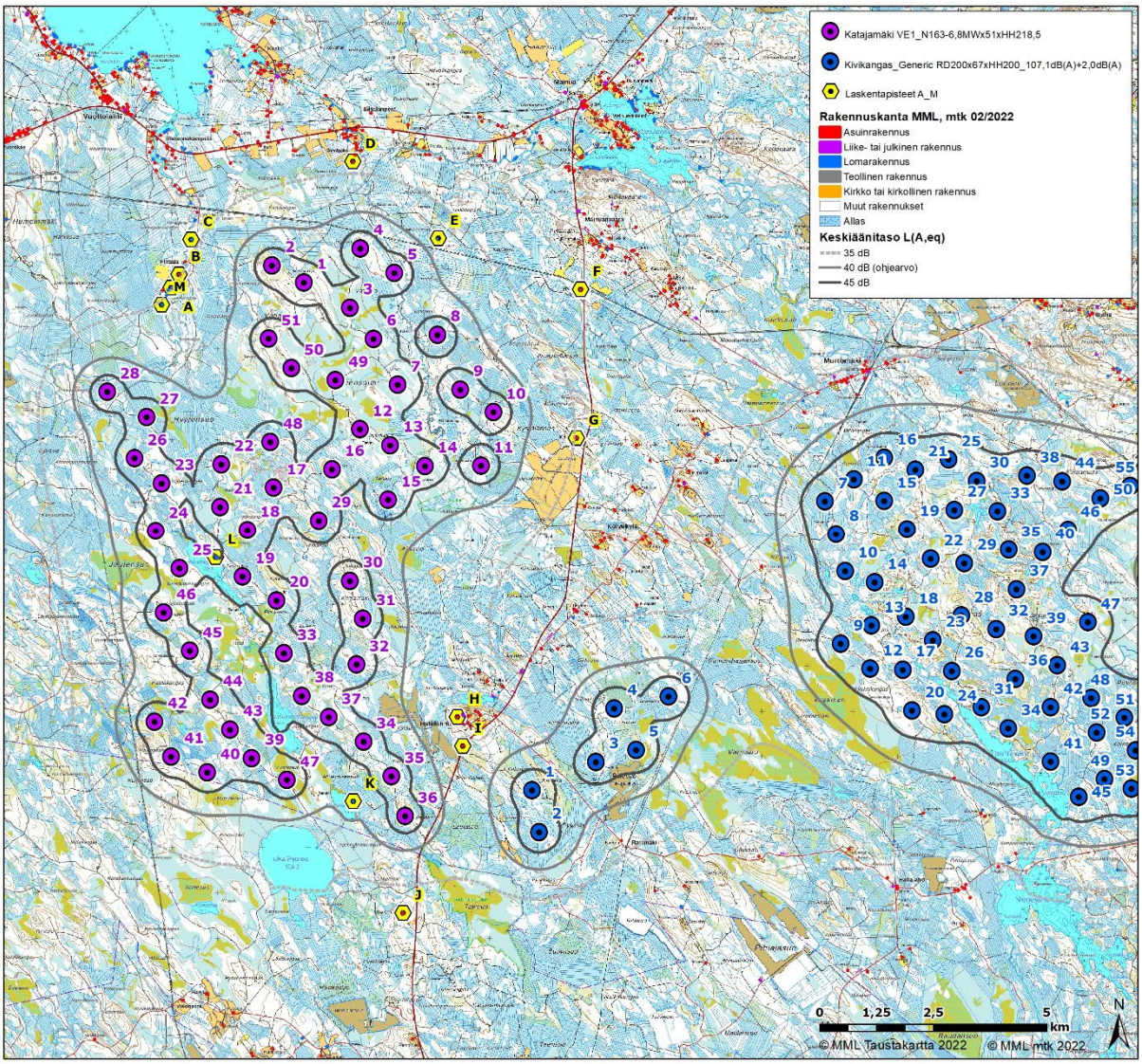
3.1.1 Melun laskentatulokset ISO 9613-2 voimalaitoksella N163 - 6,8 MW (106,4 dB + 1,5 dB)

Vaihtoehto 1 (VE1) melumallinnuksen mukaan melutaso 40 dB(A) ylittyy lähimmillä asuin- ja lomarakennuksilla laskentapisteissä Lomarakennus K (40,7 dB(A)) ja Lomarakennus L (44,9 dB(A)), (Taulukko 8). Katso tarkemmat laskentatulokset liitteestä 1.



Kuva 1. Melumallinnuksen tulos VE1.

Vaihtoehto 1 (VE1) yhteisvaikutukset Kivikankaan hankkeen kanssa. Melumallinnuksen mukaan melutaso 40 dB(A) ylittyy lähimmillä asuin- ja lomarakennuksilla laskentapisteissä Lomarakennus K (40,8 dB(A)) ja Lomarakennus L (44,9 dB(A)), (Taulukko 9). Katso tarkemmat laskentatulokset liitteestä 2.



Kuva 2. Melumallinnuksen tulos Katajanmäki VE1 yhdessä Kivikankaan hankkeen kanssa.

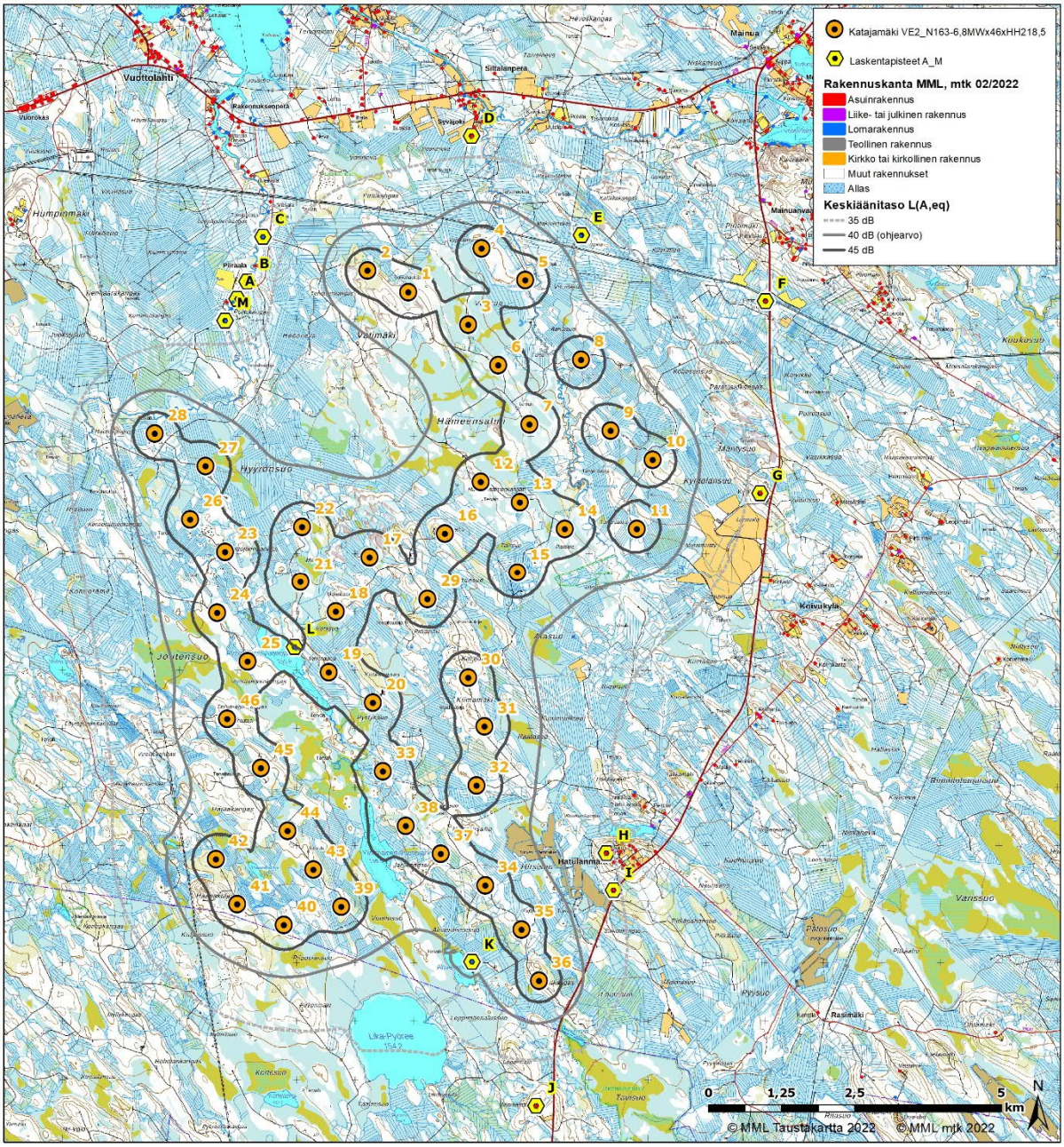
Taulukko 8. Laskennalliset melutasot Katajamäen tuulivoimahankkeen ympäristössä voimalaitoksella N163 - 6,8 MW VE1.

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-korkeus (m)	Melutaso dB(A)
Lomarakennus A	512 987	7 106 346	135,0	4,0	34,9
Asuinrakennus B	513 159	7 106 642	134,7	4,0	34,8
Lomarakennus C	513 426	7 107 406	131,3	4,0	34,3
Asuinrakennus D	516 993	7 109 125	130,2	4,0	33,9
Lomarakennus E	518 871	7 107 433	147,5	4,0	37,6
Asuinrakennus F	522 013	7 106 307	152,5	4,0	31,2
Asuinrakennus G	521 923	7 103 034	185,7	4,0	34,2
Asuinrakennus H	519 294	7 096 871	217,3	4,0	35,6
Asuinrakennus I	519 418	7 096 236	190,0	4,0	35,6
Asuinrakennus J	518 094	7 092 553	194,7	4,0	31,9
Lomarakennus K	516 998	7 095 013	155,3	4,0	40,7
Lomarakennus L	513 968	7 100 391	157,5	4,0	44,9
Lomarakennus M	512 778	7 105 974	135,0	4,0	35,1

Taulukko 9. Laskennalliset melutasot Katajamäen tuulivoimahankkeen ympäristössä voimalaitoksella N163 - 6,8 MW VE1. Yhteisvaikutukset Kivikankaan (Generic RD200-10MW) hankkeen kanssa.

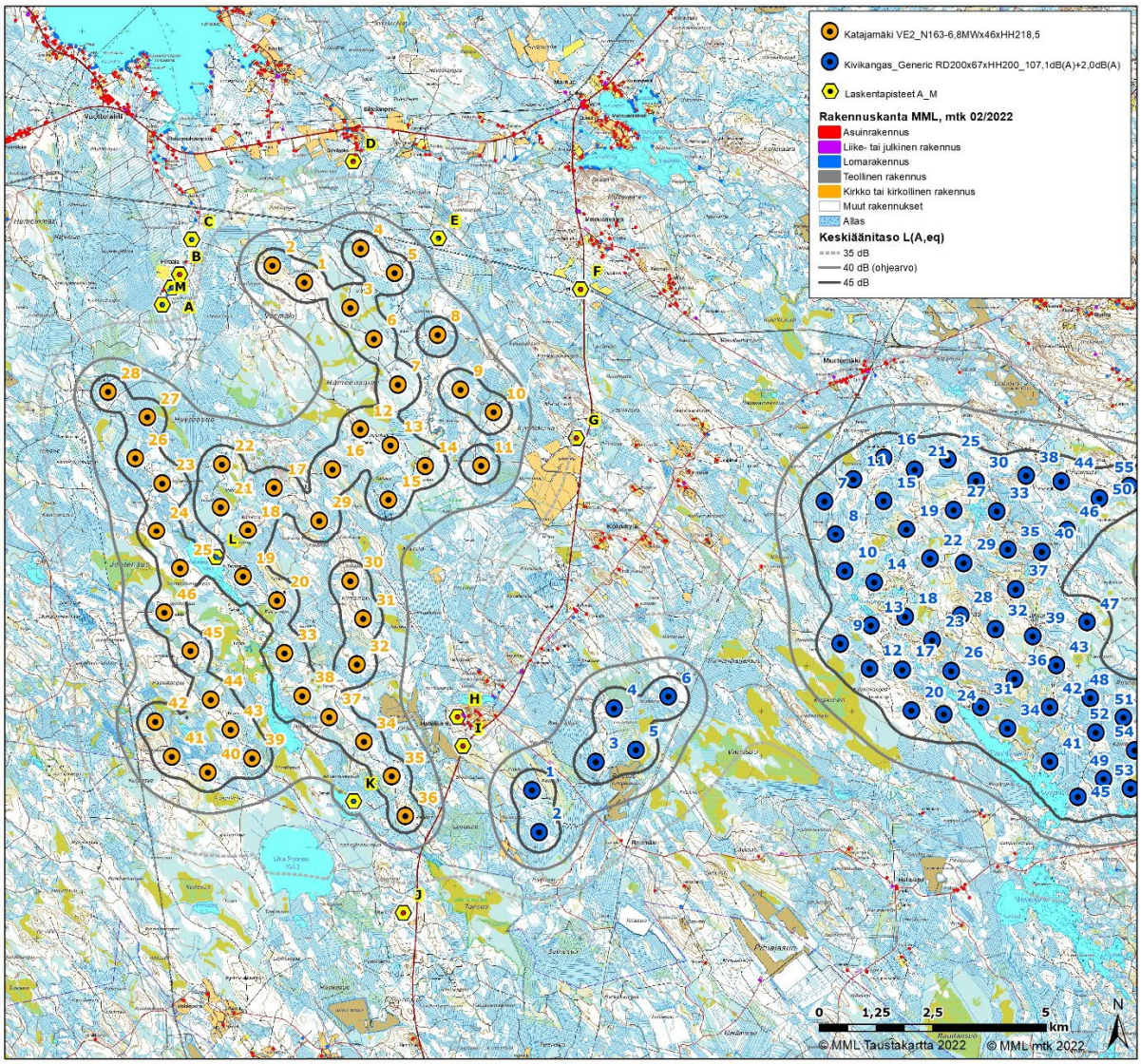
Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-korkeus (m)	Melutaso dB(A)
Lomarakennus A	512 987	7 106 346	135,0	4,0	34,9
Asuinrakennus B	513 159	7 106 642	134,7	4,0	34,9
Lomarakennus C	513 426	7 107 406	131,3	4,0	34,4
Asuinrakennus D	516 993	7 109 125	130,2	4,0	34,0
Lomarakennus E	518 871	7 107 433	147,5	4,0	37,6
Asuinrakennus F	522 013	7 106 307	152,5	4,0	31,8
Asuinrakennus G	521 923	7 103 034	185,7	4,0	34,8
Asuinrakennus H	519 294	7 096 871	217,3	4,0	36,8
Asuinrakennus I	519 418	7 096 236	190,0	4,0	37,4
Asuinrakennus J	518 094	7 092 553	194,7	4,0	32,8
Lomarakennus K	516 998	7 095 013	155,3	4,0	40,8
Lomarakennus L	513 968	7 100 391	157,5	4,0	44,9
Lomarakennus M	512 778	7 105 974	135,0	4,0	35,2

Vaihtoehdon 2 (VE2) melumallinnuksen mukaan melutaso 40 dB(A) ylittyy lähimmillä asuin- ja lomarakennuksilla laskentapisteissä Lomarakennus K (40,2 dB(A)) ja Lomarakennus L (44,9 dB(A)), (Taulukko 10). Katso tarkemmat laskentatulokset liitteestä 3.



Kuva 3. Melumallinnuksen tulos VE2.

Vaihtoehdon 2 (VE2) yhteisvaikutukset Kivikankaan hankkeen kanssa. Melumallinnuksen mukaan melutaso 40 dB(A) ylittyy lähimmillä asuin- ja lomarakennuksilla laskentapisteissä Lomarakennus K (40,3 dB(A)) ja Lomarakennus L (44,9 dB(A)), (Taulukko 11). Katso tarkemmat laskentatulokset liitteestä 4.



Kuva 4. Melumallinnuksen tulos Katajanmäki VE2 yhdessä Kivikankaan hankkeen kanssa.

Taulukko 10. Laskennalliset melutasot Katajamäen tuulivoimahankkeen ympäristössä voimalaitoksella N163 - 6,8 MW VE2.

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-korkeus (m)	Melutaso dB(A)
Lomarakennus A	512 987	7 106 346	135,0	4,0	33,7
Asuinrakennus B	513 159	7 106 642	134,7	4,0	33,7
Lomarakennus C	513 426	7 107 406	131,3	4,0	33,4
Asuinrakennus D	516 993	7 109 125	130,2	4,0	33,5
Lomarakennus E	518 871	7 107 433	147,5	4,0	37,3
Asuinrakennus F	522 013	7 106 307	152,5	4,0	30,9
Asuinrakennus G	521 923	7 103 034	185,7	4,0	34,1
Asuinrakennus H	519 294	7 096 871	217,3	4,0	35,4
Asuinrakennus I	519 418	7 096 236	190,0	4,0	35,5
Asuinrakennus J	518 094	7 092 553	194,7	4,0	31,6
Lomarakennus K	516 998	7 095 013	155,3	4,0	40,2
Lomarakennus L	513 968	7 100 391	157,5	4,0	44,9
Lomarakennus M	512 778	7 105 974	135,0	4,0	34,1

Taulukko 11. Laskennalliset melutasot Katajamäen tuulivoimahankkeen ympäristössä voimalaitoksella N163 - 6,8 MW VE2. Yhteisvaikutukset Kivikankaan (Generic RD200-10MW) hankkeen kanssa.

Laskentapiste	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskenta-korkeus (m)	Melutaso dB(A)
Lomarakennus A	512 987	7 106 346	135,0	4,0	33,8
Asuinrakennus B	513 159	7 106 642	134,7	4,0	33,8
Lomarakennus C	513 426	7 107 406	131,3	4,0	33,5
Asuinrakennus D	516 993	7 109 125	130,2	4,0	33,6
Lomarakennus E	518 871	7 107 433	147,5	4,0	37,4
Asuinrakennus F	522 013	7 106 307	152,5	4,0	31,6
Asuinrakennus G	521 923	7 103 034	185,7	4,0	34,6
Asuinrakennus H	519 294	7 096 871	217,3	4,0	36,7
Asuinrakennus I	519 418	7 096 236	190,0	4,0	37,3
Asuinrakennus J	518 094	7 092 553	194,7	4,0	32,5
Lomarakennus K	516 998	7 095 013	155,3	4,0	40,3
Lomarakennus L	513 968	7 100 391	157,5	4,0	44,9
Lomarakennus M	512 778	7 105 974	135,0	4,0	34,2

3.1.2 Matalataajuiset melutasot voimalaitoksella N163 – 6,8 MW (106,4 dB + 1,5 dB)

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.

Mallinnettaessa Katajamäen tuulivoimahankkeen matalataajuisia melutasoja voimalaitostyypillä N163 - 6,8 MW vaihtoehdossa 1 (VE 1) matalataajuinen melu ylittää Sosiaali- ja terveysministeriön asumisterveysohjearvoa laskentapisteissä lomarakennus K ja lomarakennus L. Taulukoissa näkyy toimenpiderajan alitus (negatiivinen arvo) tai ylitys (positiivinen arvo). Rakennusten sisätiloissa melu on enimmillään 3,6 dB yli toimenpiderajan taajuudella 63 Hz (Lomarakennus L).

Taulukko 12. Matalataajuisen melun laskentatulokset VE1.

Rakennus	Äänitaso ulkona		Äänitaso sisällä	
	L eq,1h – Asumis-terveys ohje sisällä	Hz	L eq,1h – Asumis-terveys ohje sisällä	Hz
Lomarakennus A	9,7	63	-3,3	63
Asuinrakennus B	9,6	63	-3,4	63
Lomarakennus C	9,1	63	-3,9	63
Asuinrakennus D	8,5	63	-4,5	63
Lomarakennus E	11,1	63	-1,9	63
Asuinrakennus F	6,9	63	-6,1	63
Asuinrakennus G	8,9	63	-4,1	63
Asuinrakennus H	10,1	63	-2,9	63
Asuinrakennus I	9,9	63	-3,1	63
Asuinrakennus J	7,1	63	-5,9	63
Lomarakennus K	13,3	63	0,3	63
Lomarakennus L	16,6	63	3,6	63
Lomarakennus M	9,9	63	-3,1	63

Mallinnettaessa Katajamäen tuulivoimahankkeen matalataajuisia melutasoja voimalaitostyypillä N163 - 6,8 MW vaihtoehdossa 1 (VE 1) yhteisvaikutuksia Kivikankaan (Generic RD200-10MW) hankkeen kanssa, matalataajuinen melu ylittää Sosiaali- ja terveysministeriön asumisterveysohjearvoa laskentapisteissä lomarakennus K ja lomarakennus L. Taulukoissa näkyy toimenpiderajan alitus (negatiivinen arvo) tai ylitys (positiivinen arvo). Rakennusten sisätiloissa melu on enimmillään 3,6 dB yli toimenpiderajan taajuudella 63 Hz (Lomarakennus L).

Taulukko 13. Matalataajuisen melun laskentatulokset VE1. Yhteisvaikutukset Kivikankaan hankkeen kanssa.

Rakennus	Äänitaso ulkona		Äänitaso sisällä	
	L eq,1h – Asumisterveys ohje sisällä	Hz	L eq,1h – Asumis-terveys ohje sisällä	Hz
Lomarakennus A	9,8	63	-3,2	63
Asuinrakennus B	9,7	63	-3,3	63
Lomarakennus C	9,2	63	-3,8	63
Asuinrakennus D	8,6	63	-4,4	63
Lomarakennus E	11,1	63	-1,9	63
Asuinrakennus F	7,2	63	-5,8	63
Asuinrakennus G	9,2	63	-3,8	63
Asuinrakennus H	10,4	63	-2,6	63
Asuinrakennus I	10,3	63	-2,7	63
Asuinrakennus J	7,4	63	-5,6	63
Lomarakennus K	13,3	63	0,3	63
Lomarakennus L	16,6	63	3,6	63
Lomarakennus M	10,0	63	-3,0	63

Mallinnettaessa Katajamäen tuulivoimahankkeen matalataajuisia melutasoja voimalaitostyypillä N163 - 6,8 MW vaihtoehdossa 2 (VE 2) matalataajuinen melu ylittää Sosiaali- ja terveysministeriön asumisterveysohjearvoa laskentapisteissä lomarakennus L. Taulukoissa näkyy toimenpiderajan alitus (negatiivinen arvo) tai ylitys (positiivinen arvo). Rakennusten sisätiloissa melu on enimmillään 3,5 dB yli toimenpiderajan taajuudella 63 Hz (Lomarakennus L).

Taulukko 14. Matalataajuisen melun laskentatulokset VE2.

Rakennus	Äänitaso ulkona		Äänitaso sisällä	
	L eq,1h – Asumis-terveys ohje si-sällä	Hz	L eq,1h – Asu-mis-terveys ohje sisällä	Hz
Lomarakennus A	8,7	63	-4,3	63
Asuinrakennus B	8,7	63	-4,3	63
Lomarakennus C	8,3	63	-4,7	63
Asuinrakennus D	8,1	63	-4,9	63
Lomarakennus E	10,7	63	-2,3	63
Asuinrakennus F	6,6	63	-6,4	63
Asuinrakennus G	8,6	63	-4,4	63
Asuinrakennus H	9,8	63	-3,2	63
Asuinrakennus I	9,7	63	-3,3	63
Asuinrakennus J	6,7	63	-6,3	63
Lomarakennus K	12,8	63	-0,2	63
Lomarakennus L	16,5	63	3,5	63
Lomarakennus M	9,0	63	-4,0	63

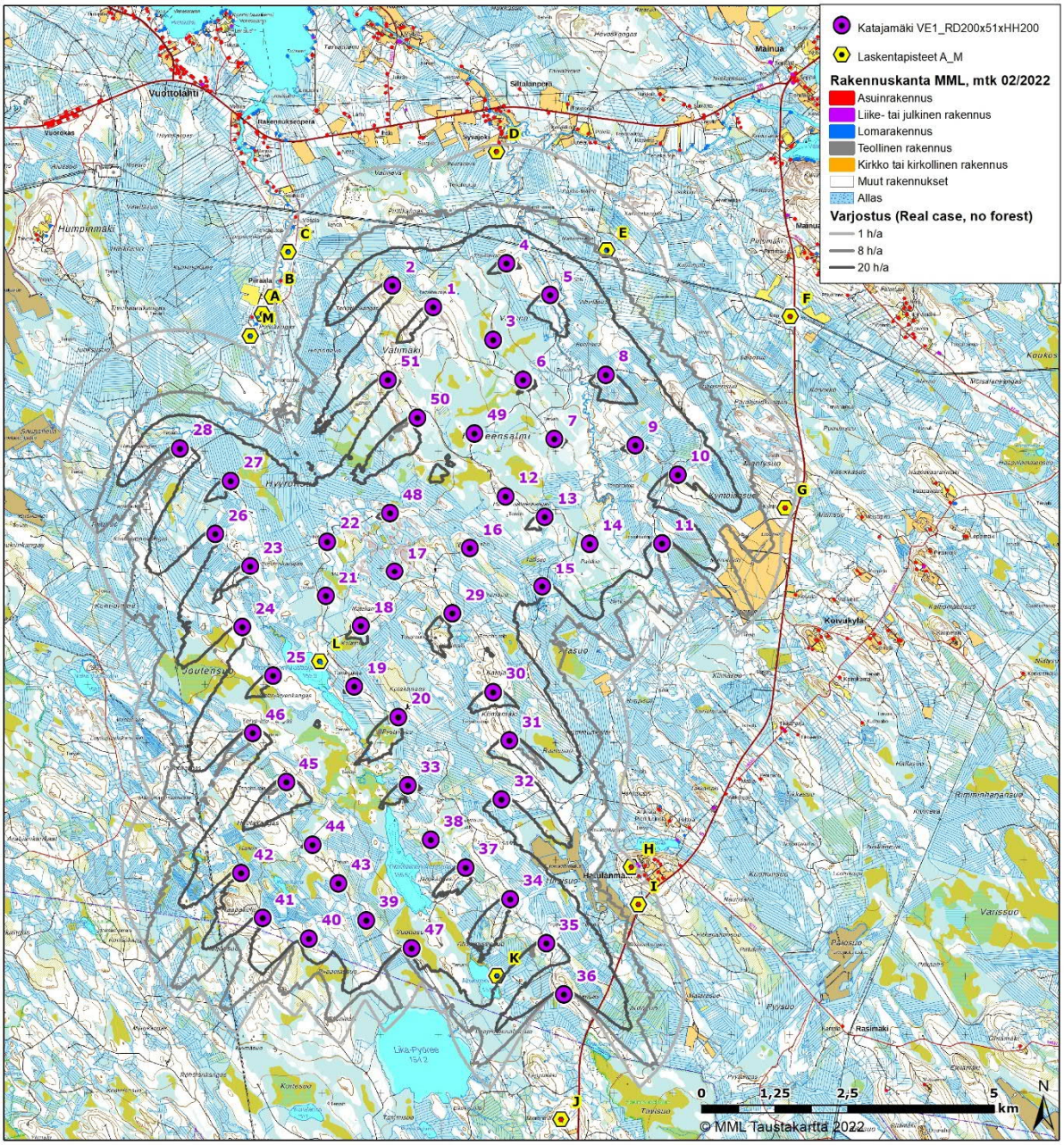
Mallinnettaessa Katajamäen tuulivoimahankkeen matalataajuisia melutasoja voimalaitostyypillä N163 - 6,8 MW vaihtoehdossa 2 (VE 2) yhteisvaikutuksia Kivikankaan (Generic RD200-10MW) hankkeen kanssa, matalataajuinen melu ylittää Sosiaali- ja terveysministeriön asumisterveysohjearvoa laskentapisteissä lomarakennus L. Taulukoissa näkyy toimenpiderajan alitus (negatiivinen arvo) tai ylitys (positiivinen arvo). Rakennusten sisätiloissa melu on enimmillään 3,5 dB yli toimenpiderajan taajuudella 63 Hz (Lomarakennus L).

Taulukko 15. Matalataajuisen melun laskentatulokset VE2. Yhteisvaikutukset Kivikankaan hankkeen kanssa.

Rakennus	Äänitaso ulkona		Äänitaso sisällä	
	L eq,1h – Asumisterveys ohje sisällä	Hz	L eq,1h – Asumis-terveys ohje sisällä	Hz
Lomarakennus A	8,8	63	-4,2	63
Asuinrakennus B	8,7	63	-4,3	63
Lomarakennus C	8,3	63	-4,7	63
Asuinrakennus D	8,1	63	-4,9	63
Lomarakennus E	10,8	63	-2,2	63
Asuinrakennus F	6,9	63	-6,1	63
Asuinrakennus G	9,0	63	-4,0	63
Asuinrakennus H	10,2	63	-2,8	63
Asuinrakennus I	10,1	63	-2,9	63
Asuinrakennus J	7,0	63	-6,0	63
Lomarakennus K	12,9	63	-0,1	63
Lomarakennus L	16,5	63	3,5	63
Lomarakennus M	9,1	63	-3,9	63

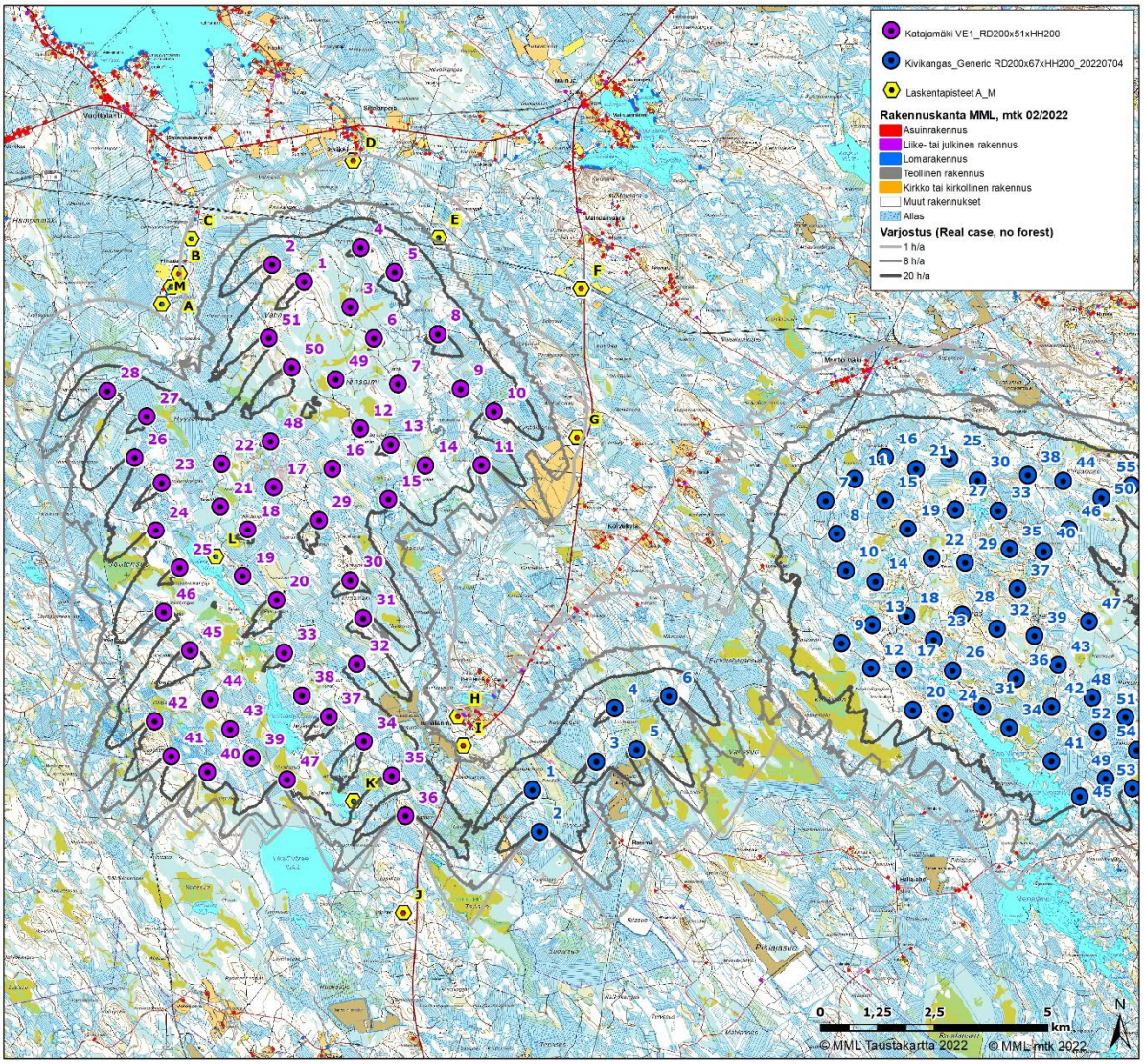
3.2 Varjostusmallinnus voimalaitoksella Generic RD200 HH200

Vaihtoehdossa 1 (VE1) tuulivoimahanketta lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on yli 8 h/a laskentapisteissä lomarakennus K (26 h 13 min/vuosi) ja lomarakennus L (45 h 9 min /vuosi) (Taulukko 16), kun puuston suojaavaa vaikutusta ei ole huomioitu.



Kuva 5. Varjostusmallinnuksen tulos, kun puuston suojaavaa vaikutusta ei ole huomioitu VE1.

Vaihtoehdossa 1 (VE1) mallinnettaessa yhdessä Kivikankaan hankkeen kanssa tuulivoimahanketta lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on yli 8 h/a laskentapisteissä lomarakennus K (26 h 13 min/vuosi) ja lomarakennus L (45 h 9 min /vuosi) (Taulukko 17), kun puuston suojaavaa vaikutusta ei ole huomioitu.



Kuva 6. Varjostusmallinnuksen tulos, kun puuston suojaavaa vaikutusta ei ole huomioitu, VE1 yhdessä Kivikankaan hankkeen kanssa.

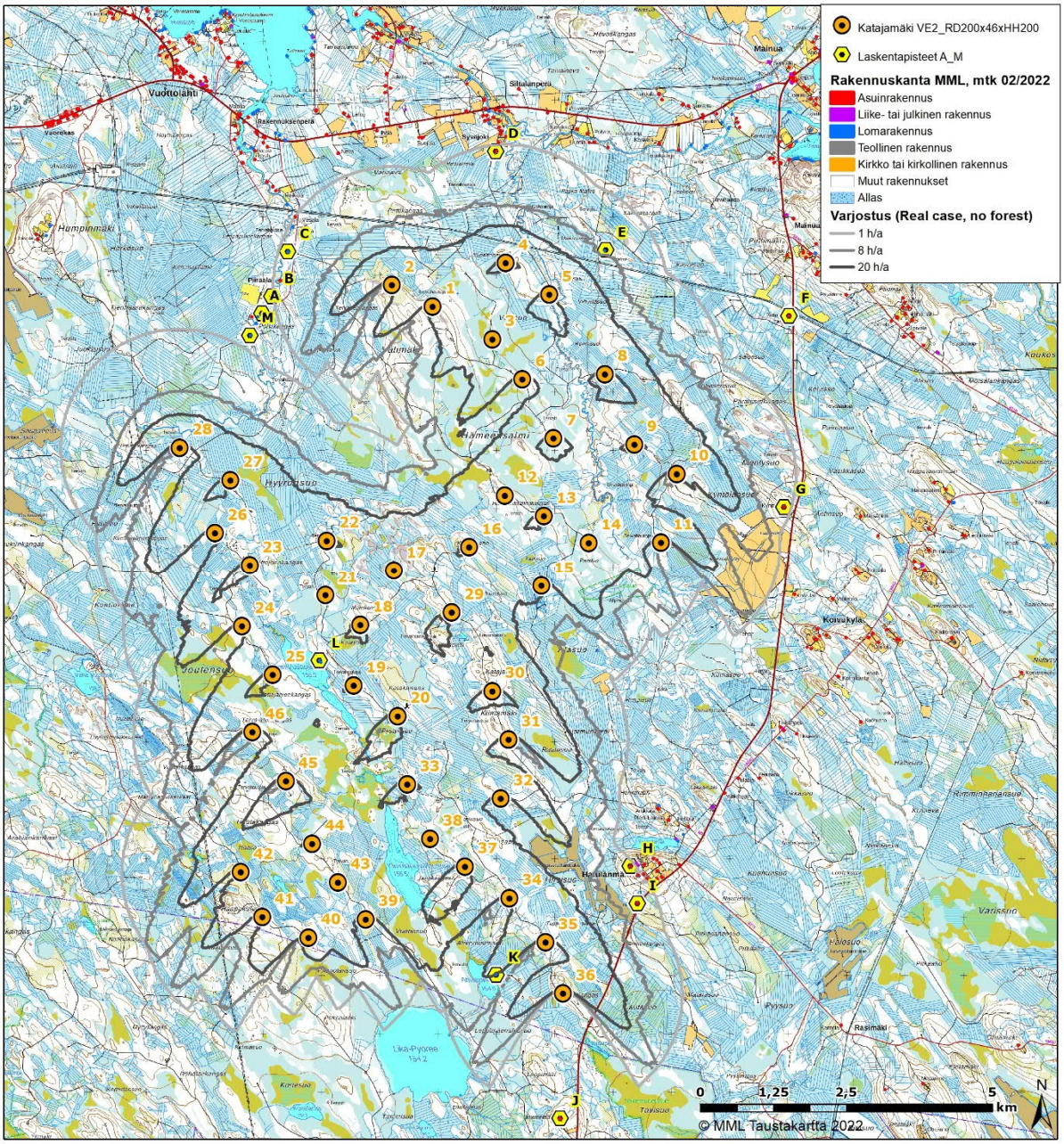
Taulukko 16. Varjostusmallinnuksen tulos VE1, kun puuston suojaavaa vaikutusta ei ole huomioitu "real case, no forest".

	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikkuna (m)	Varjostus (h/a)
Lomarakennus A	512 987	7 106 346	135,0	5,0 x 5,0	0:00
Asuinrakennus B	513 159	7 106 642	134,7	5,0 x 5,0	0:00
Lomarakennus C	513 426	7 107 406	131,3	5,0 x 5,0	2:11
Asuinrakennus D	516 993	7 109 125	130,2	5,0 x 5,0	1:42
Lomarakennus E	518 871	7 107 433	147,5	5,0 x 5,0	7:00
Asuinrakennus F	522 013	7 106 307	152,5	5,0 x 5,0	0:00
Asuinrakennus G	521 923	7 103 034	185,7	5,0 x 5,0	3:02
Asuinrakennus H	519 294	7 096 871	217,3	5,0 x 5,0	1:18
Asuinrakennus I	519 418	7 096 236	190,0	5,0 x 5,0	3:51
Asuinrakennus J	518 094	7 092 553	194,7	5,0 x 5,0	0:00
Lomarakennus K	516 998	7 095 013	155,3	5,0 x 5,0	26:13
Lomarakennus L	513 968	7 100 391	157,5	5,0 x 5,0	45:09
Lomarakennus M	512 778	7 105 974	135,0	5,0 x 5,0	0:00

Taulukko 17. Varjostusmallinnuksen tulos. VE1 yhteisvaikutukset Kivikankaan hankkeen kanssa, kun puuston suojaavaa vaikutusta ei ole huomioitu "real case, no forest".

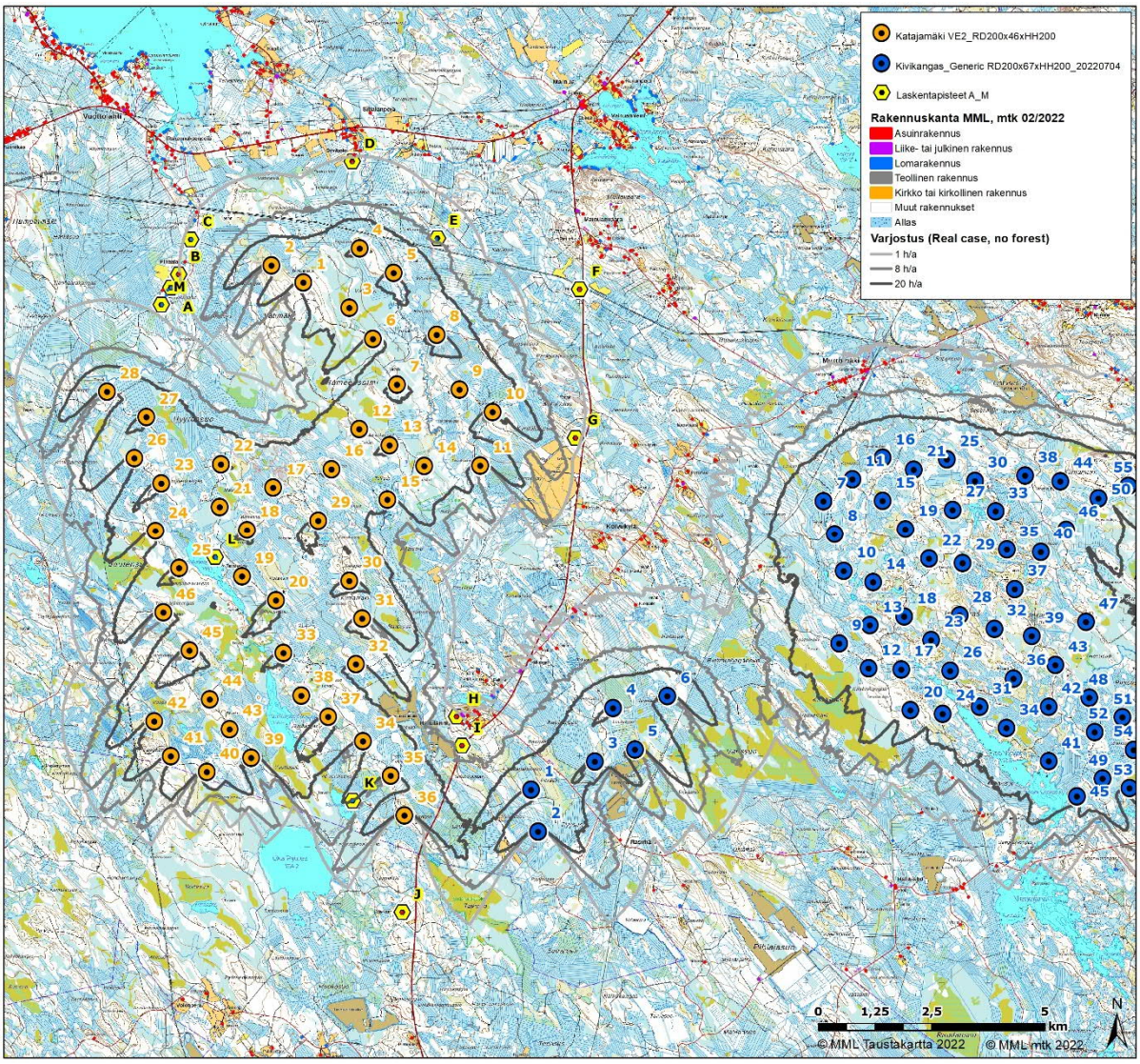
	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikkuna (m)	Varjostus (h/a)
Lomarakennus A	512 987	7 106 346	135,0	5,0 x 5,0	0:00
Asuinrakennus B	513 159	7 106 642	134,7	5,0 x 5,0	0:00
Lomarakennus C	513 426	7 107 406	131,3	5,0 x 5,0	2:11
Asuinrakennus D	516 993	7 109 125	130,2	5,0 x 5,0	1:42
Lomarakennus E	518 871	7 107 433	147,5	5,0 x 5,0	7:00
Asuinrakennus F	522 013	7 106 307	152,5	5,0 x 5,0	0:00
Asuinrakennus G	521 923	7 103 034	185,7	5,0 x 5,0	3:02
Asuinrakennus H	519 294	7 096 871	217,3	5,0 x 5,0	2:11
Asuinrakennus I	519 418	7 096 236	190,0	5,0 x 5,0	6:33
Asuinrakennus J	518 094	7 092 553	194,7	5,0 x 5,0	0:00
Lomarakennus K	516 998	7 095 013	155,3	5,0 x 5,0	26:13
Lomarakennus L	513 968	7 100 391	157,5	5,0 x 5,0	45:09
Lomarakennus M	512 778	7 105 974	135,0	5,0 x 5,0	0:00

Vaihtoehdossa 2 (VE2) tuulivoimahanketta lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on yli 8 h/a laskentapisteissä lomarakennus K ja lomarakennus L (20 h 36 min/vuosi) ja lomarakennus L (45 h 9 min /vuosi) (Taulukko 18), kun puuston suojaavaa vaikutusta ei ole huomioitu.



Kuva 7. Varjostusmallinnuksen tulos, kun puuston suojaavaa vaikutusta ei ole huomioitu VE2.

Vaihtoehdossa 2 (VE2) mallinnettaessa yhdessä Kivikankaan hankkeen kanssa tuulivoimahanketta lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on yli 8 h/a laskentapisteissä lomarakennus K ja lomarakennus L (20 h 36 min/vuosi) ja lomarakennus L (45 h 9 min /vuosi) (Taulukko 19), kun puuston suojaavaa vaikutusta ei ole huomioitu.



Kuva 8. Varjostusmallinnuksen tulos, kun puuston suojaavaa vaikutusta ei ole huomioitu, VE2 yhdessä Kivikankaan hankkeen kanssa.

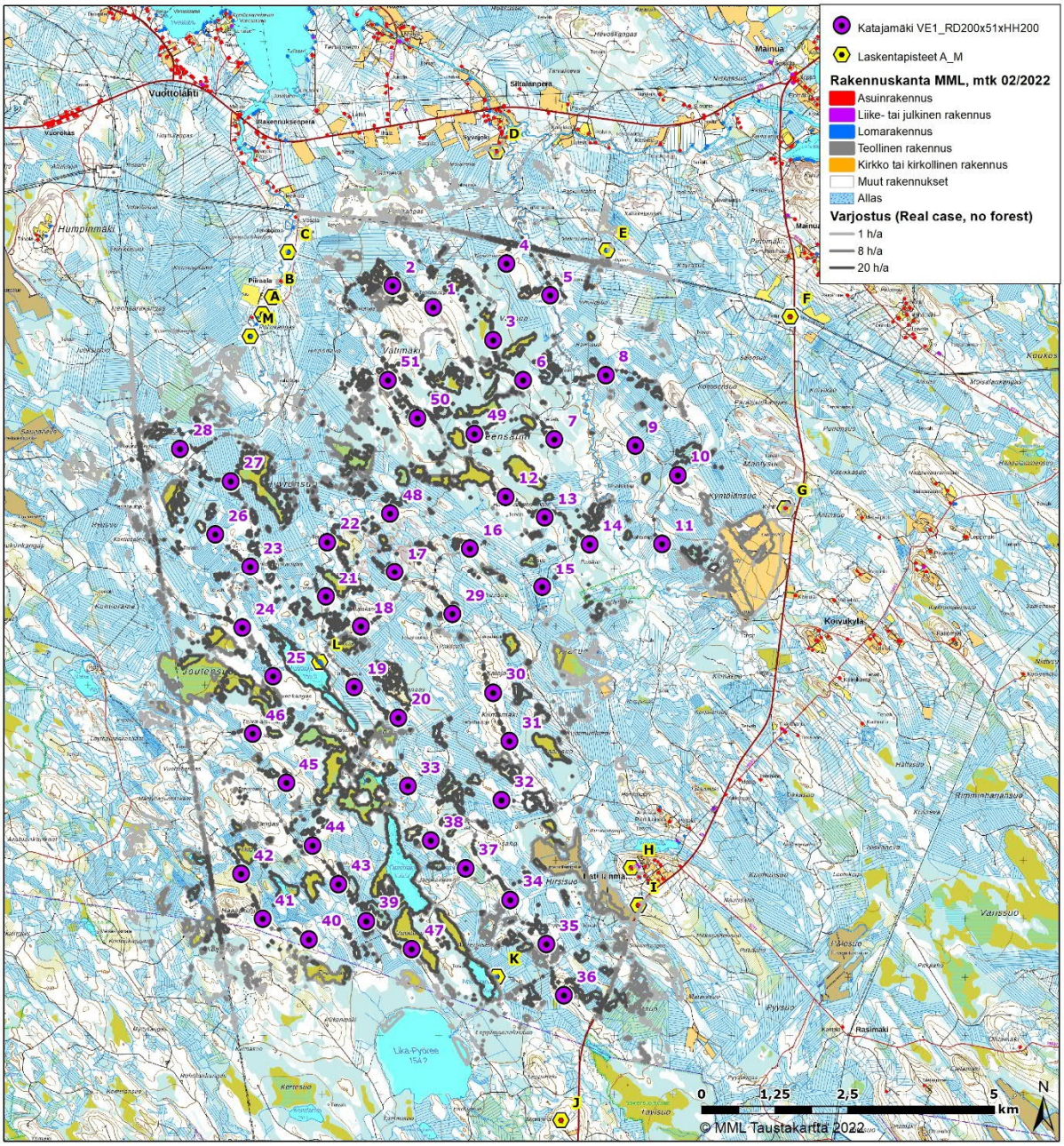
Taulukko 18. Varjostusmallinnuksen tulos VE2, kun puuston suojaavaa vaikutusta ei ole huomioitu "real case, no forest".

	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Lasken-taikkuna (m)	Varjostus (h/a)
Lomarakennus A	512 987	7 106 346	135,0	5,0 x 5,0	0:00
Asuinrakennus B	513 159	7 106 642	134,7	5,0 x 5,0	0:00
Lomarakennus C	513 426	7 107 406	131,3	5,0 x 5,0	2:11
Asuinrakennus D	516 993	7 109 125	130,2	5,0 x 5,0	1:42
Lomarakennus E	518 871	7 107 433	147,5	5,0 x 5,0	7:00
Asuinrakennus F	522 013	7 106 307	152,5	5,0 x 5,0	0:00
Asuinrakennus G	521 923	7 103 034	185,7	5,0 x 5,0	3:02
Asuinrakennus H	519 294	7 096 871	217,3	5,0 x 5,0	1:18
Asuinrakennus I	519 418	7 096 236	190,0	5,0 x 5,0	3:51
Asuinrakennus J	518 094	7 092 553	194,7	5,0 x 5,0	0:00
Lomarakennus K	516 998	7 095 013	155,3	5,0 x 5,0	20:36
Lomarakennus L	513 968	7 100 391	157,5	5,0 x 5,0	45:09
Lomarakennus M	512 778	7 105 974	135,0	5,0 x 5,0	0:00

Taulukko 19. Varjostusmallinnuksen tulos. VE2 yhteisvaikutukset Kivikankaan hankkeen kanssa, kun puuston suojaavaa vaikutusta ei ole huomioitu "real case, no forest".

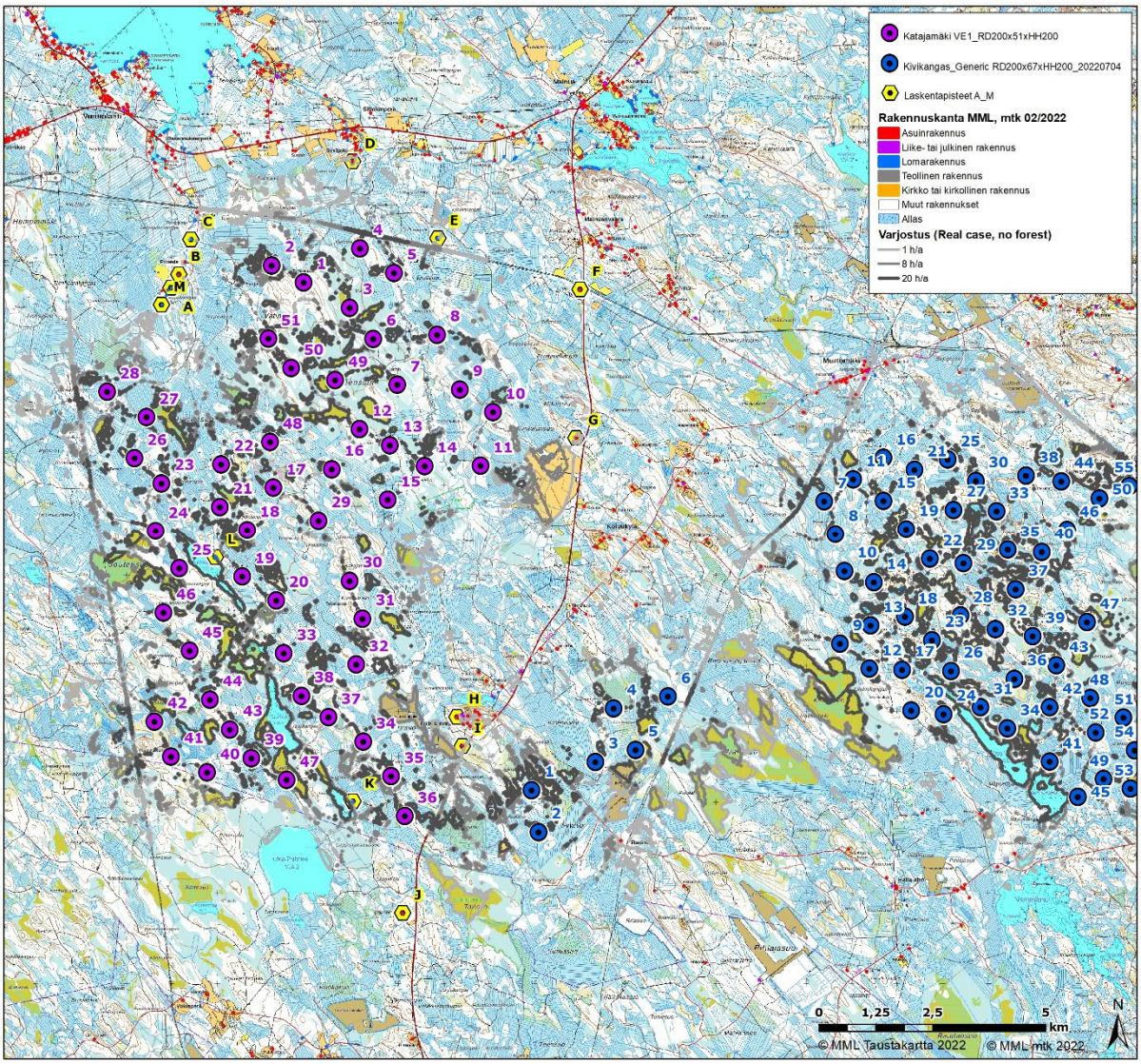
	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Lasken-taikkuna (m)	Varjostus (h/a)
Lomarakennus A	512 987	7 106 346	135,0	5,0 x 5,0	0:00
Asuinrakennus B	513 159	7 106 642	134,7	5,0 x 5,0	0:00
Lomarakennus C	513 426	7 107 406	131,3	5,0 x 5,0	2:11
Asuinrakennus D	516 993	7 109 125	130,2	5,0 x 5,0	1:42
Lomarakennus E	518 871	7 107 433	147,5	5,0 x 5,0	7:00
Asuinrakennus F	522 013	7 106 307	152,5	5,0 x 5,0	0:00
Asuinrakennus G	521 923	7 103 034	185,7	5,0 x 5,0	3:02
Asuinrakennus H	519 294	7 096 871	217,3	5,0 x 5,0	2:11
Asuinrakennus I	519 418	7 096 236	190,0	5,0 x 5,0	6:33
Asuinrakennus J	518 094	7 092 553	194,7	5,0 x 5,0	0:00
Lomarakennus K	516 998	7 095 013	155,3	5,0 x 5,0	20:36
Lomarakennus L	513 968	7 100 391	157,5	5,0 x 5,0	45:09
Lomarakennus M	512 778	7 105 974	135,0	5,0 x 5,0	0:00

Vaihtoehdossa 1 (VE1) tuulivoimahanketta lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on yli 8 h/a laskentapisteessä lomarakennus L (11 h 43 min) (Taulukko 20), kun puuston suojaava vaikutus on huomioitu (Luonnonvarakeskuksen puuston keskipituus aineisto 2019).



Kuva 9. Varjostusmallinnuksen tulos, kun puuston suojaavaa vaikutus on huomioitu VE1.

Vaihtoehdossa 1 (VE1) mallinnettaessa yhdessä Kivikankaan hankkeen kanssa tuulivoimahanketta lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on yli 8 h/a laskentapisteessä lomarakennus L (11 h 43 min) (Taulukko 21), kun puuston suojaava vaikutus on huomioitu (Luonnonvarakeskuksen puuston keskipituus aineisto 2019).



Kuva 10. Varjostusmallinnuksen tulos, kun puuston suojaavaa vaikutus on huomioitu, VE1 yhdessä Kivikankaan hankkeen kanssa.

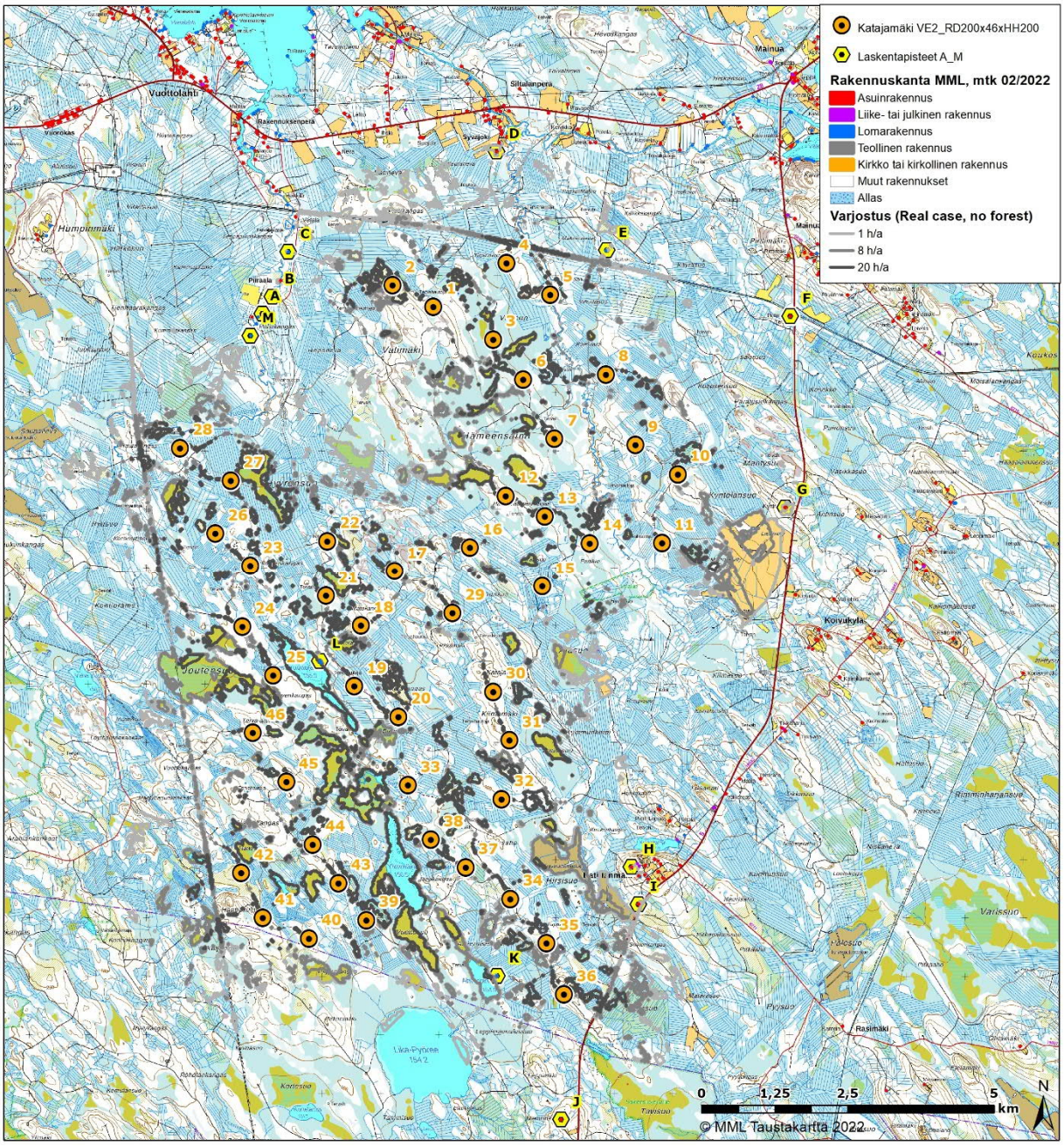
Taulukko 20. Varjostusmallinnuksen tulos VE1, kun puuston suojaava vaikutus on huomioitu "real case, Luke forest".

	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikkuna (m)	Varjostus (h/a)
Lomarakennus A	512 987	7 106 346	135,0	5,0 x 5,0	0:00
Asuinrakennus B	513 159	7 106 642	134,7	5,0 x 5,0	0:00
Lomarakennus C	513 426	7 107 406	131,3	5,0 x 5,0	2:11
Asuinrakennus D	516 993	7 109 125	130,2	5,0 x 5,0	1:42
Lomarakennus E	518 871	7 107 433	147,5	5,0 x 5,0	7:00
Asuinrakennus F	522 013	7 106 307	152,5	5,0 x 5,0	0:00
Asuinrakennus G	521 923	7 103 034	185,7	5,0 x 5,0	3:02
Asuinrakennus H	519 294	7 096 871	217,3	5,0 x 5,0	1:18
Asuinrakennus I	519 418	7 096 236	190,0	5,0 x 5,0	0:00
Asuinrakennus J	518 094	7 092 553	194,7	5,0 x 5,0	0:00
Lomarakennus K	516 998	7 095 013	155,3	5,0 x 5,0	5:34
Lomarakennus L	513 968	7 100 391	157,5	5,0 x 5,0	11:43
Lomarakennus M	512 778	7 105 974	135,0	5,0 x 5,0	0:00

Taulukko 21. Varjostusmallinnuksen tulos. VE1 yhteisvaikutukset Kivikankaan hankkeen kanssa, kun puuston suojaavaa vaikutus on huomioitu "real case, Luke forest".

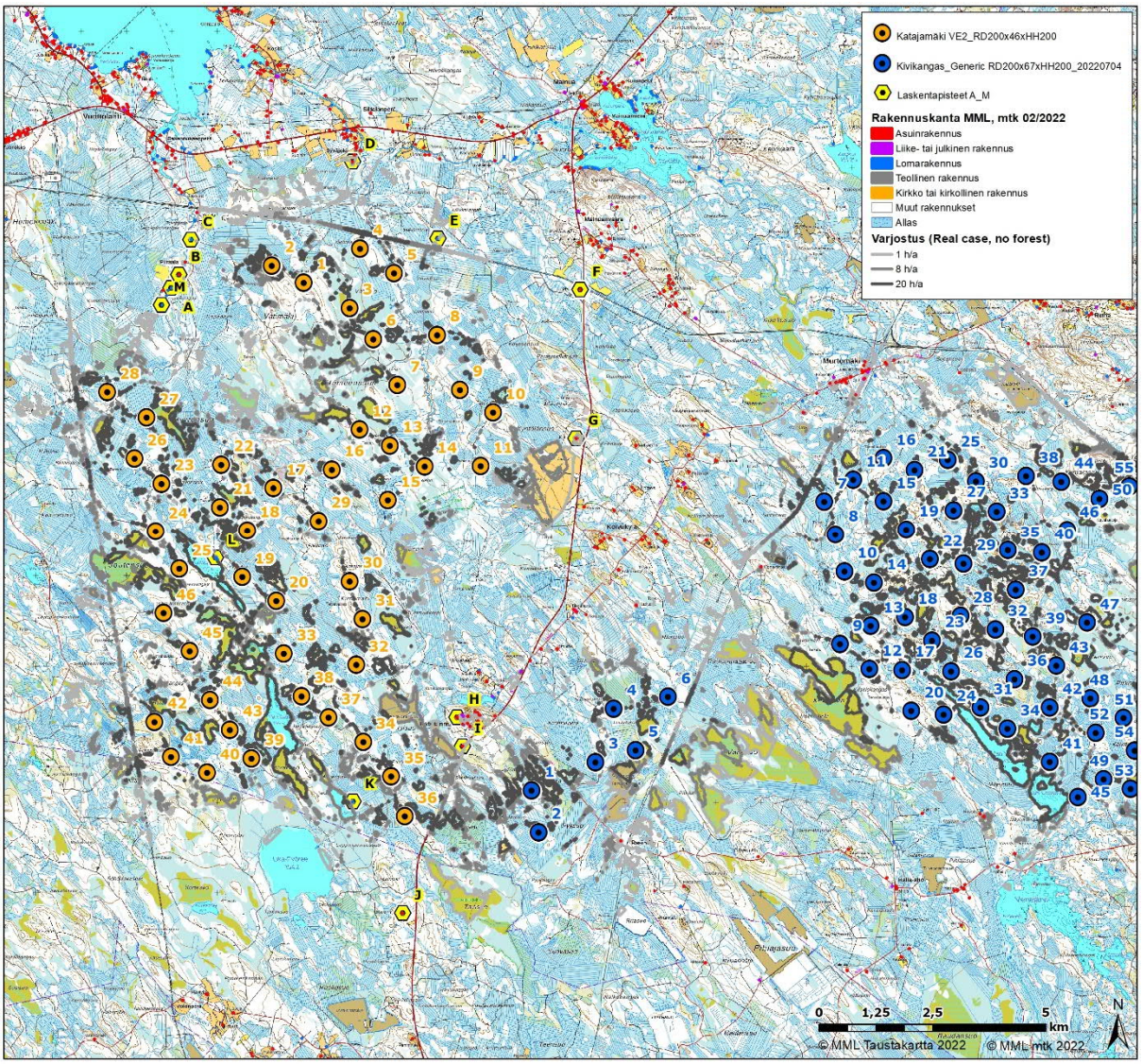
	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikkuna (m)	Varjostus (h/a)
Lomarakennus A	512 987	7 106 346	135,0	5,0 x 5,0	0:00
Asuinrakennus B	513 159	7 106 642	134,7	5,0 x 5,0	0:00
Lomarakennus C	513 426	7 107 406	131,3	5,0 x 5,0	2:11
Asuinrakennus D	516 993	7 109 125	130,2	5,0 x 5,0	1:42
Lomarakennus E	518 871	7 107 433	147,5	5,0 x 5,0	7:00
Asuinrakennus F	522 013	7 106 307	152,5	5,0 x 5,0	0:00
Asuinrakennus G	521 923	7 103 034	185,7	5,0 x 5,0	3:02
Asuinrakennus H	519 294	7 096 871	217,3	5,0 x 5,0	1:18
Asuinrakennus I	519 418	7 096 236	190,0	5,0 x 5,0	0:00
Asuinrakennus J	518 094	7 092 553	194,7	5,0 x 5,0	0:00
Lomarakennus K	516 998	7 095 013	155,3	5,0 x 5,0	5:34
Lomarakennus L	513 968	7 100 391	157,5	5,0 x 5,0	11:43
Lomarakennus M	512 778	7 105 974	135,0	5,0 x 5,0	0:00

Vaihtoehdossa 2 (VE2) tuulivoimahanketta lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on yli 8 h/a laskentapisteessä lomarakennus L (11 h 43 min) (Taulukko 22), kun puuston suojaava vaikutus on huomioitu (Luonnonvarakeskuksen puuston keskipituus aineisto 2019).



Kuva 11. Varjostusmallinnuksen tulos, kun puuston suojaavaa vaikutus on huomioitu VE2.

Vaihtoehdossa 2 (VE2) mallinnettaessa yhdessä Kivikankaan hankkeen kanssa tuulivoimahanketta lähimpien asuin- ja lomarakennusten pihapiirissä varjostusvaikutus on yli 8 h/a laskentapisteessä lomarakennus L (11 h 43 min) (Taulukko 23), kun puuston suojaava vaikutus on huomioitu (Luonnonvarakeskuksen puuston keskipituus aineisto 2019).



Kuva 12. Varjostusmallinnuksen tulos, kun puuston suojaavaa vaikutus on huomioitu, VE2 yhdessä Kivikankaan hankkeen kanssa.

Taulukko 22. Varjostusmallinnuksen tulos VE2, kun puuston suojaava vaikutus on huomioitu "real case, Luke forest".

	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikkuna (m)	Varjostus (h/a)
Lomarakennus A	512 987	7 106 346	135,0	5,0 x 5,0	0:00
Asuinrakennus B	513 159	7 106 642	134,7	5,0 x 5,0	0:00
Lomarakennus C	513 426	7 107 406	131,3	5,0 x 5,0	2:11
Asuinrakennus D	516 993	7 109 125	130,2	5,0 x 5,0	1:42
Lomarakennus E	518 871	7 107 433	147,5	5,0 x 5,0	7:00
Asuinrakennus F	522 013	7 106 307	152,5	5,0 x 5,0	0:00
Asuinrakennus G	521 923	7 103 034	185,7	5,0 x 5,0	3:02
Asuinrakennus H	519 294	7 096 871	217,3	5,0 x 5,0	1:18
Asuinrakennus I	519 418	7 096 236	190,0	5,0 x 5,0	0:00
Asuinrakennus J	518 094	7 092 553	194,7	5,0 x 5,0	0:00
Lomarakennus K	516 998	7 095 013	155,3	5,0 x 5,0	5:34
Lomarakennus L	513 968	7 100 391	157,5	5,0 x 5,0	11:43
Lomarakennus M	512 778	7 105 974	135,0	5,0 x 5,0	0:00

Taulukko 23. Varjostusmallinnuksen tulos. VE2 yhteisvaikutukset Kivikankaan hankkeen kanssa, kun puuston suojaavaa vaikutus on huomioitu "real case, Luke forest".

	ETRS89-TM35 Itä	ETRS89-TM35 Pohjoinen	Z (m)	Laskentaikkuna (m)	Varjostus (h/a)
Lomarakennus A	512 987	7 106 346	135,0	5,0 x 5,0	0:00
Asuinrakennus B	513 159	7 106 642	134,7	5,0 x 5,0	0:00
Lomarakennus C	513 426	7 107 406	131,3	5,0 x 5,0	2:11
Asuinrakennus D	516 993	7 109 125	130,2	5,0 x 5,0	1:42
Lomarakennus E	518 871	7 107 433	147,5	5,0 x 5,0	7:00
Asuinrakennus F	522 013	7 106 307	152,5	5,0 x 5,0	0:00
Asuinrakennus G	521 923	7 103 034	185,7	5,0 x 5,0	3:02
Asuinrakennus H	519 294	7 096 871	217,3	5,0 x 5,0	1:18
Asuinrakennus I	519 418	7 096 236	190,0	5,0 x 5,0	0:00
Asuinrakennus J	518 094	7 092 553	194,7	5,0 x 5,0	0:00
Lomarakennus K	516 998	7 095 013	155,3	5,0 x 5,0	5:34
Lomarakennus L	513 968	7 100 391	157,5	5,0 x 5,0	11:43
Lomarakennus M	512 778	7 105 974	135,0	5,0 x 5,0	0:00

FCG Finnish Consulting Group Oy

Henna-Riikka Rintamäki, ins. AMK
Laatija

Johanna Harju, ins. AMK
Tarkastaja

30.8.2022

Liite 1. Katajamäen tuulivoimahanke - Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2 /2014 (VE1) N163 – 6.8 MW

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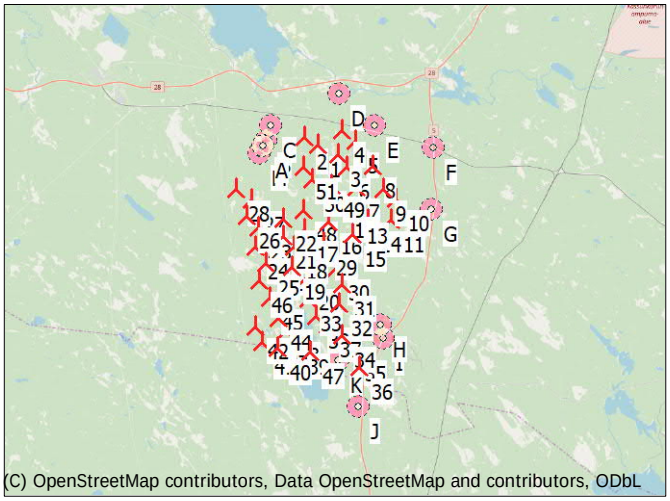
Calculated:
1.4.2022 13.00/3.5.576

DECIBEL - Main Result

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5

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



Scale 1:400 000

New WTG Noise sensitive area

WTGs

	East	North	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Creator	Name	Wind speed [m/s]	LwA,ref [dB(A)]
1	513 394	7 098 322	187,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
2	513 847	7 097 251	182,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
3	514 288	7 096 590	175,3	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
4	514 763	7 095 958	167,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
5	513 785	7 095 645	173,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
6	517 845	7 095 564	168,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
7	517 226	7 096 320	171,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
8	516 462	7 096 860	173,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
9	515 866	7 097 332	169,4	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
10	515 475	7 098 267	165,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
11	517 075	7 098 024	179,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
12	517 213	7 099 034	197,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
13	516 931	7 099 863	197,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
14	517 144	7 103 226	166,6	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
15	517 816	7 102 875	160,3	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
16	518 583	7 102 417	152,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
17	515 909	7 106 459	164,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
18	516 931	7 105 901	145,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
19	517 446	7 105 214	147,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
20	517 980	7 104 206	148,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
21	518 858	7 105 305	145,9	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
22	519 364	7 104 099	155,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
23	520 088	7 103 598	172,3	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
24	519 817	7 102 420	156,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
25	516 239	7 101 210	190,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
26	515 249	7 101 935	174,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
27	516 534	7 102 343	177,2	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
28	514 670	7 100 997	170,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
29	514 555	7 099 960	171,1	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
30	515 309	7 099 437	168,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
31	514 070	7 101 510	162,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
32	514 093	7 102 453	153,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
33	512 819	7 099 163	178,6	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
34	513 168	7 100 143	162,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
35	512 646	7 100 974	160,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
36	512 778	7 102 030	157,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
37	512 181	7 102 585	153,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
38	512 622	7 096 766	187,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
39	512 989	7 095 998	185,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
40	515 210	7 106 831	164,9	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
41	512 447	7 103 491	147,2	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
42	511 576	7 104 046	147,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
43	518 144	7 094 686	176,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9

To be continued on next page...

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Calculated:
1.4.2022 13.00/3.5.576

DECIBEL - Main Result

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Noise data Creator	Name	Wind speed	LwA,ref
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]
44	517 771	7 101 673	167,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
45	517 906	7 106 667	137,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
46	517 160	7 107 206	142,3	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
47	515 539	7 095 480	162,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
48	516 610	7 104 302	158,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
49	515 639	7 104 571	165,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
50	515 136	7 105 219	160,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
51	515 171	7 102 940	162,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9

Calculation Results

Sound level

Noise sensitive area No.	Name	East	North	Z	Immission height	Demands Noise	Sound level From WTGs	Distance to noise demand	2 dB penalty applied for one or more WTGs
				[m]	[m]	[dB(A)]	[dB(A)]	[m]	
A	Lomarakennus A	512 987	7 106 346	135,0	4,0	40,0	34,9	1 406	No
B	Asuinrakennus B	513 159	7 106 642	134,7	4,0	40,0	34,8	1 221	No
C	Lomarakennus C	513 426	7 107 406	131,3	4,0	40,0	34,3	1 079	No
D	Asuinrakennus D	516 993	7 109 125	130,2	4,0	40,0	33,9	1 113	No
E	Lomarakennus E	518 871	7 107 433	147,5	4,0	40,0	37,6	371	No
F	Asuinrakennus F	522 013	7 106 307	152,5	4,0	40,0	31,2	2 386	No
G	Asuinrakennus G	521 923	7 103 034	185,7	4,0	40,0	34,2	1 079	No
H	Asuinrakennus H	519 294	7 096 871	217,3	4,0	40,0	35,6	1 011	No
I	Asuinrakennus I	519 418	7 096 236	190,0	4,0	40,0	35,6	823	No
J	Asuinrakennus J	518 094	7 092 553	194,7	4,0	40,0	31,9	1 404	No
K	Lomarakennus K	516 998	7 095 013	155,3	4,0	40,0	40,7	-353	No
L	Lomarakennus L	513 968	7 100 391	157,5	4,0	40,0	44,9	-2 122	No
M	Lomarakennus M	512 778	7 105 974	135,0	4,0	40,0	35,1	1 429	No

Distances (m)

WTG	A	B	C	D	E	F	G	H	I	J	K	L	M
1	8034	8323	9084	11387	10631	11749	9744	6076	6375	7441	4893	2147	7677
2	9136	9416	10164	12284	11354	12194	9933	5460	5663	6333	3865	3142	8788
3	9842	10115	10850	12824	11772	12414	9991	5014	5142	5548	3135	3814	9505
4	10539	10804	11526	13355	12188	12636	10067	4622	4663	4763	2427	4504	10211
5	10731	11015	11766	13856	12838	13468	10992	5644	5664	5304	3275	4750	10378
6	11826	12028	12640	13588	11913	11523	8511	1951	1711	3021	1010	6191	11578
7	10885	11094	11719	12807	11234	11075	8194	2140	2194	3866	1327	5214	10629
8	10102	10325	10974	12276	10844	10957	8243	2832	3021	4606	1923	4323	9830
9	9463	9696	10365	11847	10539	10878	8319	3459	3717	5273	2581	3600	9177
10	8453	8689	9366	10964	9775	10363	8019	4066	4435	6286	3593	2604	8165
11	9272	9466	10067	11101	9579	9643	6972	2501	2947	5565	3012	3906	9037
12	8445	8621	9189	10093	8561	8714	6179	3002	3562	6541	4027	3517	8236
13	7588	7758	8318	9262	7815	8207	5914	3813	4398	7402	4850	3010	7389
14	5198	5249	5594	5901	4548	5762	4783	6709	7351	10715	8214	4257	5159
15	5947	5990	6309	6304	4679	5422	4110	6183	6830	10326	7904	4580	5915
16	6838	6875	7175	6894	5024	5186	3397	5591	6237	9876	7572	5040	6808
17	2924	2756	2657	2878	3118	6106	6921	10168	10809	14077	11498	6371	3168
18	3969	3844	3814	3225	2472	5098	5757	9334	9980	13399	10888	6256	4154
19	4600	4519	4579	3937	2637	4696	4980	8545	9192	12678	10211	5946	4729
20	5432	5401	5566	5017	3348	4547	4113	7452	8099	11654	9245	5536	5494
21	5963	5854	5824	4251	2128	3310	3815	8445	9086	12775	10459	6932	6117
22	6761	6706	6797	5557	3370	3449	2772	7228	7863	11616	9389	6547	6848
23	7614	7568	7674	6335	4023	3323	1920	6774	7392	11224	9124	6909	7686
24	7878	7884	8106	7275	5101	4464	2194	5574	6197	10016	7925	6191	7885
25	6079	6244	6805	7951	6757	7702	5969	5307	5903	8854	6243	2414	5888
26	4957	5150	5767	7398	6584	8054	6764	6481	7061	9804	7140	2006	4735
27	5348	5466	5941	6798	5601	6763	5433	6129	6754	9914	7345	3224	5224
28	5608	5844	6529	8453	7686	9062	7534	6197	6724	9112	6421	927	5324
29	6576	6826	7531	9484	8630	9793	7984	5657	6125	8209	5517	728	6271

To be continued on next page...

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DECIBEL - Main Result

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5

...continued from previous page

WTG	A	B	C	D	E	F	G	H	I	J	K	L	M
30	7289	7519	8188	9833	8754	9599	7529	4740	5209	7426	4735	1646	7010
31	4956	5212	5931	8157	7624	9279	8000	6986	7511	9819	7126	1124	4647
32	4047	4292	4998	7275	6901	8808	7852	7629	8186	10678	7987	2066	3759
33	7185	7487	8265	10801	10248	11643	9893	6869	7219	8457	5890	1682	6811
34	6206	6499	7268	9763	9256	10781	9220	6945	7371	9048	6402	838	5844
35	5383	5691	6479	9238	8970	10779	9503	7812	8265	10030	7381	1445	5002
36	4321	4628	5415	8253	8143	10177	9200	8311	8812	10866	8188	2025	3944
37	3847	4173	4979	8120	8262	10513	9752	9124	9627	11645	8974	2830	3441
38	9587	9890	10670	13109	12362	13387	11216	6673	6817	6906	4714	3866	9209
39	10348	10645	11416	13724	12859	13701	11372	6365	6433	6159	4128	4501	9978
40	2275	2060	1874	2905	3710	6823	7713	10765	11400	14567	11953	6559	2579
41	2906	3230	4036	7239	7537	9972	9487	9524	10061	12310	9622	3453	2505
42	2699	3041	3836	7426	8043	10680	10397	10538	11068	13213	10536	4368	2272
43	12750	12954	13567	14485	12768	12248	9164	2469	2006	2134	1192	7070	12499
44	6688	6779	7193	7493	5864	6282	4369	5038	5681	9126	6705	4013	6590
45	4929	4747	4541	2622	1232	4123	5416	9894	10540	14115	11689	7409	5175
46	4261	4041	3739	1926	1726	4936	6332	10553	11200	14683	12194	7525	4552
47	11162	11413	12112	13722	12409	12615	9890	4004	3952	3885	1531	5156	10851
48	4160	4169	4447	4838	3862	5763	5462	7901	8541	11843	9297	4720	4181
49	3191	3231	3597	4751	4317	6606	6469	8523	9151	12266	9654	4501	3187
50	2427	2436	2776	4325	4342	6963	7130	9326	9951	13007	10374	4967	2476
51	4046	4213	4795	6448	5821	7626	6753	7337	7936	10791	8135	2818	3864

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Calculated:
1.4.2022 13.00/3.5.576

DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5

Noise calculation model:
ISO 9613-2 Finland
Wind speed (in 10 m height):
8,0 m/s
Ground attenuation:
General, terrain specific
Ground factor for porous ground: 0,4
Area object with hard ground: Area object (Roughness): REGIONS_Katajamäen tuulivoimahanke_0.w2r (5)
Area type with hard ground: Vesistöt
Ground factor for hard ground: 0,0
Meteorological coefficient, C0:
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 tones penalty is added to total noise impact at receptors
Noise sensitive area
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
Uncertainty margin:
0,0 dB; Uncertainty margin in model has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)
Octave data required
Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89

WTG: NORDEX N163/6.8 HH218,5 6800 163.0 !O!
Noise: Noise

Source	Source/Date	Creator	Edited
FCG	7.3.2022	USER	8.3.2022 11.41

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data 63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	218,5	8,0	107,9	No	93,9	98,6	100,9	101,4	101,8	99,7	90,2	71,3

Noise sensitive area: A Lomarakennus A
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: B Asuinrakennus B
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: C Lomarakennus C
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

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Calculated:
1.4.2022 13.00/3.5.576

DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: D Asuinrakennus D

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: E Lomarakennus E

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: F Asuinrakennus F

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: G Asuinrakennus G

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: H Asuinrakennus H

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: I Asuinrakennus I

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: J Asuinrakennus J

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

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DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5

Noise sensitive area: K Lomarakennus K

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: L Lomarakennus L

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: M Lomarakennus M

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

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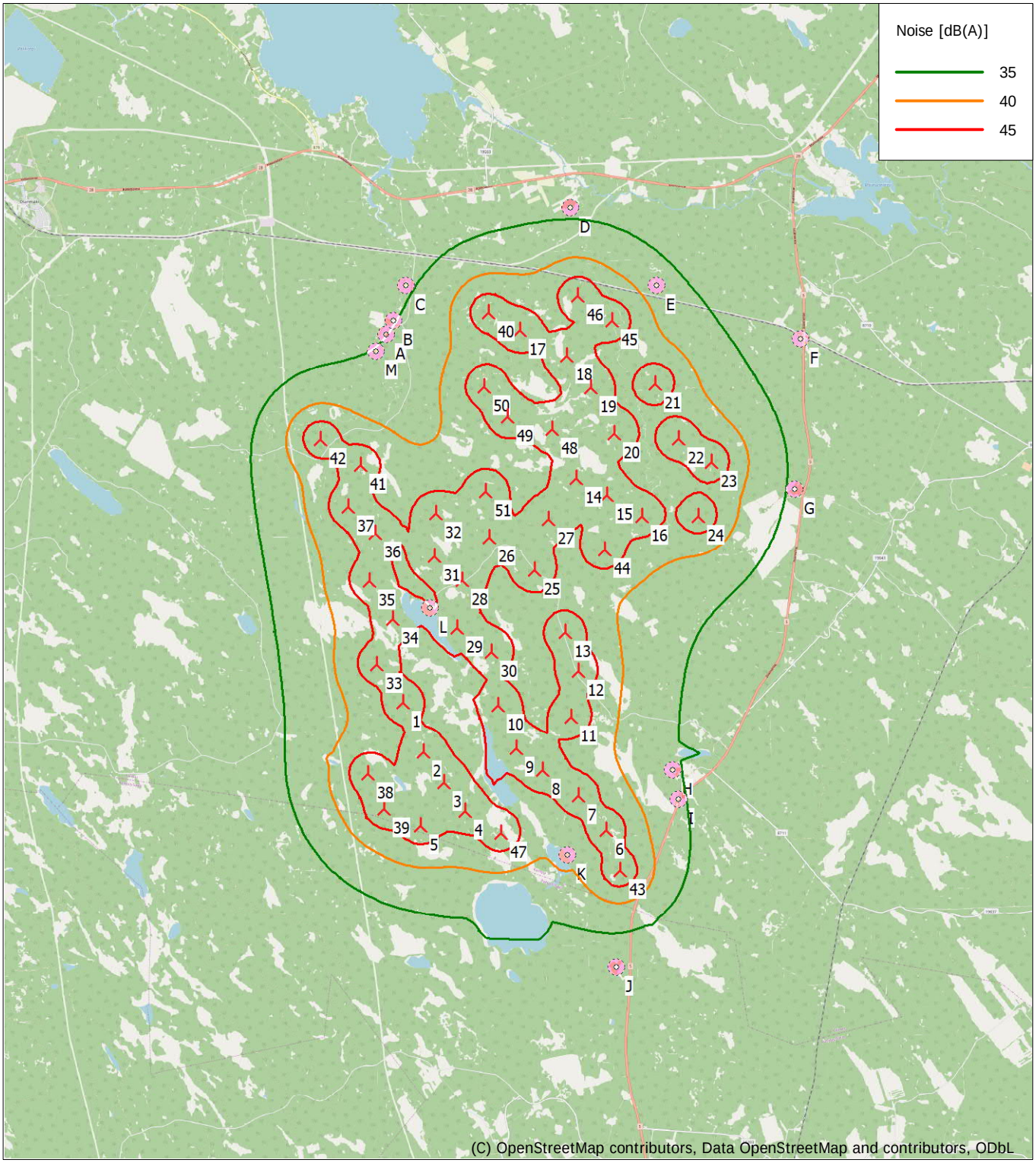
Calculated:
1.4.2022 13.00/3.5.576

DECIBEL - Map 8,0 m/s

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5



Map: EMD OpenStreetMap , Print scale 1:125 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 515 832 North: 7 100 946

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

Liite 2. Katajamäen tuulivoimahanke - Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2 /2014 (VE1) N163 – 6.8 MW. Yhteisvaikutukset Kivikankaan hankkeen kanssa.

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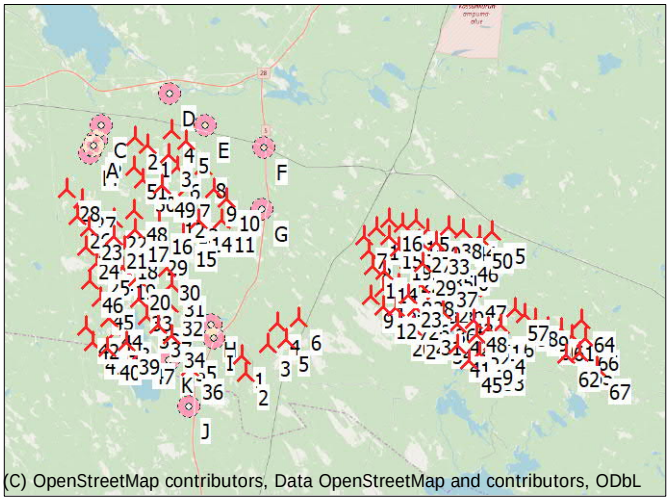
Calculated:
29.8.2022 10.50/3.5.584

DECIBEL - Main Result

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5_YV Kivikangas

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



Scale 1:400 000

New WTG Noise sensitive area

WTGs

	East	North	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Creator	Name	Wind speed [m/s]	LwA,ref [dB(A)]
1	513 394	7 098 322	187,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
2	513 847	7 097 251	182,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
3	514 288	7 096 590	175,3	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
4	514 763	7 095 958	167,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
5	513 785	7 095 645	173,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
6	517 845	7 095 564	168,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
7	517 226	7 096 320	171,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
8	516 462	7 096 860	173,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
9	515 866	7 097 332	169,4	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
10	515 475	7 098 267	165,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
11	517 075	7 098 024	179,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
12	517 213	7 099 034	197,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
13	516 931	7 099 863	197,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
14	517 144	7 103 226	166,6	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
15	517 816	7 102 875	160,3	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
16	518 583	7 102 417	152,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
17	515 909	7 106 459	164,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
18	516 931	7 105 901	145,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
19	517 446	7 105 214	147,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
20	517 980	7 104 206	148,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
21	518 858	7 105 305	145,9	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
22	519 364	7 104 099	155,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
23	520 088	7 103 598	172,3	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
24	519 817	7 102 420	156,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
25	516 239	7 101 210	190,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
26	515 249	7 101 935	174,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
27	516 534	7 102 343	177,2	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
28	514 670	7 100 997	170,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
29	514 555	7 099 960	171,1	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
30	515 309	7 099 437	168,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
31	514 070	7 101 510	162,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
32	514 093	7 102 453	153,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
33	512 819	7 099 163	178,6	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
34	513 168	7 100 143	162,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
35	512 646	7 100 974	160,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
36	512 778	7 102 030	157,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
37	512 181	7 102 585	153,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
38	512 622	7 096 766	187,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
39	512 989	7 095 998	185,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
40	515 210	7 106 831	164,9	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
41	512 447	7 103 491	147,2	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
42	511 576	7 104 046	147,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
43	518 144	7 094 686	176,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
44	517 771	7 101 673	167,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
45	517 906	7 106 667	137,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
46	517 160	7 107 206	142,3	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
47	515 539	7 095 480	162,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
48	516 610	7 104 302	158,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
49	515 639	7 104 571	165,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
50	515 136	7 105 219	160,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
51	515 171	7 102 940	162,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
52	520 945	7 095 256	175,8	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
53	521 095	7 094 331	164,6	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
54	522 355	7 095 878	172,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
55	522 755	7 097 057	176,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1

To be continued on next page...

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Calculated:
29.8.2022 10.50/3.5.584

DECIBEL - Main Result

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5_YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Noise data Creator	Name	Wind speed	LwA,ref
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]
56	523 237	7 096 145	170,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
57	523 951	7 097 319	165,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
58	527 400	7 101 633	174,1	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
59	527 645	7 100 906	176,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
60	527 745	7 098 481	187,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
61	527 847	7 100 086	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
62	528 041	7 102 119	164,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
63	528 395	7 097 931	187,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
64	528 420	7 098 881	177,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
65	528 496	7 099 831	177,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
66	528 704	7 101 642	170,3	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
67	528 710	7 102 595	162,3	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
68	529 120	7 097 906	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
69	529 181	7 099 074	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
70	529 211	7 101 016	183,6	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
71	529 320	7 097 006	192,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
72	529 393	7 102 332	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
73	529 727	7 100 356	205,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
74	529 779	7 098 556	172,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
75	530 031	7 096 928	171,8	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
76	530 120	7 102 556	174,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
77	530 192	7 097 881	182,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
78	530 249	7 101 446	190,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
79	530 402	7 099 101	206,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
80	530 470	7 100 256	185,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
81	530 749	7 102 088	177,1	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
82	530 845	7 097 081	167,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
83	531 170	7 098 806	195,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
84	531 199	7 101 417	177,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
85	531 442	7 096 615	167,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
86	531 445	7 100 556	184,3	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
87	531 595	7 097 706	177,8	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
88	531 620	7 099 681	192,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
89	531 848	7 102 200	181,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
90	531 995	7 098 644	192,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
91	532 195	7 100 506	177,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
92	532 370	7 095 881	167,3	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
93	532 373	7 097 087	172,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
94	532 519	7 098 005	172,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
95	532 627	7 102 078	185,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
96	532 995	7 095 106	166,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
97	532 752	7 101 003	186,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
98	533 198	7 098 953	173,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
99	533 270	7 097 281	170,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
100	533 563	7 095 498	170,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
101	533 473	7 101 697	197,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
102	534 002	7 096 854	195,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
103	533 383	7 096 525	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
104	534 153	7 095 289	171,6	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
105	534 246	7 096 135	174,8	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
106	534 129	7 101 976	207,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
107	534 691	7 096 987	186,2	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
108	535 406	7 097 920	183,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
109	535 963	7 097 629	190,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
110	536 487	7 097 358	208,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
111	537 145	7 096 906	218,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
112	537 870	7 096 856	208,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
113	538 185	7 095 540	187,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
114	538 465	7 096 494	193,2	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
115	538 995	7 097 356	197,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
116	538 846	7 095 554	189,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
117	539 204	7 096 413	190,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
118	539 802	7 094 885	187,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1

Calculation Results

Sound level

Noise sensitive area					Demands	Sound level			
No.	Name	East	North	Z	Immission height	Noise	From WTGs	Distance to noise demand	2 dB penalty applied for one or more WTGs
				[m]	[m]	[dB(A)]	[dB(A)]	[m]	
A	Lomarakennus A	512 987	7 106 346	135,0	4,0	40,0	34,9	1 402	No
B	Asuinrakennus B	513 159	7 106 642	134,7	4,0	40,0	34,9	1 218	No
C	Lomarakennus C	513 426	7 107 406	131,3	4,0	40,0	34,4	1 077	No
D	Asuinrakennus D	516 993	7 109 125	130,2	4,0	40,0	34,0	1 112	No
E	Lomarakennus E	518 871	7 107 433	147,5	4,0	40,0	37,6	368	No
F	Asuinrakennus F	522 013	7 106 307	152,5	4,0	40,0	31,8	2 374	No
G	Asuinrakennus G	521 923	7 103 034	185,7	4,0	40,0	34,8	1 063	No
H	Asuinrakennus H	519 294	7 096 871	217,3	4,0	40,0	36,8	957	No

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DECIBEL - Main Result

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5_YV Kivikangas

...continued from previous page

Noise sensitive area						Demands	Sound level		
No.	Name	East	North	Z	Immission height	Noise	From WTGs	Distance to noise demand	2 dB penalty applied for one or more WTGs
				[m]	[m]	[dB(A)]	[dB(A)]	[m]	
I	Asuinrakennus I	519 418	7 096 236	190,0	4,0	40,0	37,4	759	No
J	Asuinrakennus J	518 094	7 092 553	194,7	4,0	40,0	32,8	1 384	No
K	Lomarakennus K	516 998	7 095 013	155,3	4,0	40,0	40,8	-390	No
L	Lomarakennus L	513 968	7 100 391	157,5	4,0	40,0	44,9	-2 126	No
M	Lomarakennus M	512 778	7 105 974	135,0	4,0	40,0	35,2	1 427	No

Distances (m)

WTG	A	B	C	D	E	F	G	H	I	J	K	L	M
1	8034	8323	9084	11387	10631	11749	9744	6076	6375	7441	4893	2147	7677
2	9136	9416	10164	12284	11354	12194	9933	5460	5663	6333	3865	3142	8788
3	9842	10115	10850	12824	11772	12414	9991	5014	5142	5548	3135	3814	9505
4	10539	10804	11526	13355	12188	12636	10067	4622	4663	4763	2427	4504	10211
5	10731	11015	11766	13856	12838	13468	10992	5644	5664	5304	3275	4750	10378
6	11826	12028	12640	13588	11913	11523	8511	1951	1711	3021	1010	6191	11578
7	10885	11094	11719	12807	11234	11075	8194	2140	2194	3866	1327	5214	10629
8	10102	10325	10974	12276	10844	10957	8243	2832	3021	4606	1923	4323	9830
9	9463	9696	10365	11847	10539	10878	8319	3459	3717	5273	2581	3600	9177
10	8453	8689	9366	10964	9775	10363	8019	4066	4435	6286	3593	2604	8165
11	9272	9466	10067	11101	9579	9643	6972	2501	2947	5565	3012	3906	9037
12	8445	8621	9189	10093	8561	8714	6179	3002	3562	6541	4027	3517	8236
13	7588	7758	8318	9262	7815	8207	5914	3813	4398	7402	4850	3010	7389
14	5198	5249	5594	5901	4548	5762	4783	6709	7351	10715	8214	4257	5159
15	5947	5990	6309	6304	4679	5422	4110	6183	6830	10326	7904	4580	5915
16	6838	6875	7175	6894	5024	5186	3397	5591	6237	9876	7572	5040	6808
17	2924	2756	2657	2878	3118	6106	6921	10168	10809	14077	11498	6371	3168
18	3969	3844	3814	3225	2472	5098	5757	9334	9980	13399	10888	6256	4154
19	4600	4519	4579	3937	2637	4696	4980	8545	9192	12678	10211	5946	4729
20	5432	5401	5566	5017	3348	4547	4113	7452	8099	11654	9245	5536	5494
21	5963	5854	5824	4251	2128	3310	3815	8445	9086	12775	10459	6932	6117
22	6761	6706	6797	5557	3370	3449	2772	7228	7863	11616	9389	6547	6848
23	7614	7568	7674	6335	4023	3323	1920	6774	7392	11224	9124	6909	7686
24	7878	7884	8106	7275	5101	4464	2194	5574	6197	10016	7925	6191	7885
25	6079	6244	6805	7951	6757	7702	5969	5307	5903	8854	6243	2414	5888
26	4957	5150	5767	7398	6584	8054	6764	6481	7061	9804	7140	2006	4735
27	5348	5466	5941	6798	5601	6763	5433	6129	6754	9914	7345	3224	5224
28	5608	5844	6529	8453	7686	9062	7534	6197	6724	9112	6421	927	5324
29	6576	6826	7531	9484	8630	9793	7984	5657	6125	8209	5517	728	6271
30	7289	7519	8188	9833	8754	9599	7529	4740	5209	7426	4735	1646	7010
31	4956	5212	5931	8157	7624	9279	8000	6986	7511	9819	7126	1124	4647
32	4047	4292	4998	7275	6901	8808	7852	7629	8186	10678	7987	2066	3759
33	7185	7487	8265	10801	10248	11643	9893	6869	7219	8457	5890	1682	6811
34	6206	6499	7268	9763	9256	10781	9220	6945	7371	9048	6402	838	5844
35	5383	5691	6479	9238	8970	10779	9503	7812	8265	10030	7381	1445	5002
36	4321	4628	5415	8253	8143	10177	9200	8311	8812	10866	8188	2025	3944
37	3847	4173	4979	8120	8262	10513	9752	9124	9627	11645	8974	2830	3441
38	9587	9890	10670	13109	12362	13387	11216	6673	6817	6906	4714	3866	9209
39	10348	10645	11416	13724	12859	13701	11372	6365	6433	6159	4128	4501	9978
40	2275	2060	1874	2905	3710	6823	7713	10765	11400	14567	11953	6559	2579
41	2906	3230	4036	7239	7537	9972	9487	9524	10061	12310	9622	3453	2505
42	2699	3041	3836	7426	8043	10680	10397	10538	11068	13213	10536	4368	2272
43	12750	12954	13567	14485	12768	12248	9164	2469	2006	2134	1192	7070	12499
44	6688	6779	7193	7493	5864	6282	4369	5038	5681	9126	6705	4013	6590
45	4929	4747	4541	2622	1232	4123	5416	9894	10540	14115	11689	7409	5175
46	4261	4041	3739	1926	1726	4936	6332	10553	11200	14683	12194	7525	4552
47	11162	11413	12112	13722	12409	12615	9890	4004	3952	3885	1531	5156	10851
48	4160	4169	4447	4838	3862	5763	5462	7901	8541	11843	9297	4720	4181
49	3191	3231	3597	4751	4317	6606	6469	8523	9151	12266	9654	4501	3187
50	2427	2436	2776	4325	4342	6963	7130	9326	9951	13007	10374	4967	2476
51	4046	4213	4795	6448	5821	7626	6753	7337	7936	10791	8135	2818	3864
52	13650	13794	14288	14421	12352	11102	7839	2310	1814	3929	3954	8663	13475
53	14495	14647	15158	15352	13289	12011	8742	3114	2538	3488	4153	9355	14308

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Calculated:
29.8.2022 10.50/3.5.584

DECIBEL - Main Result

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5_YV Kivikangas

...continued from previous page

WTG	A	B	C	D	E	F	G	H	I	J	K	L	M
54	14047	14157	14581	14291	12069	10435	7169	3218	2958	5404	5426	9524	13915
55	13480	13563	13933	13373	11079	9280	6035	3466	3436	6482	6109	9398	13381
56	14461	14551	14935	14404	12103	10235	7013	4009	3820	6273	6340	10195	14352
57	14202	14261	14578	13704	11318	9195	6064	4679	4661	7551	7326	10445	14133
58	15164	15097	15120	12823	10315	7132	5654	9402	9636	13002	12330	13490	15253
59	15635	15580	15634	13454	10935	7803	6105	9275	9460	12688	12169	13687	15707
60	16723	16714	16873	15129	12605	9701	7391	8603	8624	11326	11293	13909	16738
61	16125	16085	16172	14125	11599	8529	6617	9137	9267	12323	11976	13882	16178
62	15636	15554	15542	13082	10598	7340	6186	10201	10439	13800	13132	14179	15742
63	17556	17550	17716	15978	13453	10530	8242	9163	9136	11620	11765	14635	17566
64	17144	17121	17248	15347	12819	9808	7711	9345	9383	12111	12059	14531	17175
65	16822	16781	16867	14788	12265	9163	7312	9666	9764	12695	12467	14539	16876
66	16406	16329	16329	13898	11412	8157	6922	10550	10745	13971	13453	14789	16505
67	16164	16069	16023	13414	10964	7657	6801	11019	11260	14613	13952	14906	16286
68	18207	18195	18345	16521	13993	11004	8837	9880	9845	12257	12462	15354	18225
69	17752	17719	17823	15798	13273	10183	8268	10129	10167	12863	12842	15270	17795
70	17077	17009	17029	14664	12169	8933	7562	10748	10897	13972	13609	15256	17165
71	18815	18816	18994	17287	14762	11828	9542	10027	9932	12077	12482	15721	18817
72	16890	16796	16754	14139	11693	8382	7503	11481	11690	14943	14395	15547	17009
73	17779	17720	17760	15461	12959	9743	8251	11000	11102	14008	13805	15759	17856
74	18511	18483	18594	16589	14064	10972	9043	10620	10618	13137	13263	15917	18549
75	19473	19469	19635	17854	15326	12339	10150	10737	10636	12713	13173	16432	19481
76	17547	17446	17384	14679	12261	8933	8211	12228	12429	15642	15136	16296	17676
77	19175	19154	19283	17339	14812	11743	9743	10945	10899	13219	13502	16417	19203
78	17944	17862	17848	15320	12857	9564	8476	11872	12019	15061	14730	16315	18048
79	18862	18820	18899	16742	14226	11059	9347	11330	11351	13941	14014	16485	18917
80	18513	18451	18483	16133	13640	10399	8987	11677	11760	14577	14456	16503	18593
81	18265	18170	18121	15451	13025	9701	8877	12587	12753	15845	15464	16867	18386
82	20118	20105	20249	18356	15828	12772	10726	11553	11458	13531	14001	17199	20137
83	19684	19642	19718	17535	15023	11837	10168	12033	12030	14494	14671	17275	19739
84	18867	18781	18755	16162	13718	10406	9416	12743	12870	15821	15578	17262	18976
85	20863	20852	21001	19112	16585	13522	11481	12151	12030	13952	14533	17877	20879
86	19345	19272	19277	16801	14332	11047	9839	12697	12779	15566	15474	17478	19437
87	20516	20488	20596	18537	16016	12876	11042	12329	12265	14451	14843	17830	20553
88	19789	19730	19766	17411	14921	11670	10260	12642	12679	15289	15349	17666	19865
89	19311	19210	19143	16390	13992	10658	9960	13638	13787	16800	16498	17971	19440
90	20509	20464	20532	18301	15795	12584	10987	12824	12805	15177	15430	18111	20568
91	20076	20000	19997	17475	15017	11719	10579	13403	13472	16189	16159	18227	20172
92	22028	22020	22174	20294	17767	14696	12661	13113	12957	14659	15396	18947	22039
93	21484	21459	21575	19531	17010	13869	12024	13081	12983	14982	15514	18699	21516
94	21239	21200	21282	19098	16588	13390	11729	13274	13220	15422	15807	18704	21289
95	20098	19996	19926	17149	14761	11425	10746	14314	14443	17376	17152	18735	20228
96	22949	22947	23114	21274	18747	15687	13618	13814	13624	15118	15997	19747	22953
97	20474	20388	20359	17729	15298	11977	11018	14078	14160	16919	16854	18794	20583
98	21521	21464	21503	19133	16649	13386	11991	14059	14046	16404	16673	19284	21593
99	22217	22183	22278	20130	17618	14429	12722	13982	13891	15895	16429	19551	22260
100	23260	23248	23394	21453	18928	15818	13866	14334	14164	15747	16572	20196	23275
101	21006	20907	20844	18076	15688	12352	11627	14977	15078	17892	17779	19548	21132
102	23059	23027	23124	20973	18462	15267	13568	14708	14597	16479	17103	20344	23100
103	22637	22613	22731	20673	18154	14999	13179	14093	13968	15797	16455	19796	22668
104	23880	23867	24009	22043	19520	16394	14476	14943	14765	16290	17157	20820	23897
105	23584	23560	23675	21596	19080	15910	14123	14970	14828	16544	17284	20720	23615
106	21589	21483	21404	18568	16205	12867	12252	15689	15791	18599	18492	20223	21722
107	23636	23598	23680	21460	18958	15735	14128	15397	15291	17179	17803	21001	23684
108	23950	23896	23940	21554	19076	15802	14420	16146	16077	18125	18636	21580	24019
109	24574	24520	24566	22181	19704	16429	15044	16686	16603	18575	19144	22167	24641
110	25160	25108	25155	22770	20294	17017	15631	17200	17106	19010	19630	22722	25226
111	25937	25887	25939	23567	21089	17814	16409	17851	17740	19542	20236	23438	26000
112	26631	26578	26624	24215	21745	18460	17102	18576	18462	20239	20953	24162	26697
113	27418	27378	27456	25173	22683	19429	17906	18938	18780	20312	21194	24699	27467
114	27316	27265	27313	24912	22441	19156	17788	19175	19049	20749	21518	24805	27381
115	27518	27454	27473	24952	22506	19197	17991	19707	19609	21446	22121	25210	27597
116	28020	27978	28047	25724	23240	19974	18502	19596	19439	20967	21854	25343	28073
117	28036	27982	28024	25591	23127	19835	18506	19915	19787	21460	22250	25548	28102
118	29161	29121	29197	26889	24404	21140	19648	20604	20428	21833	22804	26414	29210

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Calculated:
29.8.2022 10.50/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5_YV Kivikangas

Noise calculation model:
ISO 9613-2 Finland
Wind speed (in 10 m height):
8,0 m/s
Ground attenuation:
General, terrain specific
Ground factor for porous ground: 0,4
Area object with hard ground: Area object (Roughness): REGIONS_Katajamäen tuulivoimahanke_0.w2r (5)
Area type with hard ground: Vesistöt
Ground factor for hard ground: 0,0
Meteorological coefficient, C0:
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 tones penalty is added to total noise impact at receptors
Noise sensitive area
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
Uncertainty margin:
0,0 dB; Uncertainty margin in model has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)
Octave data required
Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89

WTG: NORDEX N163/6.8 HH218,5 6800 163.0 !O!
Noise: Noise

Source	Source/Date	Creator	Edited
FCG	7.3.2022	USER	8.3.2022 11.41

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data 63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	218,5	8,0	107,9	No	93,9	98,6	100,9	101,4	101,8	99,7	90,2	71,3

WTG: Generic RD200 HH200 109.1dB 10000 200.0 !O!
Noise: Generic RD200 HH200 107.1 dB

Source	Source/Date	Creator	Edited
Generic	7.4.2021	USER	26.8.2022 12.13

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data 63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	200,0	8,0	109,1	No	87,3	95,7	101,6	104,5	103,8	99,6	92,6	82,9

Noise sensitive area: A Lomarakennus A

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

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DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5_YV Kivikangas

Noise sensitive area: B Asuinrakennus B
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: C Lomarakennus C
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: D Asuinrakennus D
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: E Lomarakennus E
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: F Asuinrakennus F
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: G Asuinrakennus G
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: H Asuinrakennus H
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: I Asuinrakennus I
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

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DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5_YV Kivikangas

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: J Asuinrakennus J

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: K Lomarakennus K

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: L Lomarakennus L

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: M Lomarakennus M

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

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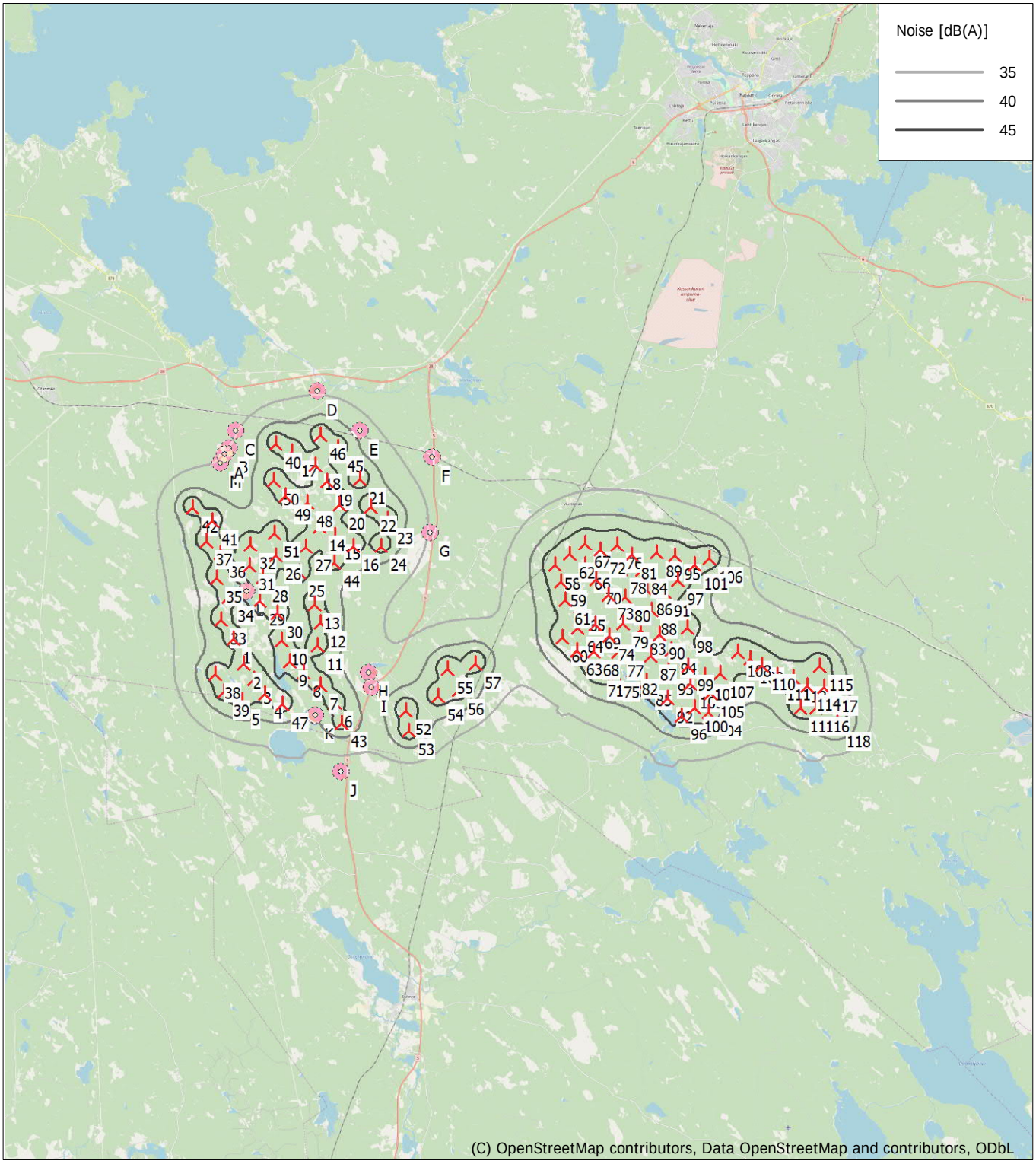
Calculated:
29.8.2022 10.50/3.5.584

DECIBEL - Map 8,0 m/s

Calculation: Katajamäki VE1_N163-6.8MWx51xHH218,5_YV Kivikangas



Map: EMD OpenStreetMap , Print scale 1:250 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 525 689 North: 7 100 768

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

Liite 3. Katajamäen tuulivoimahanke - Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2 /2014 (VE2) N163 - 6.8 MW.

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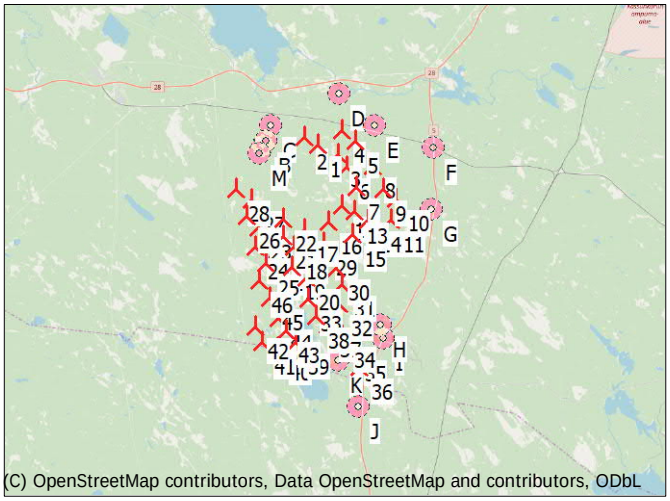
Calculated:
1.4.2022 13.27/3.5.576

DECIBEL - Main Result

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5

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



Scale 1:400 000

New WTG Noise sensitive area

WTGs

	East	North	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Creator	Name	Wind speed [m/s]	LwA,ref [dB(A)]
1	513 394	7 098 322	187,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
2	513 847	7 097 251	182,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
3	514 288	7 096 590	175,3	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
4	514 763	7 095 958	167,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
5	513 785	7 095 645	173,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
6	517 845	7 095 564	168,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
7	517 226	7 096 320	171,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
8	516 462	7 096 860	173,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
9	515 866	7 097 332	169,4	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
10	515 475	7 098 267	165,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
11	517 075	7 098 024	179,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
12	517 213	7 099 034	197,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
13	516 931	7 099 863	197,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
14	517 144	7 103 226	166,6	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
15	517 816	7 102 875	160,3	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
16	518 583	7 102 417	152,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
17	515 909	7 106 459	164,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
18	516 931	7 105 901	145,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
19	517 446	7 105 214	147,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
20	517 980	7 104 206	148,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
21	518 858	7 105 305	145,9	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
22	519 364	7 104 099	155,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
23	520 088	7 103 598	172,3	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
24	519 817	7 102 420	156,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
25	516 239	7 101 210	190,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
26	515 249	7 101 935	174,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
27	516 534	7 102 343	177,2	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
28	514 670	7 100 997	170,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
29	514 555	7 099 960	171,1	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
30	515 309	7 099 437	168,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
31	514 070	7 101 510	162,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
32	514 093	7 102 453	153,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
33	512 819	7 099 163	178,6	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
34	513 168	7 100 143	162,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
35	512 646	7 100 974	160,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
36	512 778	7 102 030	157,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
37	512 181	7 102 585	153,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
38	512 622	7 096 766	187,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
39	512 989	7 095 998	185,0	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
40	515 210	7 106 831	164,9	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
41	512 447	7 103 491	147,2	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
42	511 576	7 104 046	147,5	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
43	518 144	7 094 686	176,7	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9

To be continued on next page...

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Calculated:
1.4.2022 13.27/3.5.576

DECIBEL - Main Result

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Noise data Creator	Name	Wind speed	LwA,ref
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]
44	517 771	7 101 673	167,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
45	517 906	7 106 667	137,8	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
46	517 160	7 107 206	142,3	NORDEX N163/6.8 HH...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9

Calculation Results

Sound level

Noise sensitive area No.	Name	East	North	Z	Immission height	Demands Noise	Sound level From WTGs	Distance to noise demand	2 dB penalty applied for one or more WTGs
				[m]	[m]	[dB(A)]	[dB(A)]	[m]	
A	Lomarakennus A	512 987	7 106 346	135,0	4,0	40,0	33,7	1 512	No
B	Asuinrakennus B	513 159	7 106 642	134,7	4,0	40,0	33,7	1 304	No
C	Lomarakennus C	513 426	7 107 406	131,3	4,0	40,0	33,4	1 133	No
D	Asuinrakennus D	516 993	7 109 125	130,2	4,0	40,0	33,5	1 132	No
E	Lomarakennus E	518 871	7 107 433	147,5	4,0	40,0	37,3	391	No
F	Asuinrakennus F	522 013	7 106 307	152,5	4,0	40,0	30,9	2 404	No
G	Asuinrakennus G	521 923	7 103 034	185,7	4,0	40,0	34,1	1 087	No
H	Asuinrakennus H	519 294	7 096 871	217,3	4,0	40,0	35,4	1 028	No
I	Asuinrakennus I	519 418	7 096 236	190,0	4,0	40,0	35,5	836	No
J	Asuinrakennus J	518 094	7 092 553	194,7	4,0	40,0	31,6	1 413	No
K	Lomarakennus K	516 998	7 095 013	155,3	4,0	40,0	40,2	-230	No
L	Lomarakennus L	513 968	7 100 391	157,5	4,0	40,0	44,9	-2 106	No
M	Lomarakennus M	512 778	7 105 974	135,0	4,0	40,0	34,1	1 462	No

Distances (m)

WTG	A	B	C	D	E	F	G	H	I	J	K	L	M
1	8034	8323	9084	11387	10631	11749	9744	6076	6375	7441	4893	2147	7677
2	9136	9416	10164	12284	11354	12194	9933	5460	5663	6333	3865	3142	8788
3	9842	10115	10850	12824	11772	12414	9991	5014	5142	5548	3135	3814	9505
4	10539	10804	11526	13355	12188	12636	10067	4622	4663	4763	2427	4504	10211
5	10731	11015	11766	13856	12838	13468	10992	5644	5664	5304	3275	4750	10378
6	11826	12028	12640	13588	11913	11523	8511	1951	1711	3021	1010	6191	11578
7	10885	11094	11719	12807	11234	11075	8194	2140	2194	3866	1327	5214	10629
8	10102	10325	10974	12276	10844	10957	8243	2832	3021	4606	1923	4323	9830
9	9463	9696	10365	11847	10539	10878	8319	3459	3717	5273	2581	3600	9177
10	8453	8689	9366	10964	9775	10363	8019	4066	4435	6286	3593	2604	8165
11	9272	9466	10067	11101	9579	9643	6972	2501	2947	5565	3012	3906	9037
12	8445	8621	9189	10093	8561	8714	6179	3002	3562	6541	4027	3517	8236
13	7588	7758	8318	9262	7815	8207	5914	3813	4398	7402	4850	3010	7389
14	5198	5249	5594	5901	4548	5762	4783	6709	7351	10715	8214	4257	5159
15	5947	5990	6309	6304	4679	5422	4110	6183	6830	10326	7904	4580	5915
16	6838	6875	7175	6894	5024	5186	3397	5591	6237	9876	7572	5040	6808
17	2924	2756	2657	2878	3118	6106	6921	10168	10809	14077	11498	6371	3168
18	3969	3844	3814	3225	2472	5098	5757	9334	9980	13399	10888	6256	4154
19	4600	4519	4579	3937	2637	4696	4980	8545	9192	12678	10211	5946	4729
20	5432	5401	5566	5017	3348	4547	4113	7452	8099	11654	9245	5536	5494
21	5963	5854	5824	4251	2128	3310	3815	8445	9086	12775	10459	6932	6117
22	6761	6706	6797	5557	3370	3449	2772	7228	7863	11616	9389	6547	6848
23	7614	7568	7674	6335	4023	3323	1920	6774	7392	11224	9124	6909	7686
24	7878	7884	8106	7275	5101	4464	2194	5574	6197	10016	7925	6191	7885
25	6079	6244	6805	7951	6757	7702	5969	5307	5903	8854	6243	2414	5888
26	4957	5150	5767	7398	6584	8054	6764	6481	7061	9804	7140	2006	4735
27	5348	5466	5941	6798	5601	6763	5433	6129	6754	9914	7345	3224	5224
28	5608	5844	6529	8453	7686	9062	7534	6197	6724	9112	6421	927	5324
29	6576	6826	7531	9484	8630	9793	7984	5657	6125	8209	5517	728	6271
30	7289	7519	8188	9833	8754	9599	7529	4740	5209	7426	4735	1646	7010
31	4956	5212	5931	8157	7624	9279	8000	6986	7511	9819	7126	1124	4647
32	4047	4292	4998	7275	6901	8808	7852	7629	8186	10678	7987	2066	3759
33	7185	7487	8265	10801	10248	11643	9893	6869	7219	8457	5890	1682	6811
34	6206	6499	7268	9763	9256	10781	9220	6945	7371	9048	6402	838	5844

To be continued on next page...

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DECIBEL - Main Result

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5

...continued from previous page

WTG	A	B	C	D	E	F	G	H	I	J	K	L	M
35	5383	5691	6479	9238	8970	10779	9503	7812	8265	10030	7381	1445	5002
36	4321	4628	5415	8253	8143	10177	9200	8311	8812	10866	8188	2025	3944
37	3847	4173	4979	8120	8262	10513	9752	9124	9627	11645	8974	2830	3441
38	9587	9890	10670	13109	12362	13387	11216	6673	6817	6906	4714	3866	9209
39	10348	10645	11416	13724	12859	13701	11372	6365	6433	6159	4128	4501	9978
40	2275	2060	1874	2905	3710	6823	7713	10765	11400	14567	11953	6559	2579
41	2906	3230	4036	7239	7537	9972	9487	9524	10061	12310	9622	3453	2505
42	2699	3041	3836	7426	8043	10680	10397	10538	11068	13213	10536	4368	2272
43	12750	12954	13567	14485	12768	12248	9164	2469	2006	2134	1192	7070	12499
44	6688	6779	7193	7493	5864	6282	4369	5038	5681	9126	6705	4013	6590
45	4929	4747	4541	2622	1232	4123	5416	9894	10540	14115	11689	7409	5175
46	4261	4041	3739	1926	1726	4936	6332	10553	11200	14683	12194	7525	4552

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Calculated:
1.4.2022 13.27/3.5.576

DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5

Noise calculation model:
ISO 9613-2 Finland
Wind speed (in 10 m height):
8,0 m/s
Ground attenuation:
General, terrain specific
Ground factor for porous ground: 0,4
Area object with hard ground: Area object (Roughness): REGIONS_Katajamäen tuulivoimahanke_0.w2r (5)
Area type with hard ground: Vesistöt
Ground factor for hard ground: 0,0
Meteorological coefficient, C0:
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 tones penalty is added to total noise impact at receptors
Noise sensitive area
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
Uncertainty margin:
0,0 dB; Uncertainty margin in NSA has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)
Octave data required
Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89

WTG: NORDEX N163/6.8 HH218,5 6800 163.0 !O!

Noise: Noise

Source	Source/Date	Creator	Edited
FCG	7.3.2022	USER	8.3.2022 11.41

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	Octave data 63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	218,5	8,0	107,9	No	93,9	98,6	100,9	101,4	101,8	99,7	90,2	71,3

Noise sensitive area: A Lomarakennus A

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: B Asuinrakennus B

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: C Lomarakennus C

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

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DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: D Asuinrakennus D

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: E Lomarakennus E

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: F Asuinrakennus F

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: G Asuinrakennus G

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: H Asuinrakennus H

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: I Asuinrakennus I

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: J Asuinrakennus J

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

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Calculated:
1.4.2022 13.27/3.5.576

DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5

Noise sensitive area: K Lomarakennus K

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: L Lomarakennus L

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: M Lomarakennus M

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

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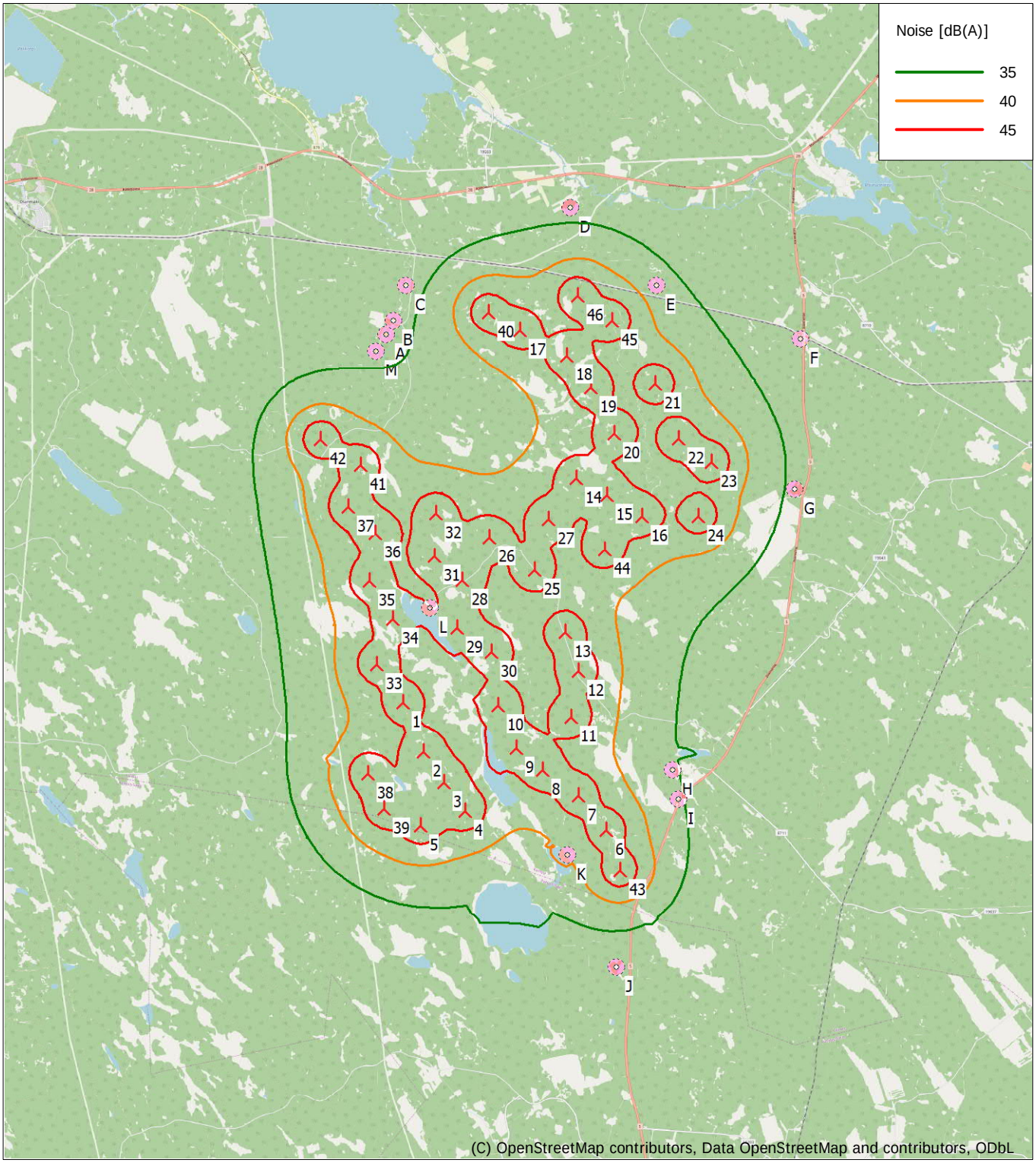
Calculated:
1.4.2022 13.27/3.5.576

DECIBEL - Map 8,0 m/s

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5



0 2,5 5 7,5 10km

Map: EMD OpenStreetMap , Print scale 1:125 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 515 832 North: 7 100 946

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

Liite 4. Katajamäen tuulivoimahanke - Melun leviämismallinnuksen tulokset ISO 9613-2, YM 2 /2014 (VE2) N163 - 6.8 MW. Yhteisvaikutukset Kivikankaan hankkeen kanssa.

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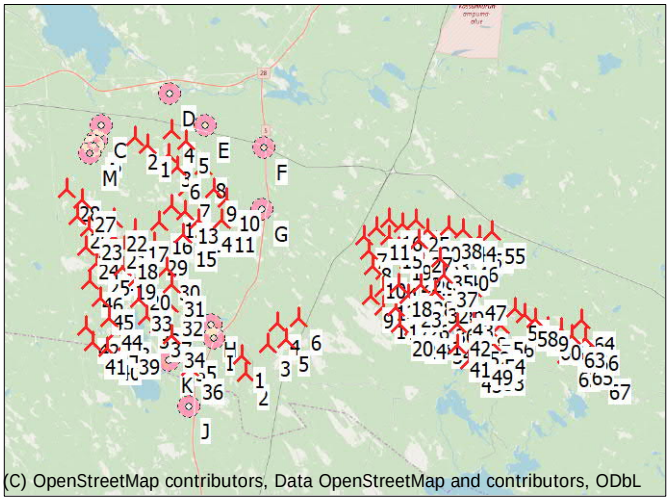
Calculated:
29.8.2022 10.27/3.5.584

DECIBEL - Main Result

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5_YV Kivikangas

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



Scale 1:400 000

New WTG Noise sensitive area

WTGs

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Noise data Rotor diameter	Hub height	Creator	Name	Wind speed	LwA,ref
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]
1	513 394	7 098 322	187,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
2	513 847	7 097 251	182,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
3	514 288	7 096 590	175,3	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
4	514 763	7 095 958	167,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
5	513 785	7 095 645	173,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
6	517 845	7 095 564	168,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
7	517 226	7 096 320	171,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
8	516 462	7 096 860	173,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
9	515 866	7 097 332	169,4	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
10	515 475	7 098 267	165,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
11	517 075	7 098 024	179,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
12	517 213	7 099 034	197,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
13	516 931	7 099 863	197,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
14	517 144	7 103 226	166,6	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
15	517 816	7 102 875	160,3	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
16	518 583	7 102 417	152,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
17	515 909	7 106 459	164,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
18	516 931	7 105 901	145,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
19	517 446	7 105 214	147,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
20	517 980	7 104 206	148,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
21	518 858	7 105 305	145,9	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
22	519 364	7 104 099	155,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
23	520 088	7 103 598	172,3	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
24	519 817	7 102 420	156,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
25	516 239	7 101 210	190,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
26	515 249	7 101 935	174,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
27	516 534	7 102 343	177,2	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
28	514 670	7 100 997	170,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
29	514 555	7 099 960	171,1	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
30	515 309	7 099 437	168,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
31	514 070	7 101 510	162,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
32	514 093	7 102 453	153,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
33	512 819	7 099 163	178,6	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
34	513 168	7 100 143	162,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
35	512 646	7 100 974	160,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
36	512 778	7 102 030	157,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
37	512 181	7 102 585	153,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
38	512 622	7 096 766	187,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
39	512 989	7 095 998	185,0	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
40	515 210	7 106 831	164,9	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
41	512 447	7 103 491	147,2	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
42	511 576	7 104 046	147,5	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
43	518 144	7 094 686	176,7	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
44	517 771	7 101 673	167,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
45	517 906	7 106 667	137,8	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
46	517 160	7 107 206	142,3	NORDEX N163/6.8 HH218,5 ...	Yes	NORDEX	N163/6.8 HH218,5-6 800	6 800	163,0	218,5	USER	Noise	8,0	107,9
47	520 945	7 095 256	175,8	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
48	521 095	7 094 331	164,6	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
49	522 355	7 095 878	172,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
50	522 755	7 097 057	176,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
51	523 237	7 096 145	170,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
52	523 951	7 097 319	165,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
53	527 400	7 101 633	174,1	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
54	527 645	7 100 906	176,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
55	527 745	7 098 481	187,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1

To be continued on next page...

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29.8.2022 10.27/3.5.584

DECIBEL - Main Result

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5_YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Noise data Creator	Name	Wind speed	LwA,ref
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]
56	527 847	7 100 086	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
57	528 041	7 102 119	164,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
58	528 395	7 097 931	187,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
59	528 420	7 098 881	177,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
60	528 496	7 099 831	177,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
61	528 704	7 101 642	170,3	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
62	528 710	7 102 595	162,3	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
63	529 120	7 097 906	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
64	529 181	7 099 074	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
65	529 211	7 101 016	183,6	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
66	529 320	7 097 006	192,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
67	529 393	7 102 332	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
68	529 727	7 100 356	205,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
69	529 779	7 098 556	172,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
70	530 031	7 096 928	171,8	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
71	530 120	7 102 556	174,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
72	530 192	7 097 881	182,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
73	530 249	7 101 446	190,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
74	530 402	7 099 101	206,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
75	530 470	7 100 256	185,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
76	530 749	7 102 088	177,1	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
77	530 845	7 097 081	167,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
78	531 170	7 098 806	195,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
79	531 199	7 101 417	177,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
80	531 442	7 096 615	167,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
81	531 445	7 100 556	184,3	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
82	531 595	7 097 706	177,8	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
83	531 620	7 099 681	192,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
84	531 848	7 102 200	181,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
85	531 995	7 098 644	192,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
86	532 195	7 100 506	177,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
87	532 370	7 095 881	167,3	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
88	532 373	7 097 087	172,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
89	532 519	7 098 005	172,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
90	532 627	7 102 078	185,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
91	532 995	7 095 106	166,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
92	532 752	7 101 003	186,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
93	533 198	7 098 953	173,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
94	533 270	7 097 281	170,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
95	533 563	7 095 498	170,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
96	533 473	7 101 697	197,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
97	534 002	7 096 854	195,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
98	533 383	7 096 525	175,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
99	534 153	7 095 289	171,6	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
100	534 246	7 096 135	174,8	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
101	534 129	7 101 976	207,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
102	534 691	7 096 987	186,2	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
103	535 406	7 097 920	183,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
104	535 963	7 097 629	190,0	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
105	536 487	7 097 358	208,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
106	537 145	7 096 906	218,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
107	537 870	7 096 856	208,4	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
108	538 185	7 095 540	187,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
109	538 465	7 096 494	193,2	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
110	538 995	7 097 356	197,5	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
111	538 846	7 095 554	189,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
112	539 204	7 096 413	190,7	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1
113	539 802	7 094 885	187,9	Generic RD200 HH200 109.1...	Yes	Generic	RD200 HH200 109.1dB-10 000	10 000	200,0	200,0	USER	Generic RD200 HH200 107.1 dB	8,0	109,1

Calculation Results

Sound level

Noise sensitive area No.	Name	East	North	Z	Immission height	Demands Noise	Sound level From WTGs	Distance to noise demand	2 dB penalty applied for one or more WTGs
				[m]	[m]	[dB(A)]	[dB(A)]	[m]	
A	Lomarakennus A	512 987	7 106 346	135,0	4,0	40,0	33,8	1 513	No
B	Asuinrakennus B	513 159	7 106 642	134,7	4,0	40,0	33,8	1 301	No
C	Lomarakennus C	513 426	7 107 406	131,3	4,0	40,0	33,5	1 132	No
D	Asuinrakennus D	516 993	7 109 125	130,2	4,0	40,0	33,6	1 131	No
E	Lomarakennus E	518 871	7 107 433	147,5	4,0	40,0	37,4	387	No
F	Asuinrakennus F	522 013	7 106 307	152,5	4,0	40,0	31,6	2 392	No
G	Asuinrakennus G	521 923	7 103 034	185,7	4,0	40,0	34,6	1 074	No
H	Asuinrakennus H	519 294	7 096 871	217,3	4,0	40,0	36,7	975	No
I	Asuinrakennus I	519 418	7 096 236	190,0	4,0	40,0	37,3	774	No
J	Asuinrakennus J	518 094	7 092 553	194,7	4,0	40,0	32,5	1 393	No
K	Lomarakennus K	516 998	7 095 013	155,3	4,0	40,0	40,3	-286	No

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Calculated:
29.8.2022 10.27/3.5.584

DECIBEL - Main Result

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5_YV Kivikangas

...continued from previous page

Noise sensitive area						Demands	Sound level			
No.	Name	East	North	Z	Immission height	Noise	From WTGs	Distance to noise demand		2 dB penalty applied for one or more WTGs
				[m]	[m]	[dB(A)]	[dB(A)]	[m]		
L	Lomarakennus L	513 968	7 100 391	157,5	4,0	40,0	44,9		-2 111	No
M	Lomarakennus M	512 778	7 105 974	135,0	4,0	40,0	34,2		1 459	No

Distances (m)

WTG	A	B	C	D	E	F	G	H	I	J	K	L	M
1	8034	8323	9084	11387	10631	11749	9744	6076	6375	7441	4893	2147	7677
2	9136	9416	10164	12284	11354	12194	9933	5460	5663	6333	3865	3142	8788
3	9842	10115	10850	12824	11772	12414	9991	5014	5142	5548	3135	3814	9505
4	10539	10804	11526	13355	12188	12636	10067	4622	4663	4763	2427	4504	10211
5	10731	11015	11766	13856	12838	13468	10992	5644	5664	5304	3275	4750	10378
6	11826	12028	12640	13588	11913	11523	8511	1951	1711	3021	1010	6191	11578
7	10885	11094	11719	12807	11234	11075	8194	2140	2194	3866	1327	5214	10629
8	10102	10325	10974	12276	10844	10957	8243	2832	3021	4606	1923	4323	9830
9	9463	9696	10365	11847	10539	10878	8319	3459	3717	5273	2581	3600	9177
10	8453	8689	9366	10964	9775	10363	8019	4066	4435	6286	3593	2604	8165
11	9272	9466	10067	11101	9579	9643	6972	2501	2947	5565	3012	3906	9037
12	8445	8621	9189	10093	8561	8714	6179	3002	3562	6541	4027	3517	8236
13	7588	7758	8318	9262	7815	8207	5914	3813	4398	7402	4850	3010	7389
14	5198	5249	5594	5901	4548	5762	4783	6709	7351	10715	8214	4257	5159
15	5947	5990	6309	6304	4679	5422	4110	6183	6830	10326	7904	4580	5915
16	6838	6875	7175	6894	5024	5186	3397	5591	6237	9876	7572	5040	6808
17	2924	2756	2657	2878	3118	6106	6921	10168	10809	14077	11498	6371	3168
18	3969	3844	3814	3225	2472	5098	5757	9334	9980	13399	10888	6256	4154
19	4600	4519	4579	3937	2637	4696	4980	8545	9192	12678	10211	5946	4729
20	5432	5401	5566	5017	3348	4547	4113	7452	8099	11654	9245	5536	5494
21	5963	5854	5824	4251	2128	3310	3815	8445	9086	12775	10459	6932	6117
22	6761	6706	6797	5557	3370	3449	2772	7228	7863	11616	9389	6547	6848
23	7614	7568	7674	6335	4023	3323	1920	6774	7392	11224	9124	6909	7686
24	7878	7884	8106	7275	5101	4464	2194	5574	6197	10016	7925	6191	7885
25	6079	6244	6805	7951	6757	7702	5969	5307	5903	8854	6243	2414	5888
26	4957	5150	5767	7398	6584	8054	6764	6481	7061	9804	7140	2006	4735
27	5348	5466	5941	6798	5601	6763	5433	6129	6754	9914	7345	3224	5224
28	5608	5844	6529	8453	7686	9062	7534	6197	6724	9112	6421	927	5324
29	6576	6826	7531	9484	8630	9793	7984	5657	6125	8209	5517	728	6271
30	7289	7519	8188	9833	8754	9599	7529	4740	5209	7426	4735	1646	7010
31	4956	5212	5931	8157	7624	9279	8000	6986	7511	9819	7126	1124	4647
32	4047	4292	4998	7275	6901	8808	7852	7629	8186	10678	7987	2066	3759
33	7185	7487	8265	10801	10248	11643	9893	6869	7219	8457	5890	1682	6811
34	6206	6499	7268	9763	9256	10781	9220	6945	7371	9048	6402	838	5844
35	5383	5691	6479	9238	8970	10779	9503	7812	8265	10030	7381	1445	5002
36	4321	4628	5415	8253	8143	10177	9200	8311	8812	10866	8188	2025	3944
37	3847	4173	4979	8120	8262	10513	9752	9124	9627	11645	8974	2830	3441
38	9587	9890	10670	13109	12362	13387	11216	6673	6817	6906	4714	3866	9209
39	10348	10645	11416	13724	12859	13701	11372	6365	6433	6159	4128	4501	9978
40	2275	2060	1874	2905	3710	6823	7713	10765	11400	14567	11953	6559	2579
41	2906	3230	4036	7239	7537	9972	9487	9524	10061	12310	9622	3453	2505
42	2699	3041	3836	7426	8043	10680	10397	10538	11068	13213	10536	4368	2272
43	12750	12954	13567	14485	12768	12248	9164	2469	2006	2134	1192	7070	12499
44	6688	6779	7193	7493	5864	6282	4369	5038	5681	9126	6705	4013	6590
45	4929	4747	4541	2622	1232	4123	5416	9894	10540	14115	11689	7409	5175
46	4261	4041	3739	1926	1726	4936	6332	10553	11200	14683	12194	7525	4552
47	13650	13794	14288	14421	12352	11102	7839	2310	1814	3929	3954	8663	13475
48	14495	14647	15158	15352	13289	12011	8742	3114	2538	3488	4153	9355	14308
49	14047	14157	14581	14291	12069	10435	7169	3218	2958	5404	5426	9524	13915
50	13480	13563	13933	13373	11079	9280	6035	3466	3436	6482	6109	9398	13381
51	14461	14551	14935	14404	12103	10235	7013	4009	3820	6273	6340	10195	14352
52	14202	14261	14578	13704	11318	9195	6064	4679	4661	7551	7326	10445	14133
53	15164	15097	15120	12823	10315	7132	5654	9402	9636	13002	12330	13490	15253
54	15635	15580	15634	13454	10935	7803	6105	9275	9460	12688	12169	13687	15707
55	16723	16714	16873	15129	12605	9701	7391	8603	8624	11326	11293	13909	16738
56	16125	16085	16172	14125	11599	8529	6617	9137	9267	12323	11976	13882	16178

To be continued on next page...

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DECIBEL - Main Result

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5_YV Kivikangas

...continued from previous page

WTG	A	B	C	D	E	F	G	H	I	J	K	L	M
57	15636	15554	15542	13082	10598	7340	6186	10201	10439	13800	13132	14179	15742
58	17556	17550	17716	15978	13453	10530	8242	9163	9136	11620	11765	14635	17566
59	17144	17121	17248	15347	12819	9808	7711	9345	9383	12111	12059	14531	17175
60	16822	16781	16867	14788	12265	9163	7312	9666	9764	12695	12467	14539	16876
61	16406	16329	16329	13898	11412	8157	6922	10550	10745	13971	13453	14789	16505
62	16164	16069	16023	13414	10964	7657	6801	11019	11260	14613	13952	14906	16286
63	18207	18195	18345	16521	13993	11004	8837	9880	9845	12257	12462	15354	18225
64	17752	17719	17823	15798	13273	10183	8268	10129	10167	12863	12842	15270	17795
65	17077	17009	17029	14664	12169	8933	7562	10748	10897	13972	13609	15256	17165
66	18815	18816	18994	17287	14762	11828	9542	10027	9932	12077	12482	15721	18817
67	16890	16796	16754	14139	11693	8382	7503	11481	11690	14943	14395	15547	17009
68	17779	17720	17760	15461	12959	9743	8251	11000	11102	14008	13805	15759	17856
69	18511	18483	18594	16589	14064	10972	9043	10620	10618	13137	13263	15917	18549
70	19473	19469	19635	17854	15326	12339	10150	10737	10636	12713	13173	16432	19481
71	17547	17446	17384	14679	12261	8933	8211	12228	12429	15642	15136	16296	17676
72	19175	19154	19283	17339	14812	11743	9743	10945	10899	13219	13502	16417	19203
73	17944	17862	17848	15320	12857	9564	8476	11872	12019	15061	14730	16315	18048
74	18862	18820	18899	16742	14226	11059	9347	11330	11351	13941	14014	16485	18917
75	18513	18451	18483	16133	13640	10399	8987	11677	11760	14577	14456	16503	18593
76	18265	18170	18121	15451	13025	9701	8877	12587	12753	15845	15464	16867	18386
77	20118	20105	20249	18356	15828	12772	10726	11553	11458	13531	14001	17199	20137
78	19684	19642	19718	17535	15023	11837	10168	12033	12030	14494	14671	17275	19739
79	18867	18781	18755	16162	13718	10406	9416	12743	12870	15821	15578	17262	18976
80	20863	20852	21001	19112	16585	13522	11481	12151	12030	13952	14533	17877	20879
81	19345	19272	19277	16801	14332	11047	9839	12697	12779	15566	15474	17478	19437
82	20516	20488	20596	18537	16016	12876	11042	12329	12265	14451	14843	17830	20553
83	19789	19730	19766	17411	14921	11670	10260	12642	12679	15289	15349	17666	19865
84	19311	19210	19143	16390	13992	10658	9960	13638	13787	16800	16498	17971	19440
85	20509	20464	20532	18301	15795	12584	10987	12824	12805	15177	15430	18111	20568
86	20076	20000	19997	17475	15017	11719	10579	13403	13472	16189	16159	18227	20172
87	22028	22020	22174	20294	17767	14696	12661	13113	12957	14659	15396	18947	22039
88	21484	21459	21575	19531	17010	13869	12024	13081	12983	14982	15514	18699	21516
89	21239	21200	21282	19098	16588	13390	11729	13274	13220	15422	15807	18704	21289
90	20098	19996	19926	17149	14761	11425	10746	14314	14443	17376	17152	18735	20228
91	22949	22947	23114	21274	18747	15687	13618	13814	13624	15118	15997	19747	22953
92	20474	20388	20359	17729	15298	11977	11018	14078	14160	16919	16854	18794	20583
93	21521	21464	21503	19133	16649	13386	11991	14059	14046	16404	16673	19284	21593
94	22217	22183	22278	20130	17618	14429	12722	13982	13891	15895	16429	19551	22260
95	23260	23248	23394	21453	18928	15818	13866	14334	14164	15747	16572	20196	23275
96	21006	20907	20844	18076	15688	12352	11627	14977	15078	17892	17779	19548	21132
97	23059	23027	23124	20973	18462	15267	13568	14708	14597	16479	17103	20344	23100
98	22637	22613	22731	20673	18154	14999	13179	14093	13968	15797	16455	19796	22668
99	23880	23867	24009	22043	19520	16394	14476	14943	14765	16290	17157	20820	23897
100	23584	23560	23675	21596	19080	15910	14123	14970	14828	16544	17284	20720	23615
101	21589	21483	21404	18568	16205	12867	12252	15689	15791	18599	18492	20223	21722
102	23636	23598	23680	21460	18958	15735	14128	15397	15291	17179	17803	21001	23684
103	23950	23896	23940	21554	19076	15802	14420	16146	16077	18125	18636	21580	24019
104	24574	24520	24566	22181	19704	16429	15044	16686	16603	18575	19144	22167	24641
105	25160	25108	25155	22770	20294	17017	15631	17200	17106	19010	19630	22722	25226
106	25937	25887	25939	23567	21089	17814	16409	17851	17740	19542	20236	23438	26000
107	26631	26578	26624	24215	21745	18460	17102	18576	18462	20239	20953	24162	26697
108	27418	27378	27456	25173	22683	19429	17906	18938	18780	20312	21194	24699	27467
109	27316	27265	27313	24912	22441	19156	17788	19175	19049	20749	21518	24805	27381
110	27518	27454	27473	24952	22506	19197	17991	19707	19609	21446	22121	25210	27597
111	28020	27978	28047	25724	23240	19974	18502	19596	19439	20967	21854	25343	28073
112	28036	27982	28024	25591	23127	19835	18506	19915	19787	21460	22250	25548	28102
113	29161	29121	29197	26889	24404	21140	19648	20604	20428	21833	22804	26414	29210

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Calculated:
29.8.2022 10.27/3.5.584

DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5_YV Kivikangas

Noise calculation model:
ISO 9613-2 Finland
Wind speed (in 10 m height):
8,0 m/s
Ground attenuation:
General, terrain specific
Ground factor for porous ground: 0,4
Area object with hard ground: Area object (Roughness): REGIONS_Katajamäen tuulivoimahanke_0.w2r (5)
Area type with hard ground: Vesistöt
Ground factor for hard ground: 0,0
Meteorological coefficient, C0:
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 tones penalty is added to total noise impact at receptors
Noise sensitive area
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
Uncertainty margin:
0,0 dB; Uncertainty margin in model has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0,0 dB(A)
Octave data required
Frequency dependent air absorption

63	125	250	500	1 000	2 000	4 000	8 000
[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]	[dB/km]
0,10	0,38	1,12	2,36	4,08	8,78	26,60	95,00

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89

WTG: NORDEX N163/6.8 HH218,5 6800 163.0 !O!
Noise: Noise

Source	Source/Date	Creator	Edited
FCG	7.3.2022	USER	8.3.2022 11.41

					Octave data							
Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	218,5	8,0	107,9	No	93,9	98,6	100,9	101,4	101,8	99,7	90,2	71,3

WTG: Generic RD200 HH200 109.1dB 10000 200.0 !O!
Noise: Generic RD200 HH200 107.1 dB

Source	Source/Date	Creator	Edited
Generic	7.4.2021	USER	26.8.2022 12.13

					Octave data							
Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones	63 [dB]	125 [dB]	250 [dB]	500 [dB]	1000 [dB]	2000 [dB]	4000 [dB]	8000 [dB]
From Windcat	200,0	8,0	109,1	No	87,3	95,7	101,6	104,5	103,8	99,6	92,6	82,9

Noise sensitive area: A Lomarakennus A

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

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DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5_YV Kivikangas

Noise sensitive area: B Asuinrakennus B
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: C Lomarakennus C
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: D Asuinrakennus D
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: E Lomarakennus E
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: F Asuinrakennus F
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: G Asuinrakennus G
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: H Asuinrakennus H
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: I Asuinrakennus I
Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

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DECIBEL - Assumptions for noise calculation

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5_YV Kivikangas

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: J Asuinrakennus J

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: K Lomarakennus K

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: L Lomarakennus L

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

Noise sensitive area: M Lomarakennus M

Predefined calculation standard:
Immission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 40,0 dB(A)
No distance demand
Pure tone penalty: 0 dB

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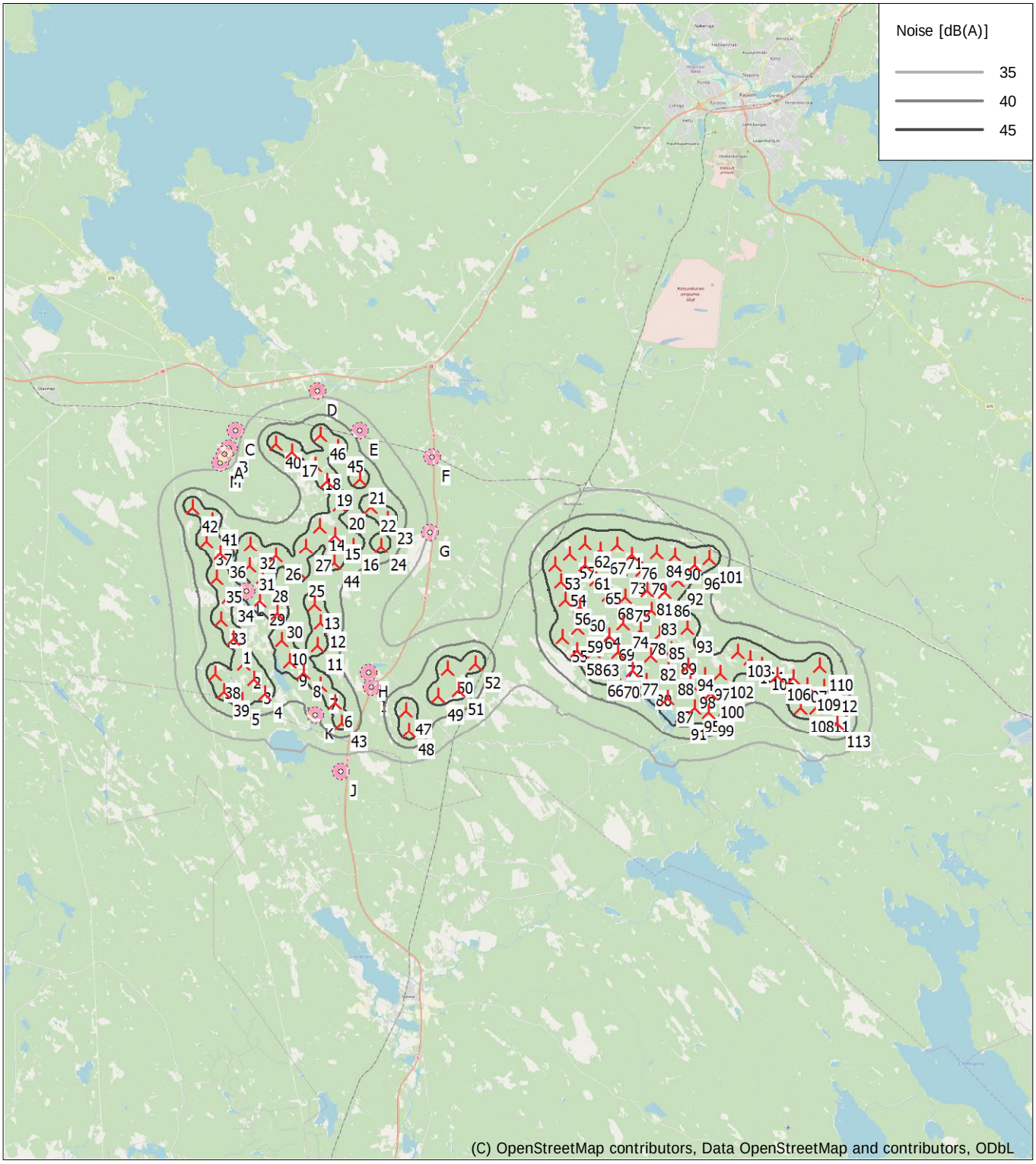
Calculated:
29.8.2022 10.27/3.5.584

DECIBEL - Map 8,0 m/s

Calculation: Katajamäki VE2_N163-6.8MWx46xHH218,5_YV Kivikangas

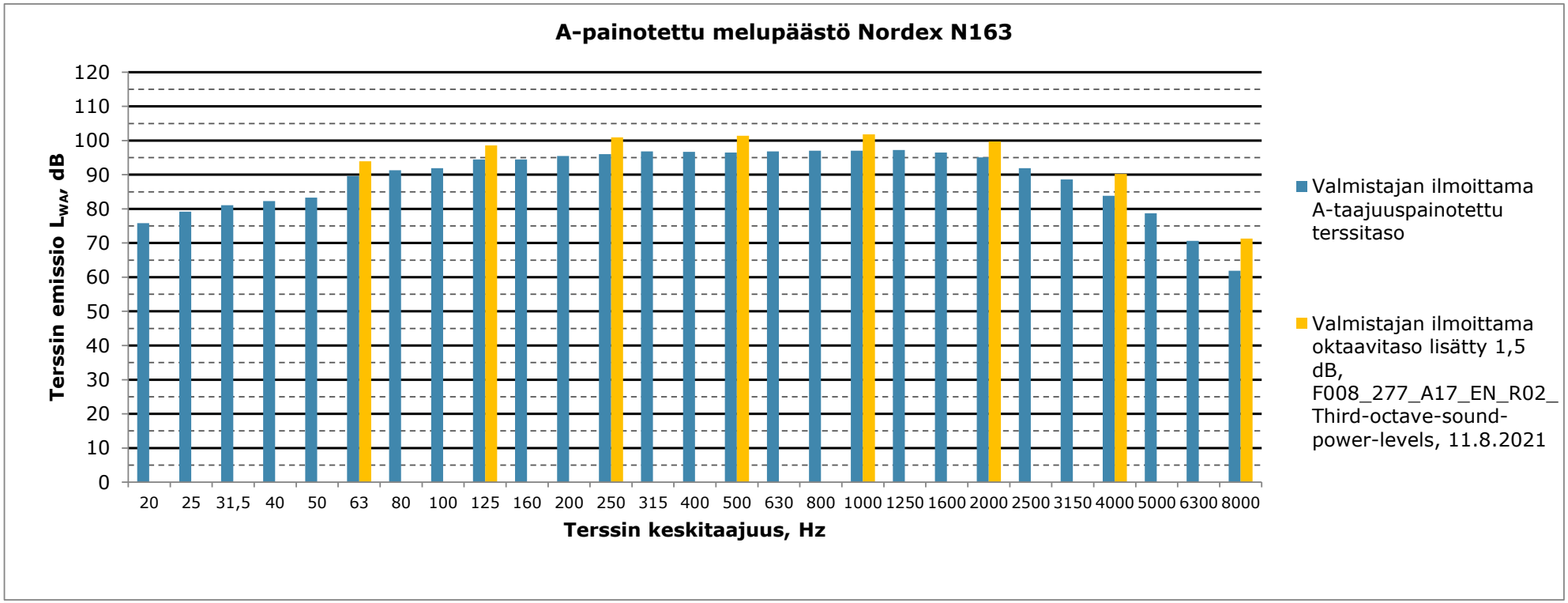


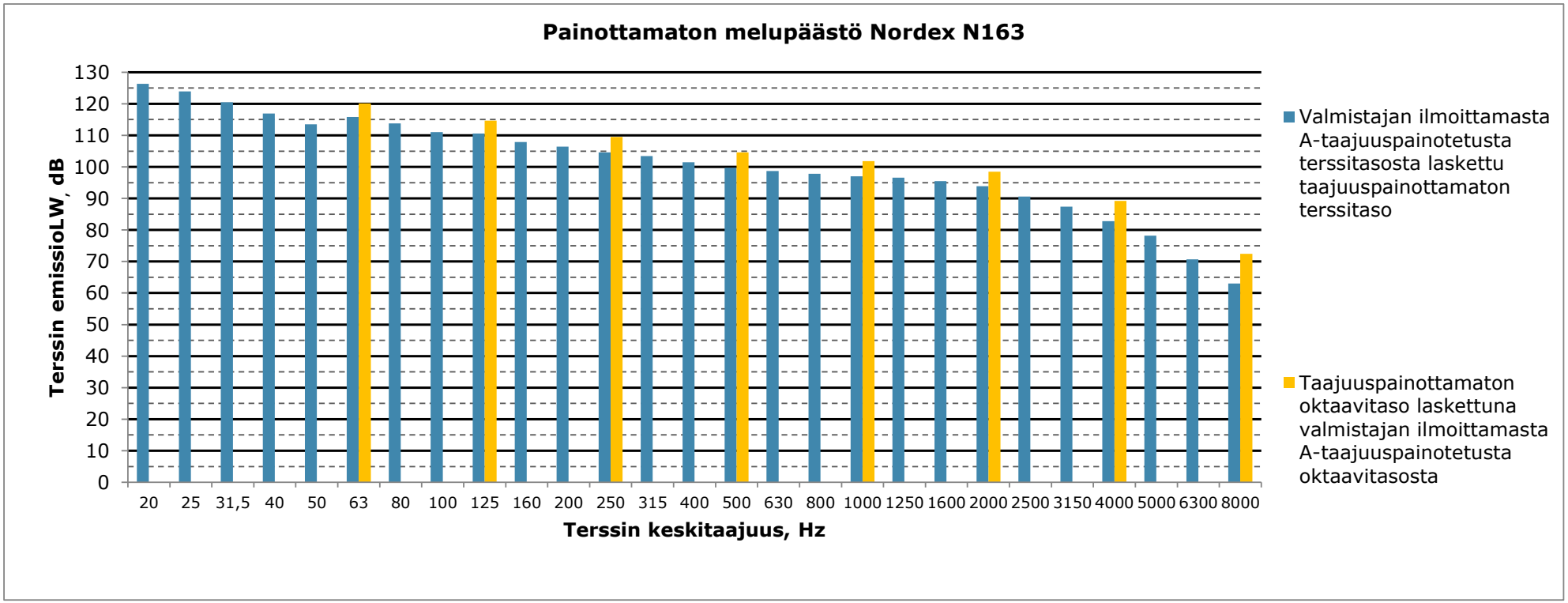
Map: EMD OpenStreetMap , Print scale 1:250 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 525 689 North: 7 100 768

New WTG Noise sensitive area

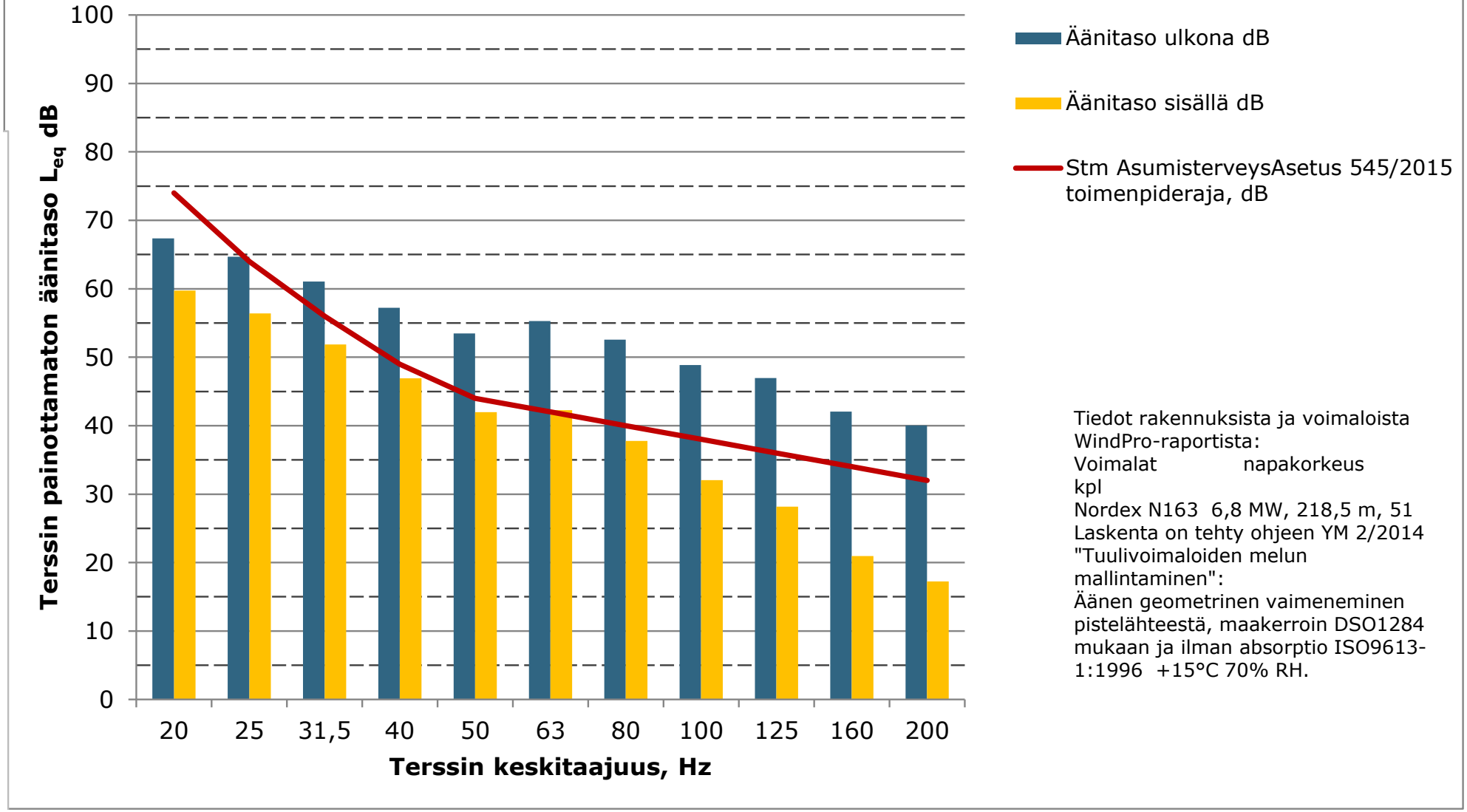
Noise calculation model: ISO 9613-2 Finland. Wind speed: 8,0 m/s
Height above sea level from active line object

Liite 5. Katajamäen tuulivoimahanke – matalataajuisen melun rakennuskohtaiset arvot VE1 N163 - 6.8 MW.


A-painotettu melupäästö Nordex N163
Terssin emissio L_{WA} dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso lisätty 1,5 dB, F008_277_A17_EN_R02_ Third-octave-sound-power-levels, 11.8.2021

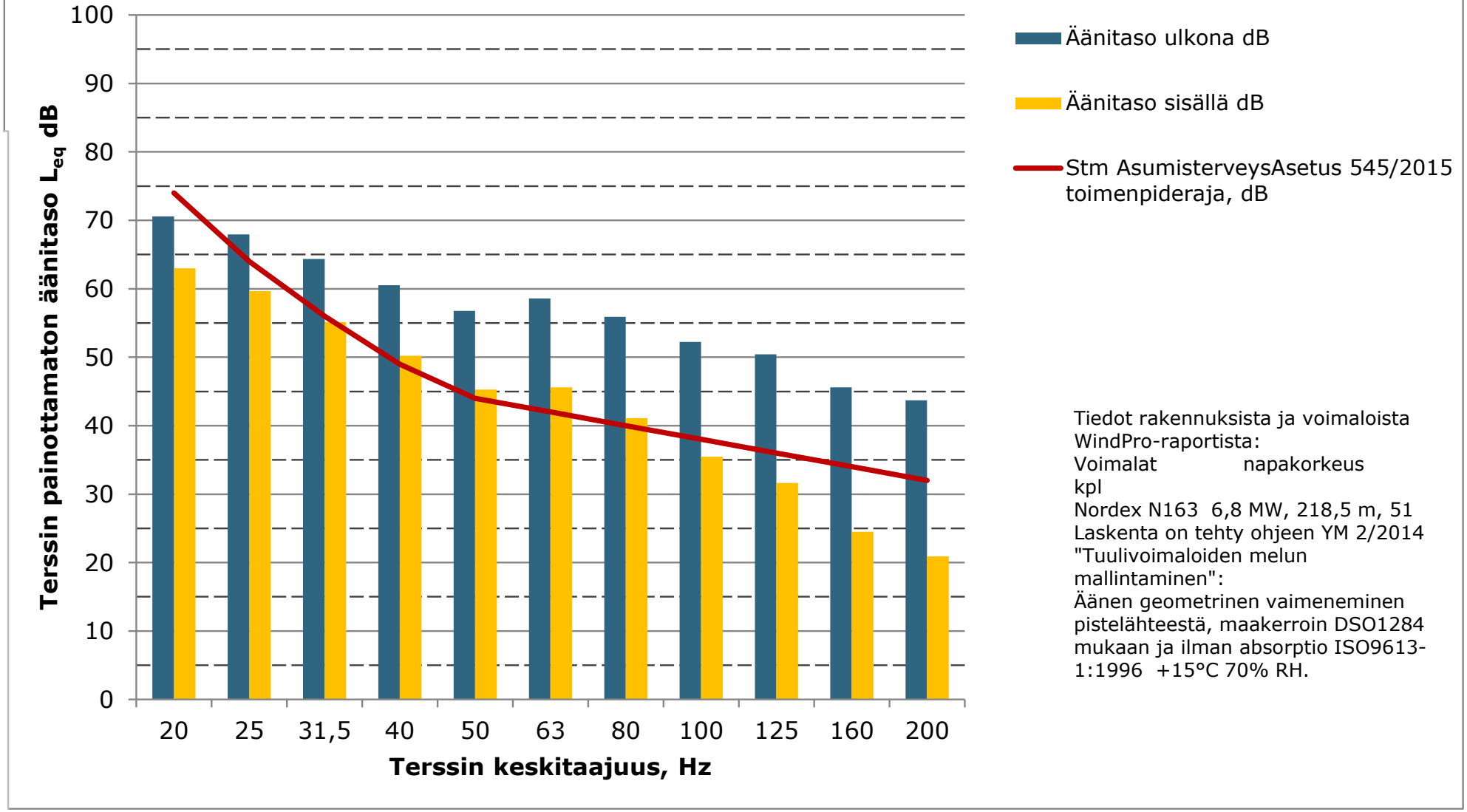

Painottamaton melupäästö Nordex N163
Terssin emissioLW, dB
130
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus K, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

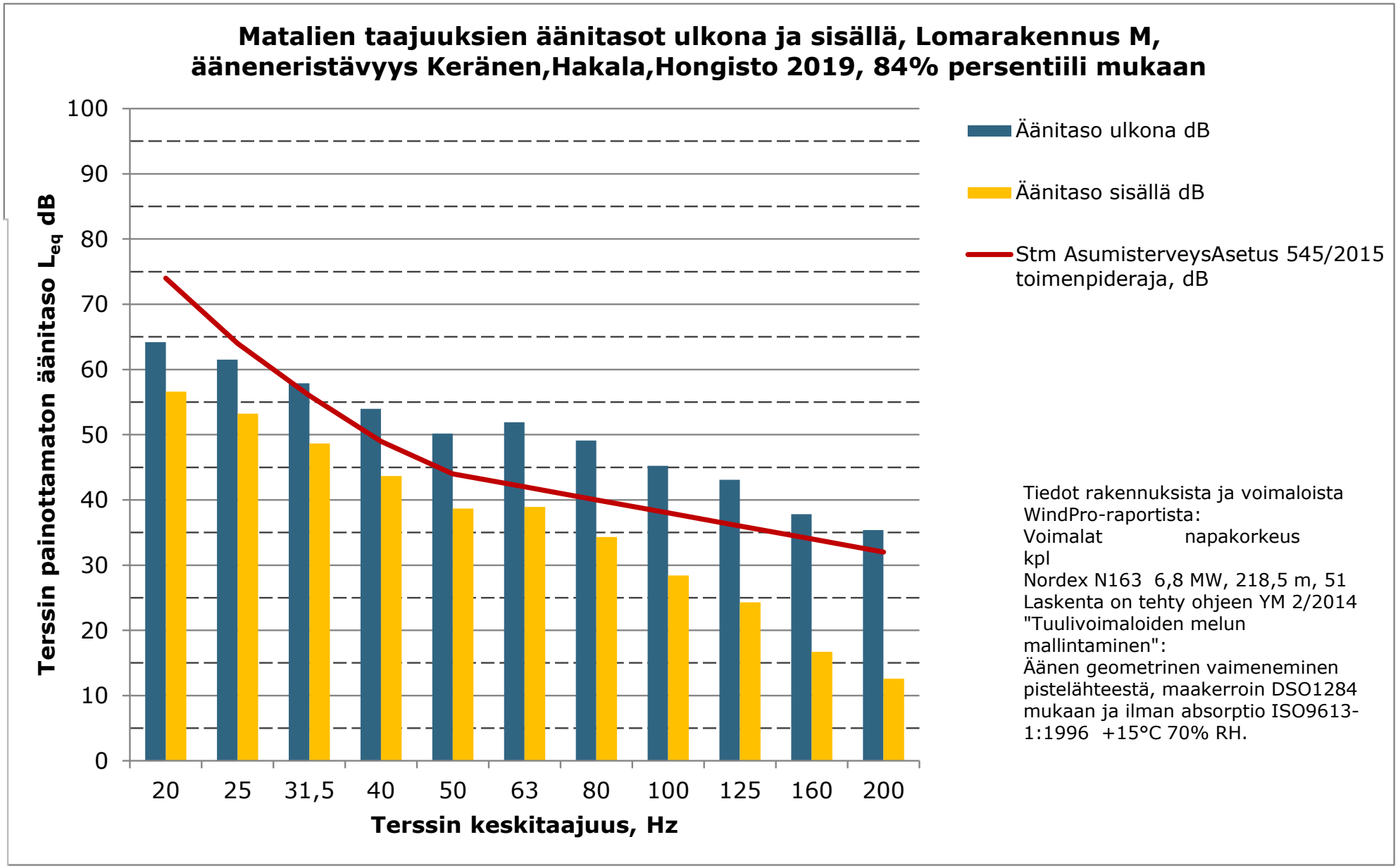


Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

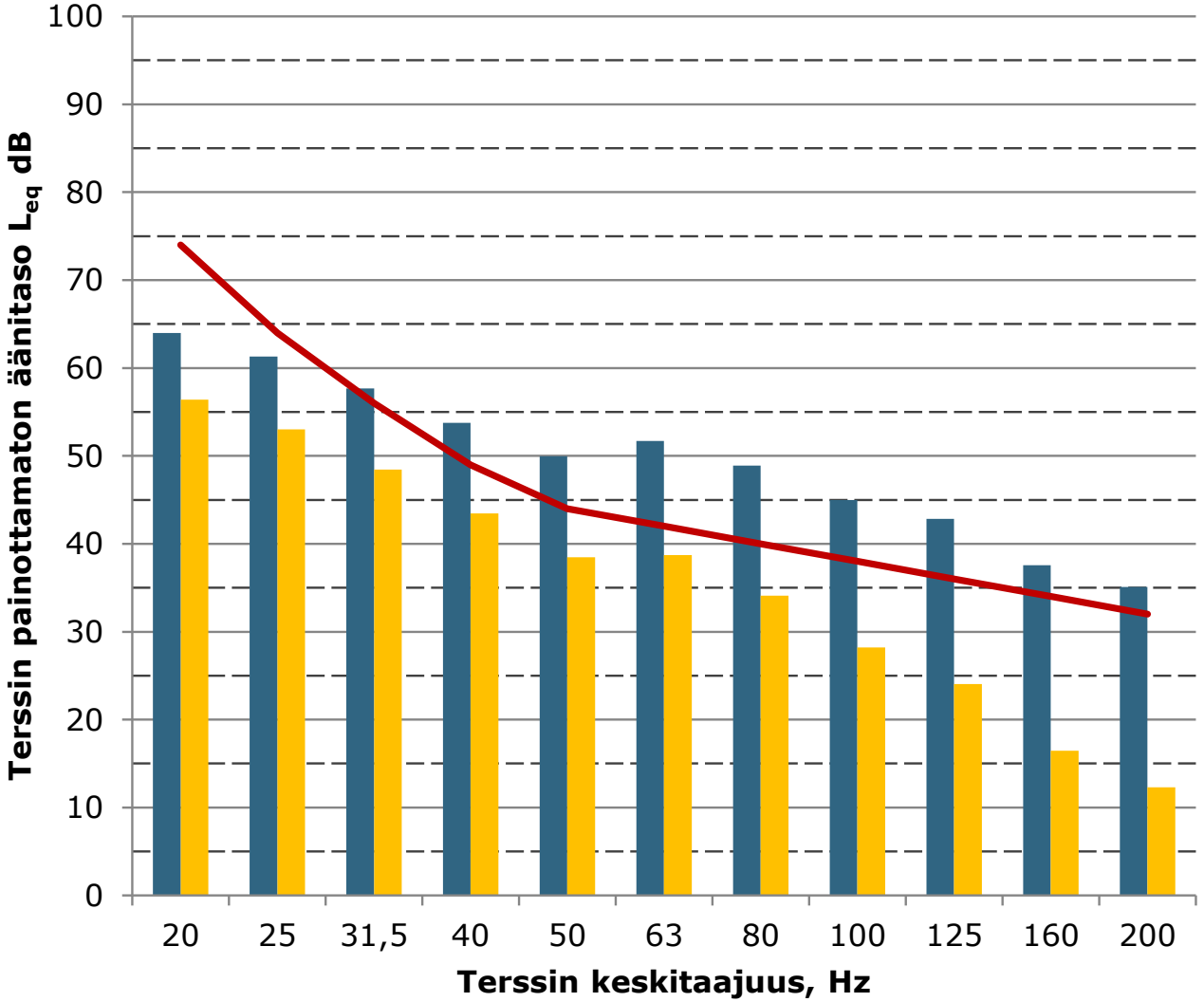
Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus L, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

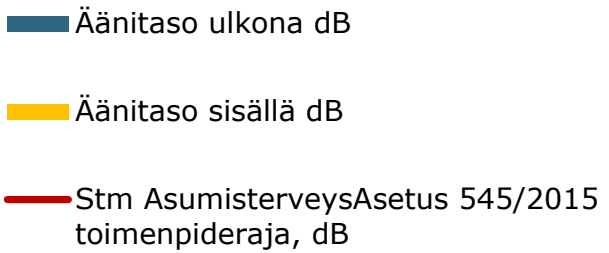


Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

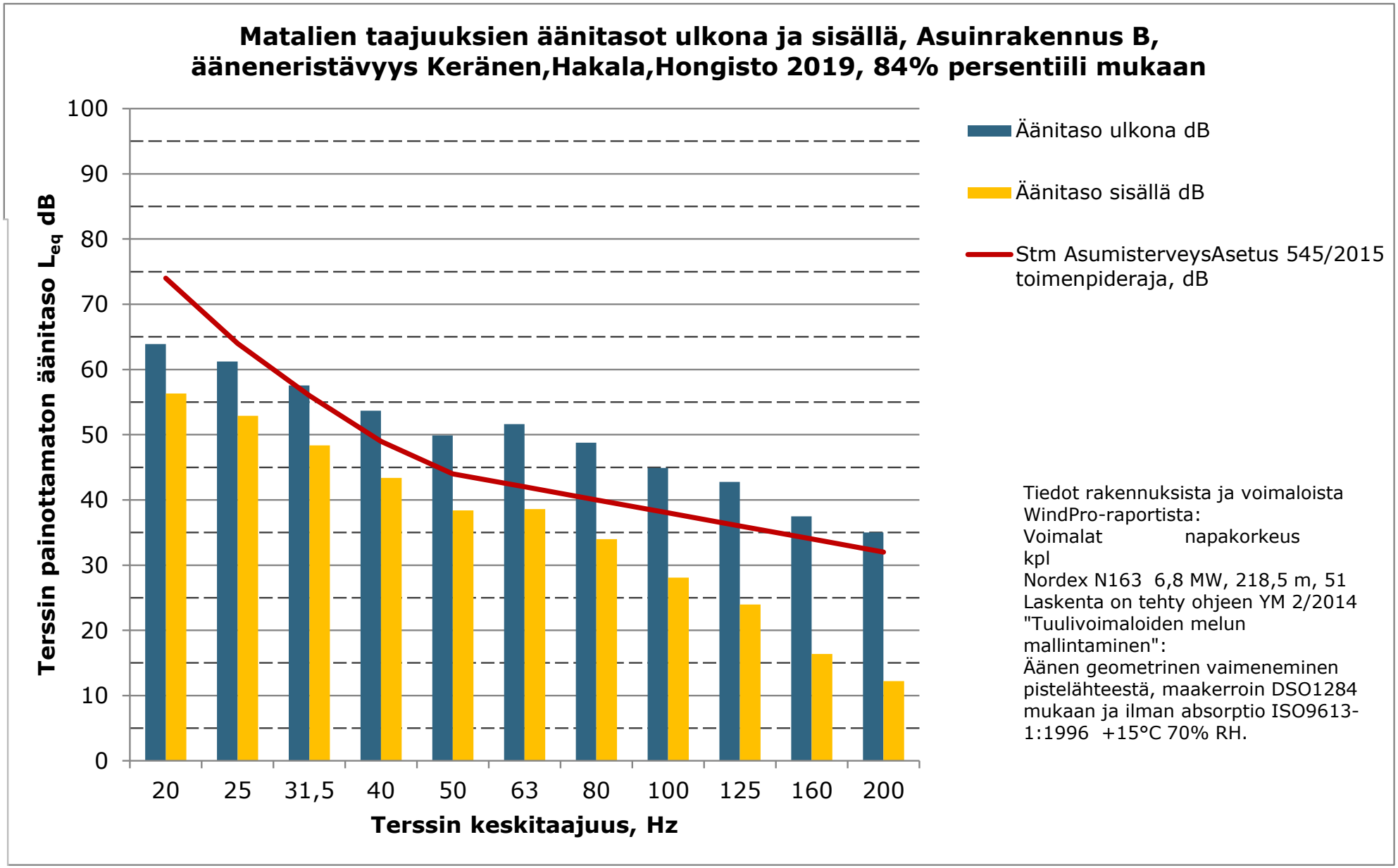

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus M, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan
Terssin painottamaton äänitaso L_{eq} dB
100
90
80
70
60
50
40
30
20
10
0
20
25
31,5
40
50
63
80
100
125
160
200
Terssin keskitaajuus, Hz
Äänitaso ulkona dB
Äänitaso sisällä dB
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus A, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

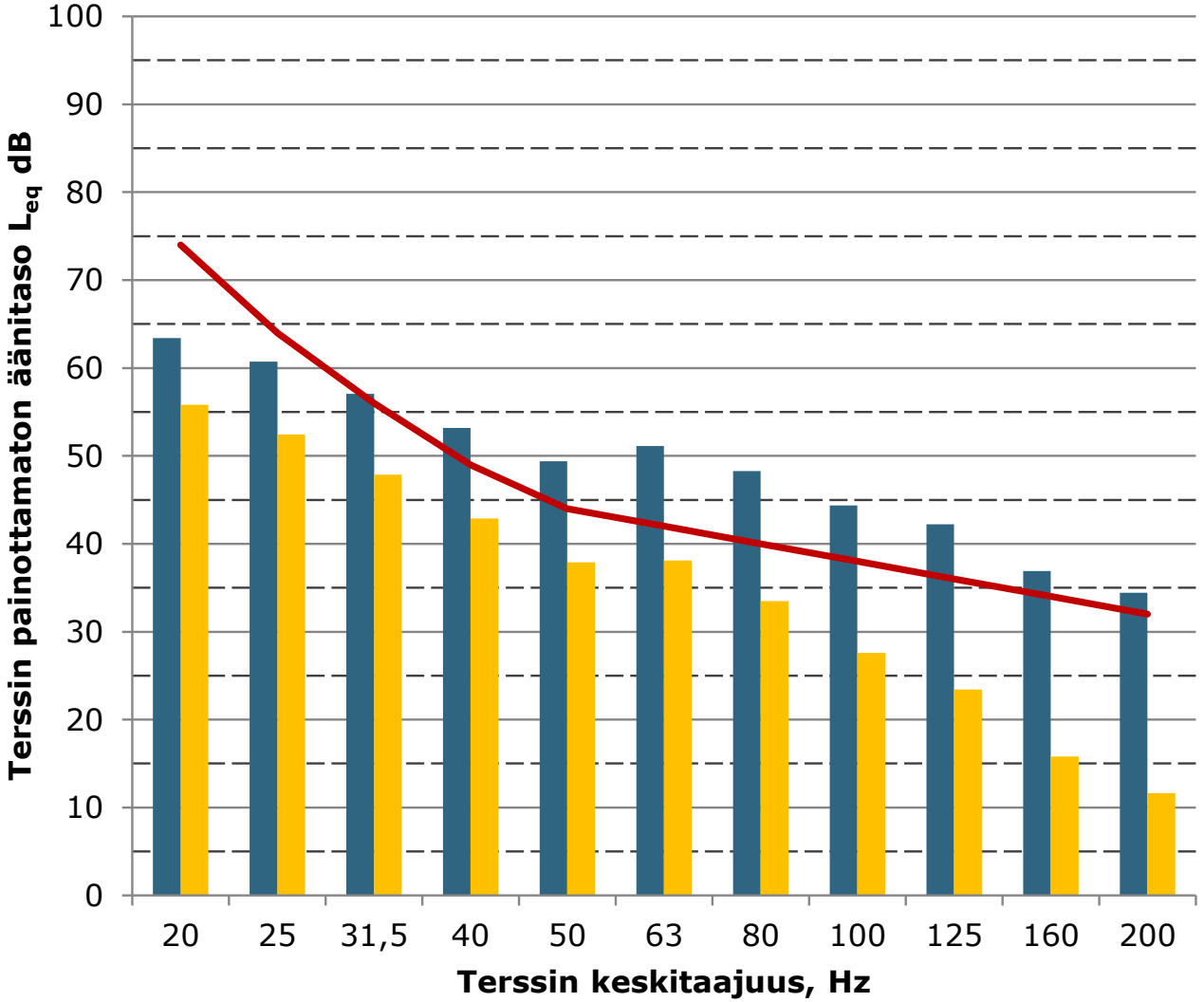


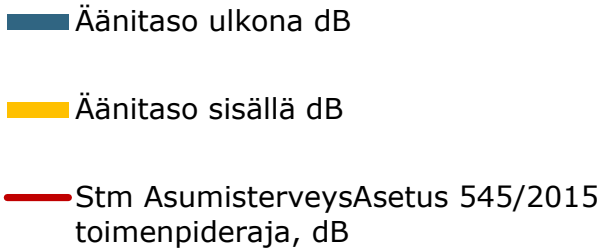


Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.


Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus B, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan
Terssin painottamaton äänitaso L_{eq} dB
100
90
80
70
60
50
40
30
20
10
0
20
25
31,5
40
50
63
80
100
125
160
200
Terssin keskitaajuus, Hz
Äänitaso ulkona dB
Äänitaso sisällä dB
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

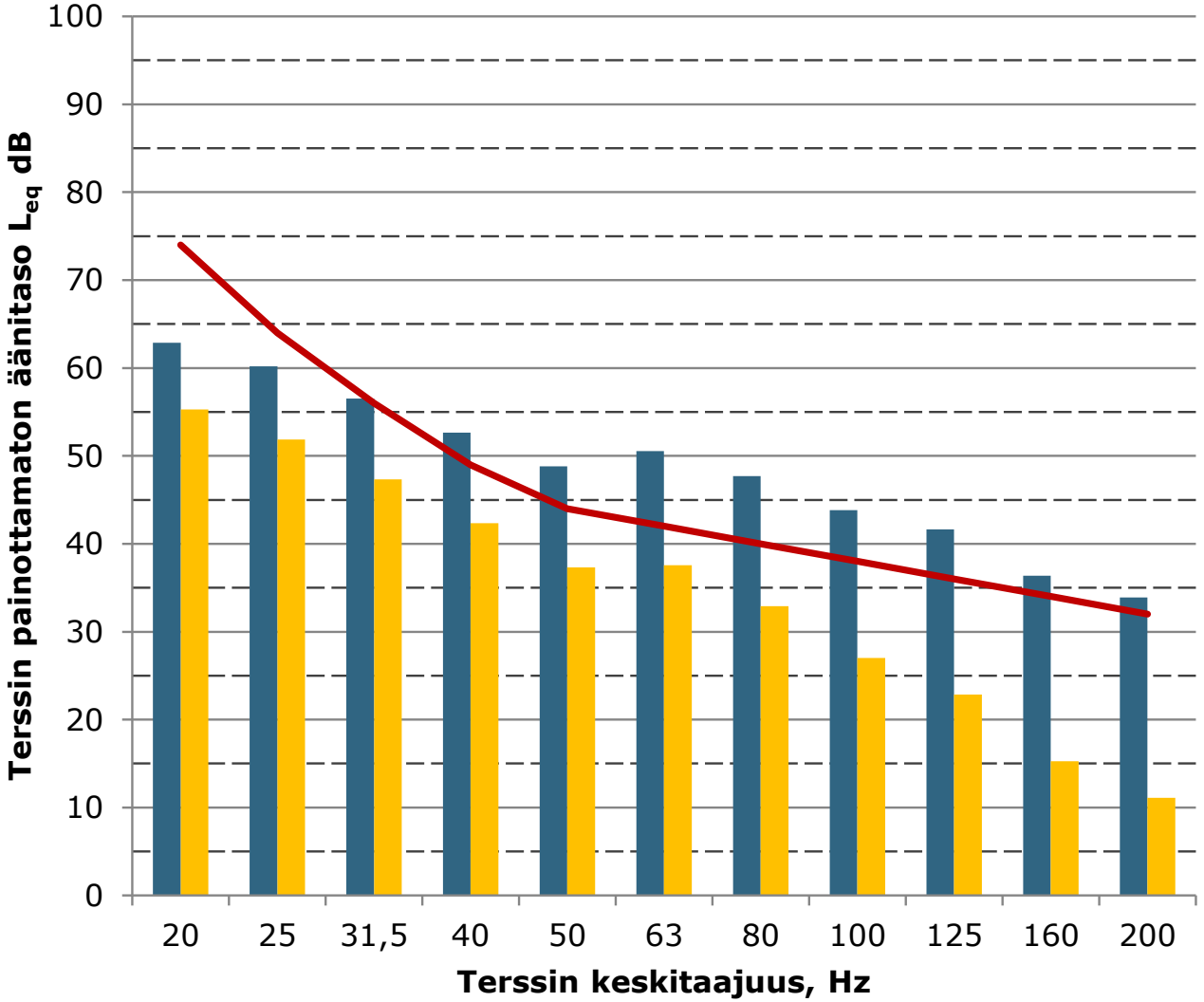
Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus C, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

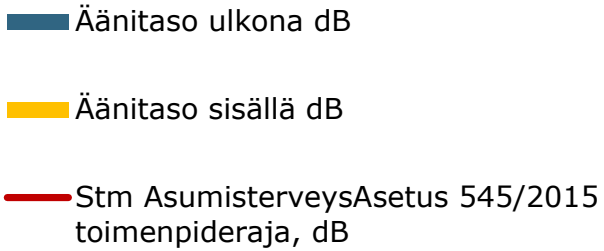




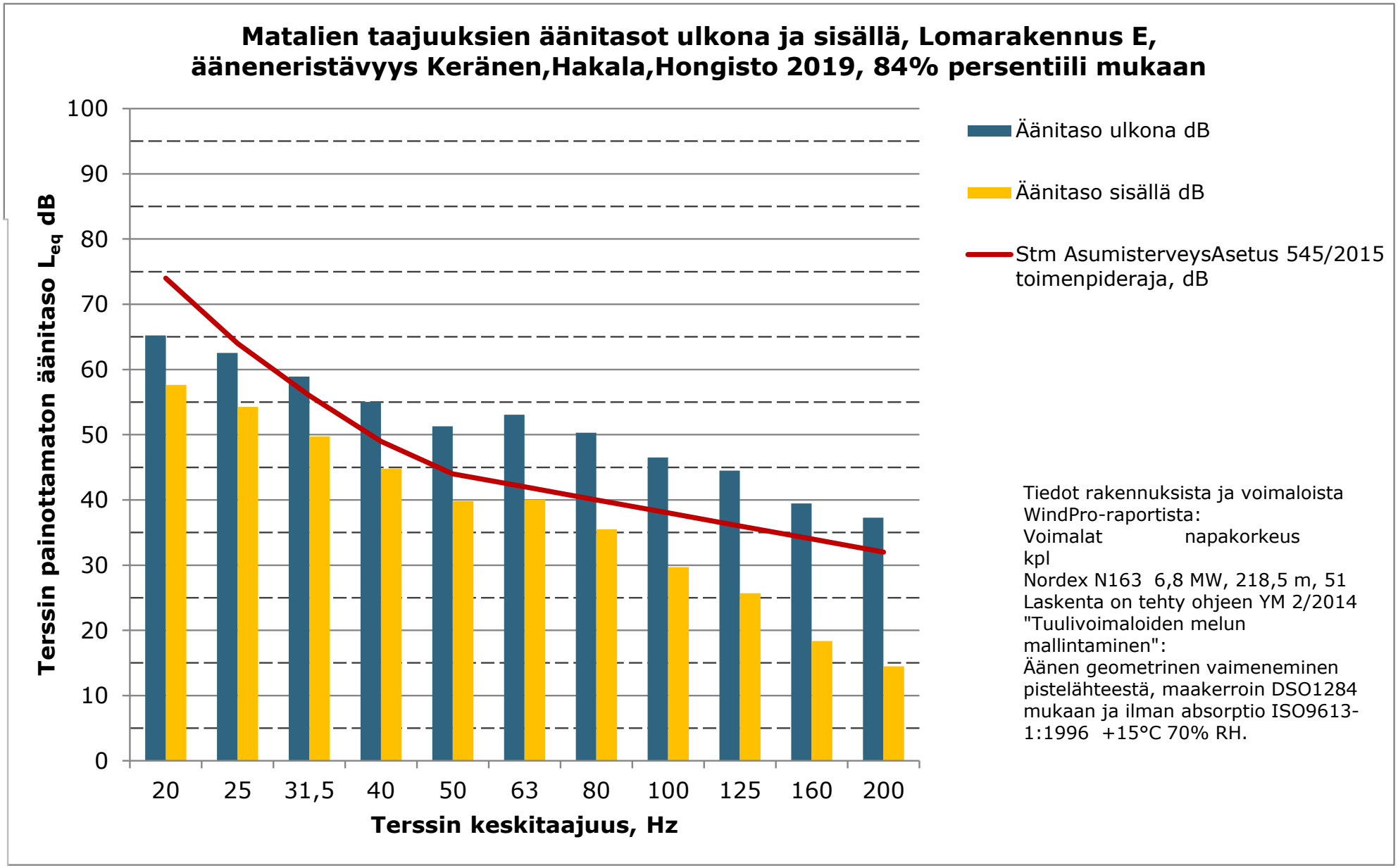
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

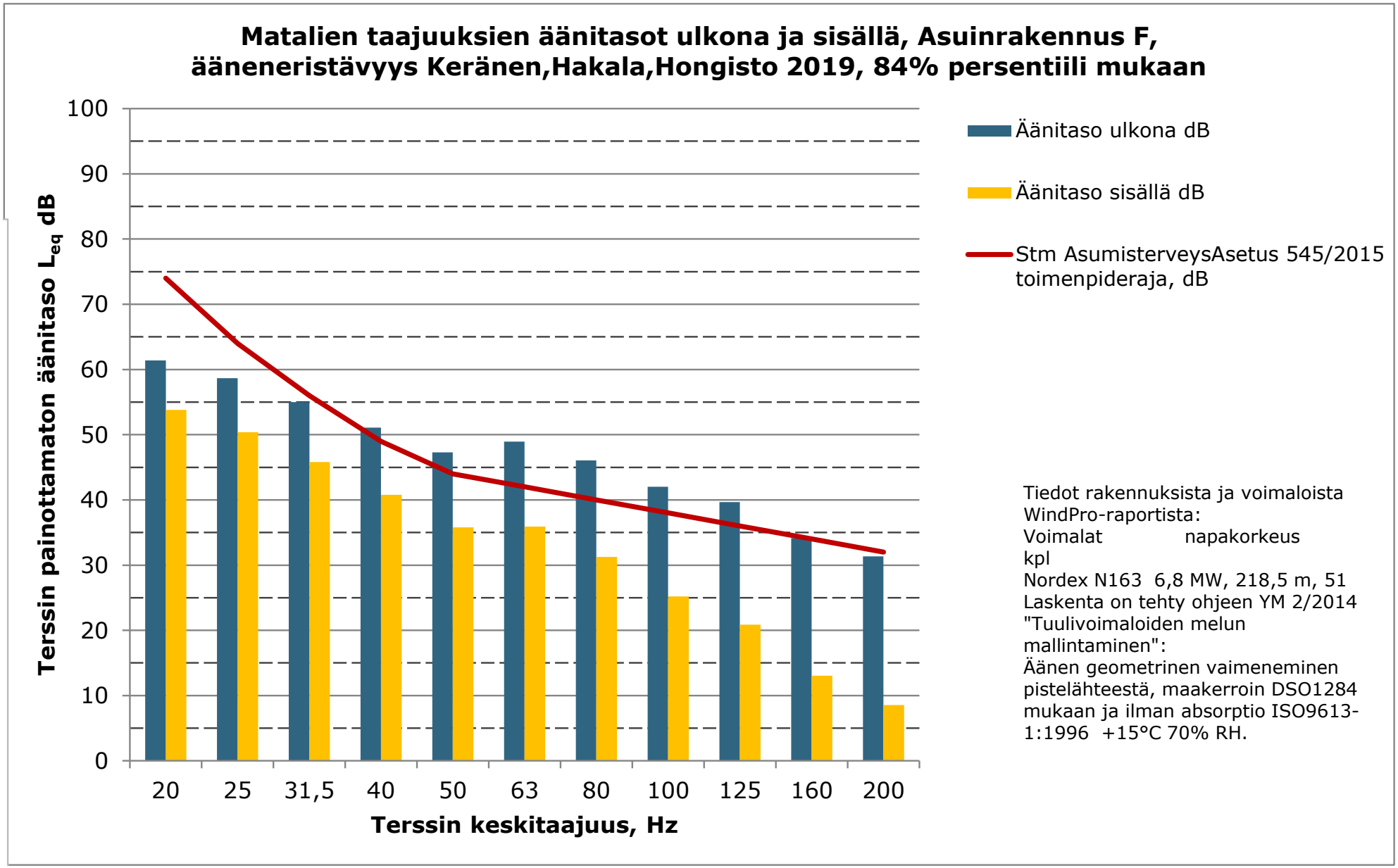
Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus D, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



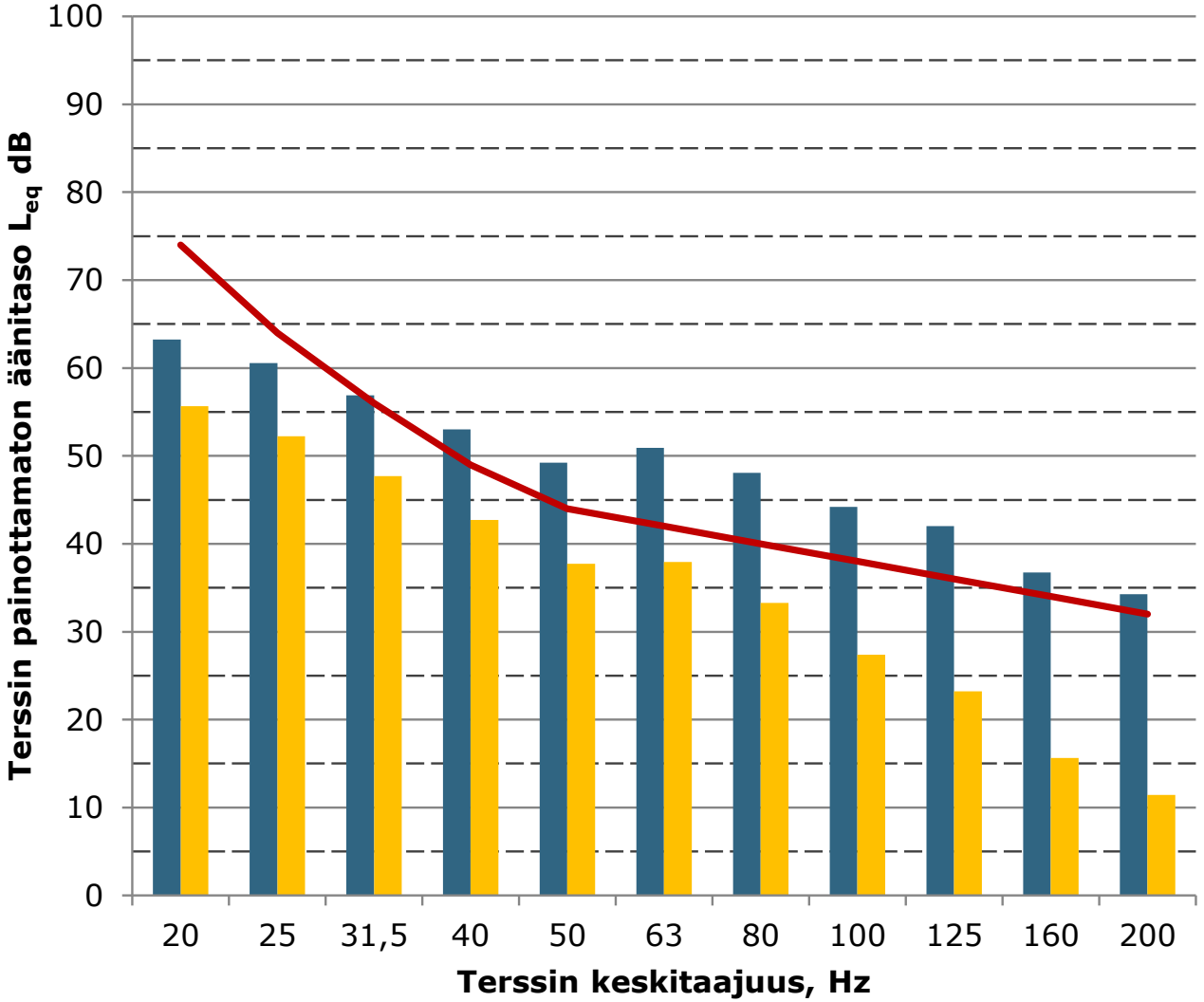


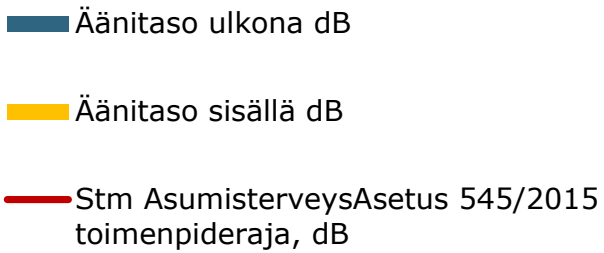
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.


Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus E, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan
Terssin painottamaton äänitaso L_{eq} dB
100
90
80
70
60
50
40
30
20
10
0
20
25
31,5
40
50
63
80
100
125
160
200
Terssin keskitaajuus, Hz
Äänitaso ulkona dB
Äänitaso sisällä dB
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.


Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus F, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan
Terssin painottamaton äänitaso L_{eq} dB
100
90
80
70
60
50
40
30
20
10
0
20
25
31,5
40
50
63
80
100
125
160
200
Terssin keskitaajuus, Hz
Äänitaso ulkona dB
Äänitaso sisällä dB
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

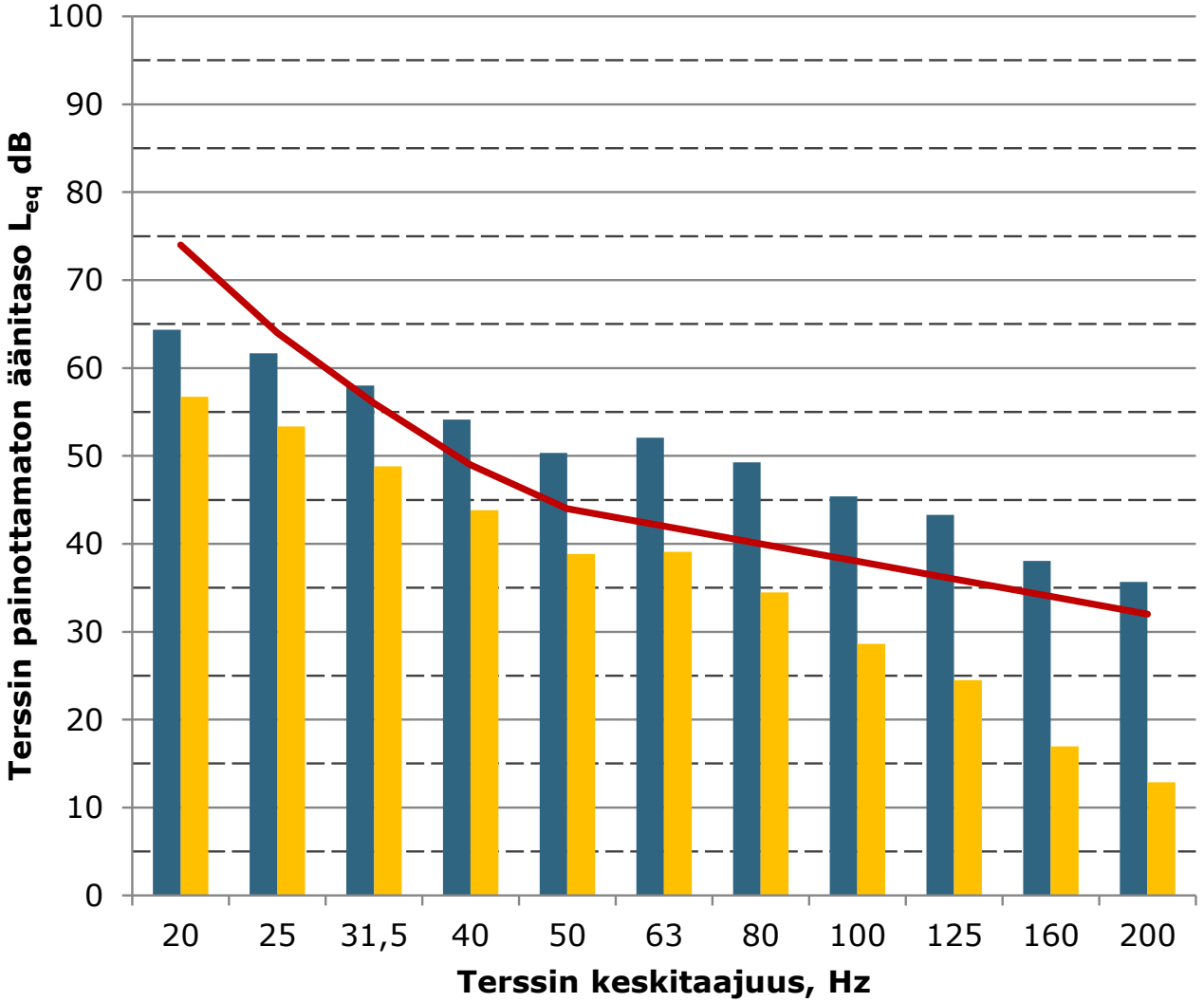
Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus G, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

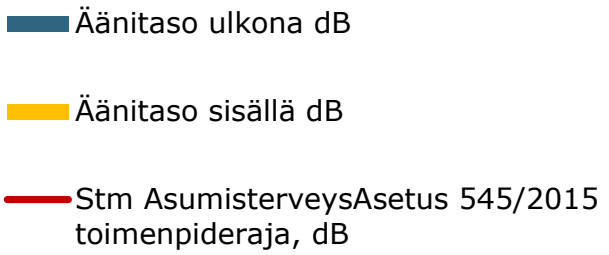




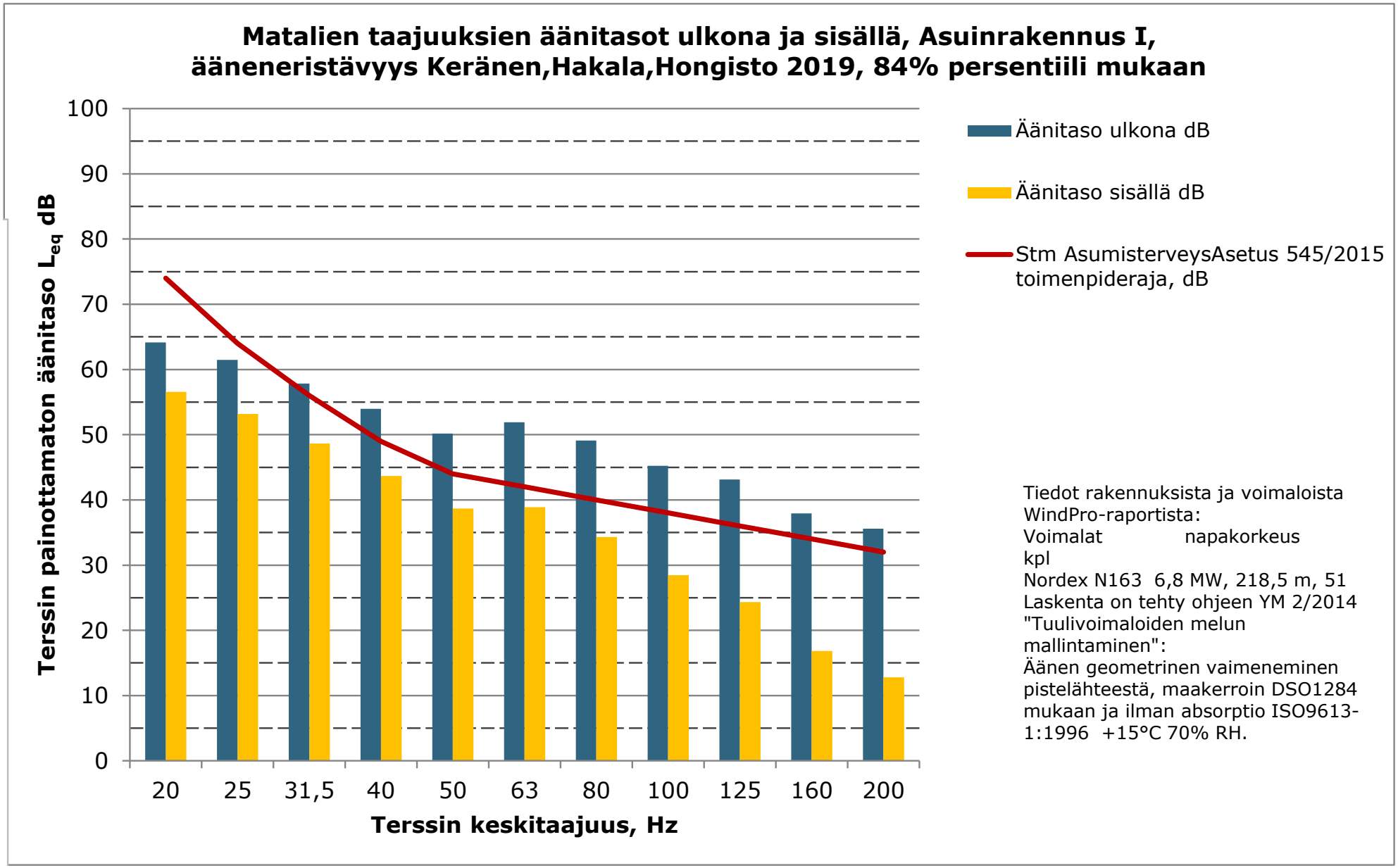
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus H, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

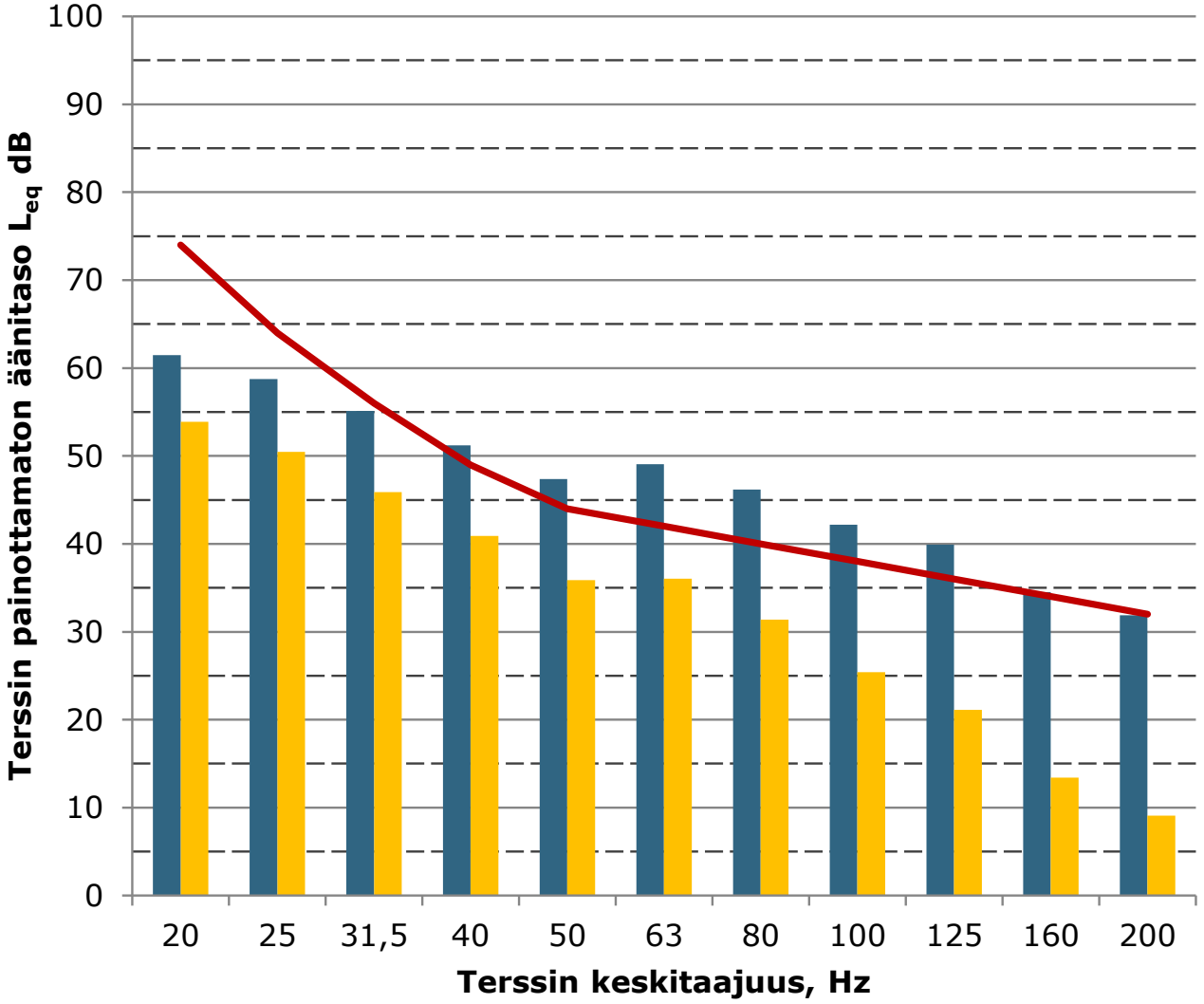


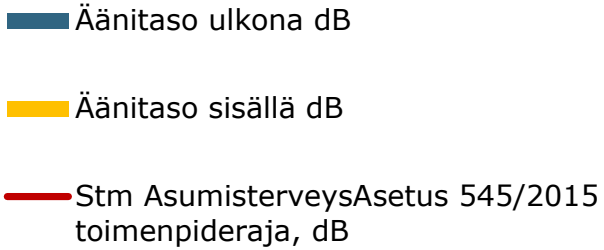


Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.


Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus I, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan
Terssin painottamaton äänitaso L_{eq} dB
100
90
80
70
60
50
40
30
20
10
0
20
25
31,5
40
50
63
80
100
125
160
200
Terssin keskitaajuus, Hz
Äänitaso ulkona dB
Äänitaso sisällä dB
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

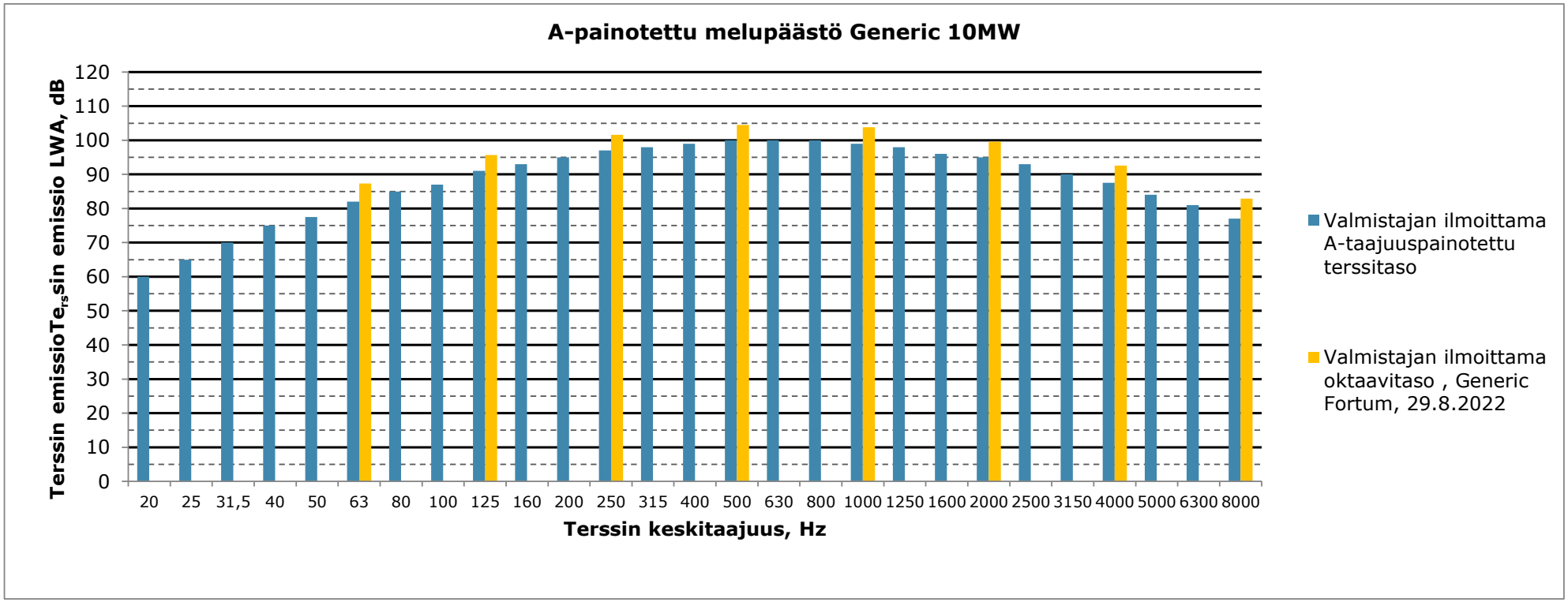
Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus J, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

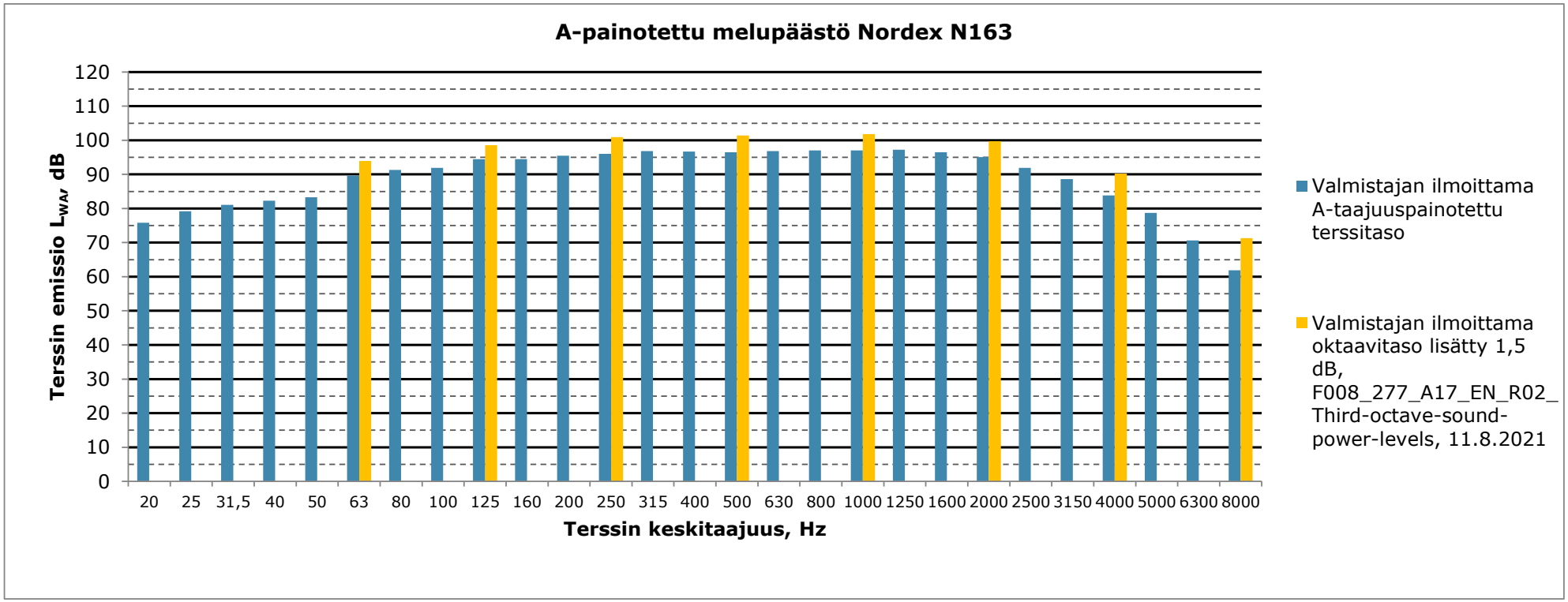


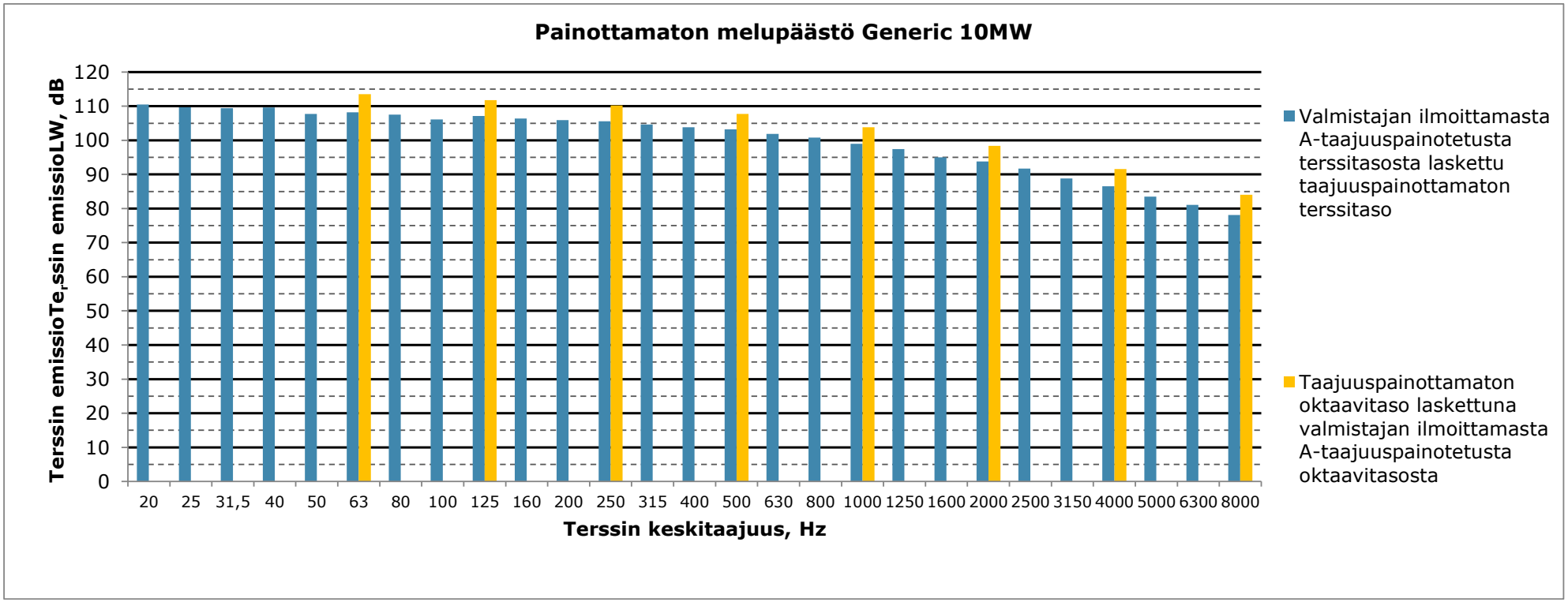


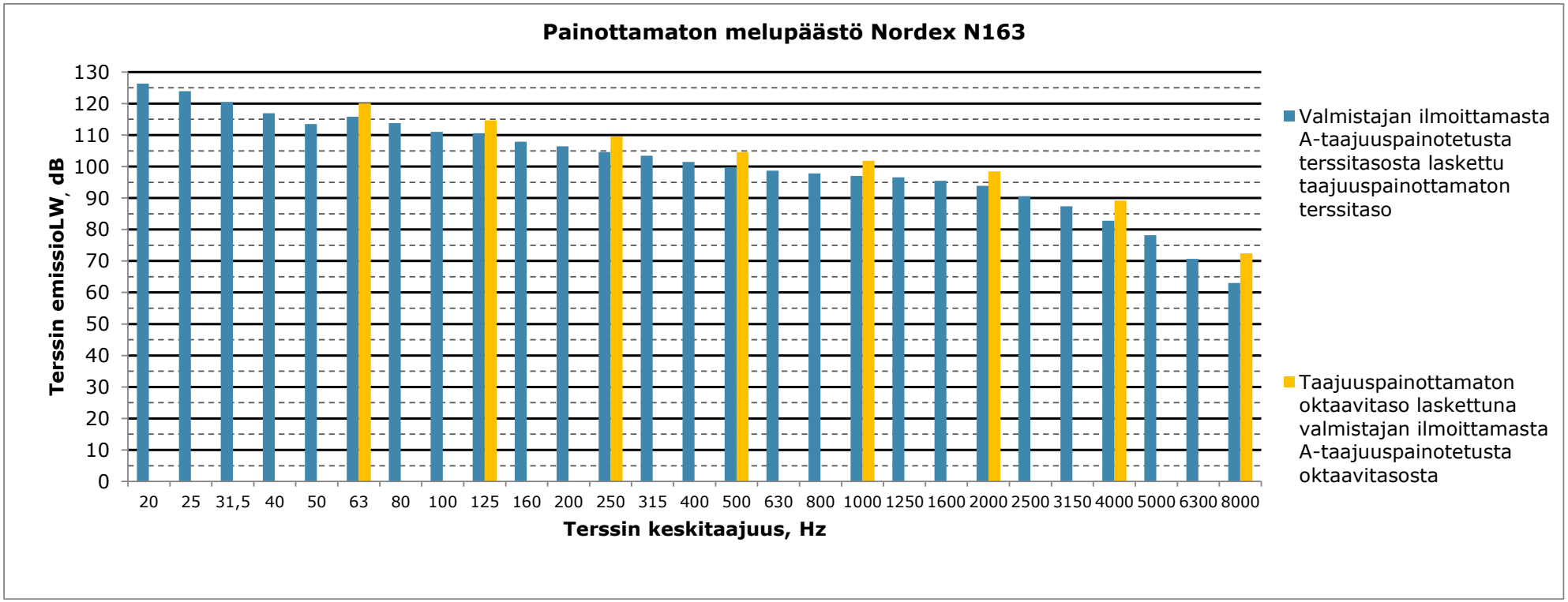
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Liite 6. Katajamäen tuulivoimahanke – matalataajuisen melun rakennuskohtaiset arvot VE1 N163 - 6.8 MW. Yhteisvaikutukset Kivikankaan hankkeen kanssa.

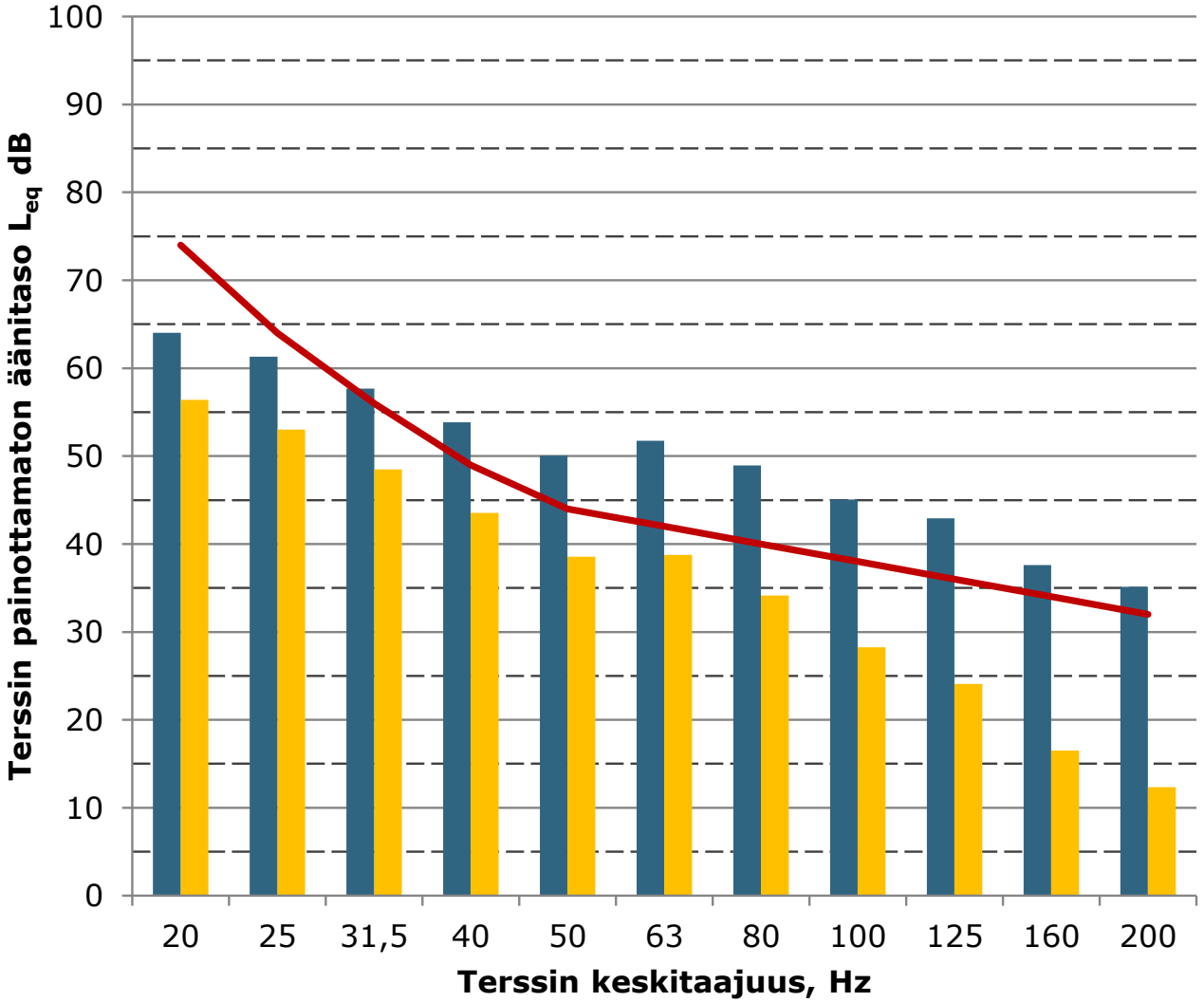

A-painotettu melupäästö Generic 10MW
Terssin emissioTe$_{rs}$sin emissio LWA, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso , Generic Fortum, 29.8.2022

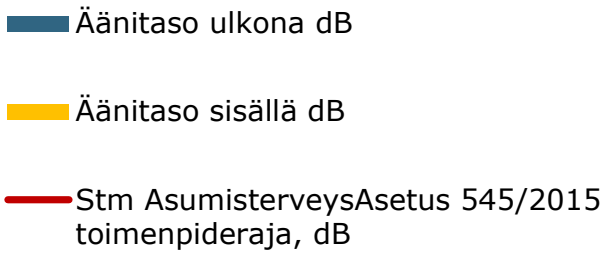

A-painotettu melupäästö Nordex N163
Terssin emissio L_{WA} dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso lisätty 1,5 dB, F008_277_A17_EN_R02_ Third-octave-sound-power-levels, 11.8.2021


Painottamaton melupäästö Generic 10MW
Terssin emissioTe,ssin emissioLW, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta


Painottamaton melupäästö Nordex N163
Terssin emissioLW, dB
130
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus A, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



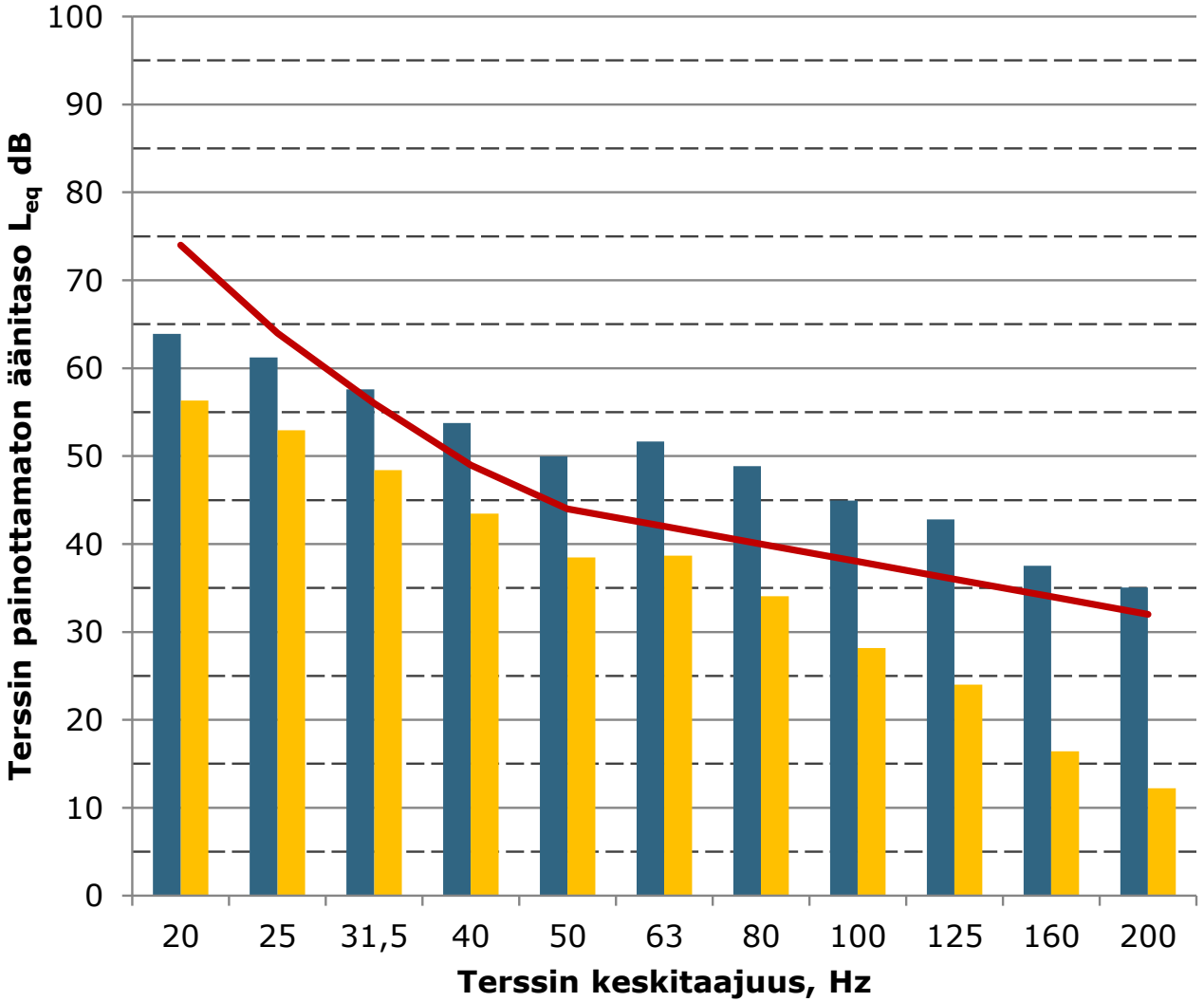


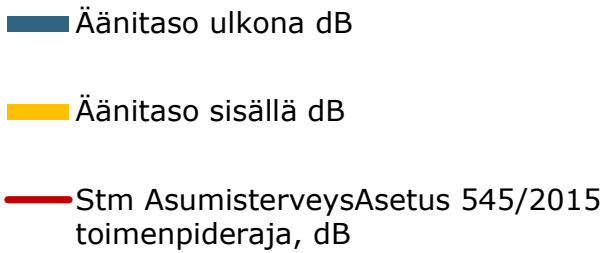
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus B, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



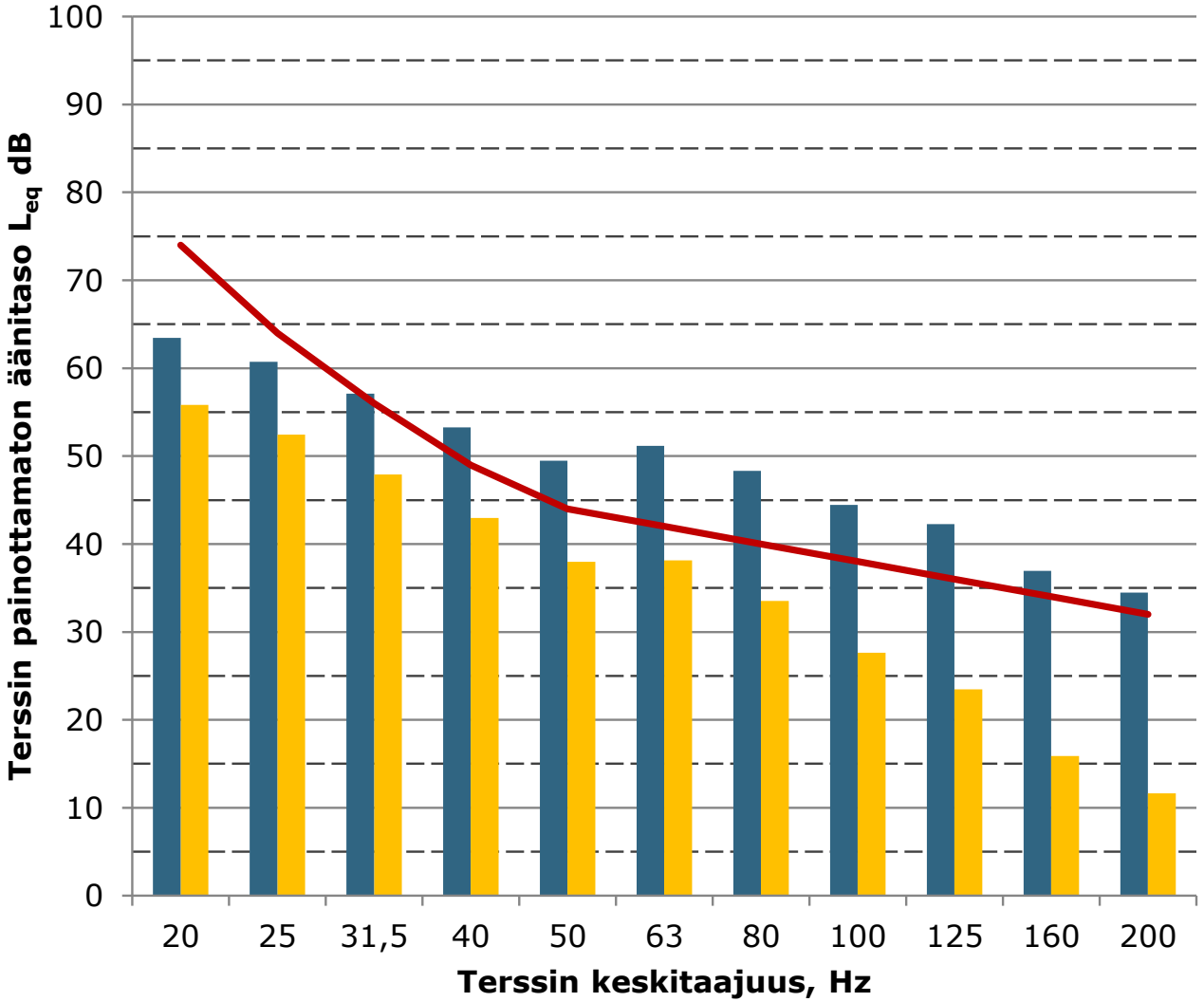


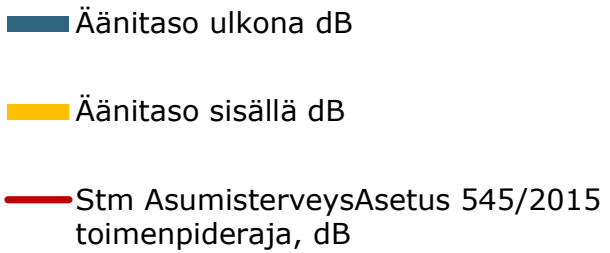
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus C, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



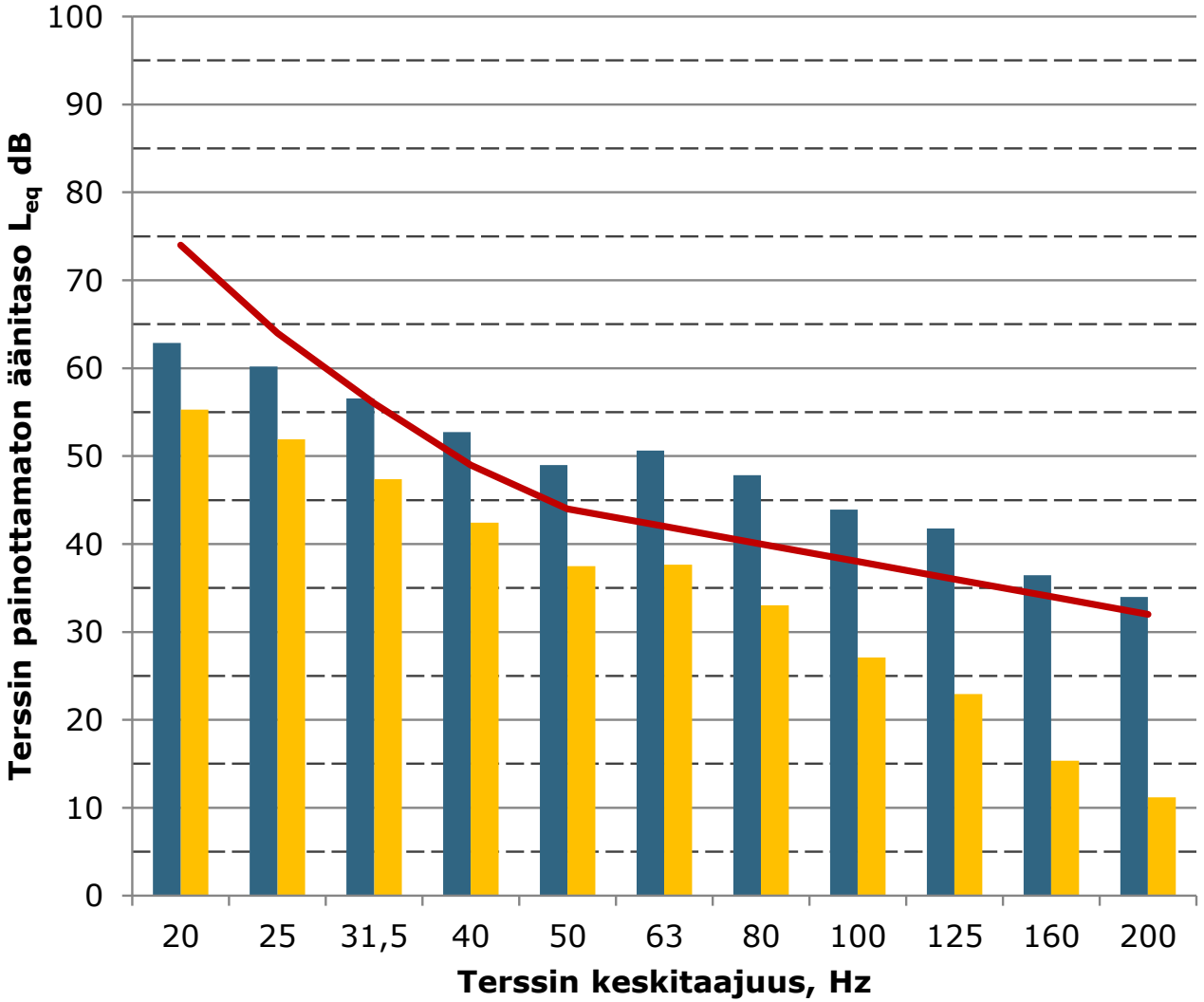


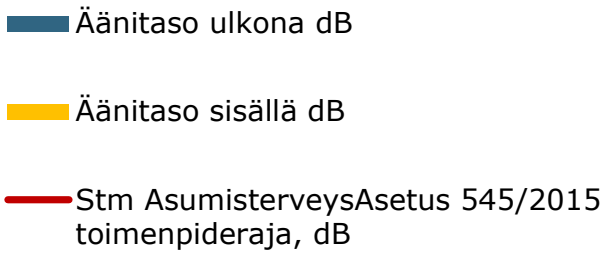
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus D, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



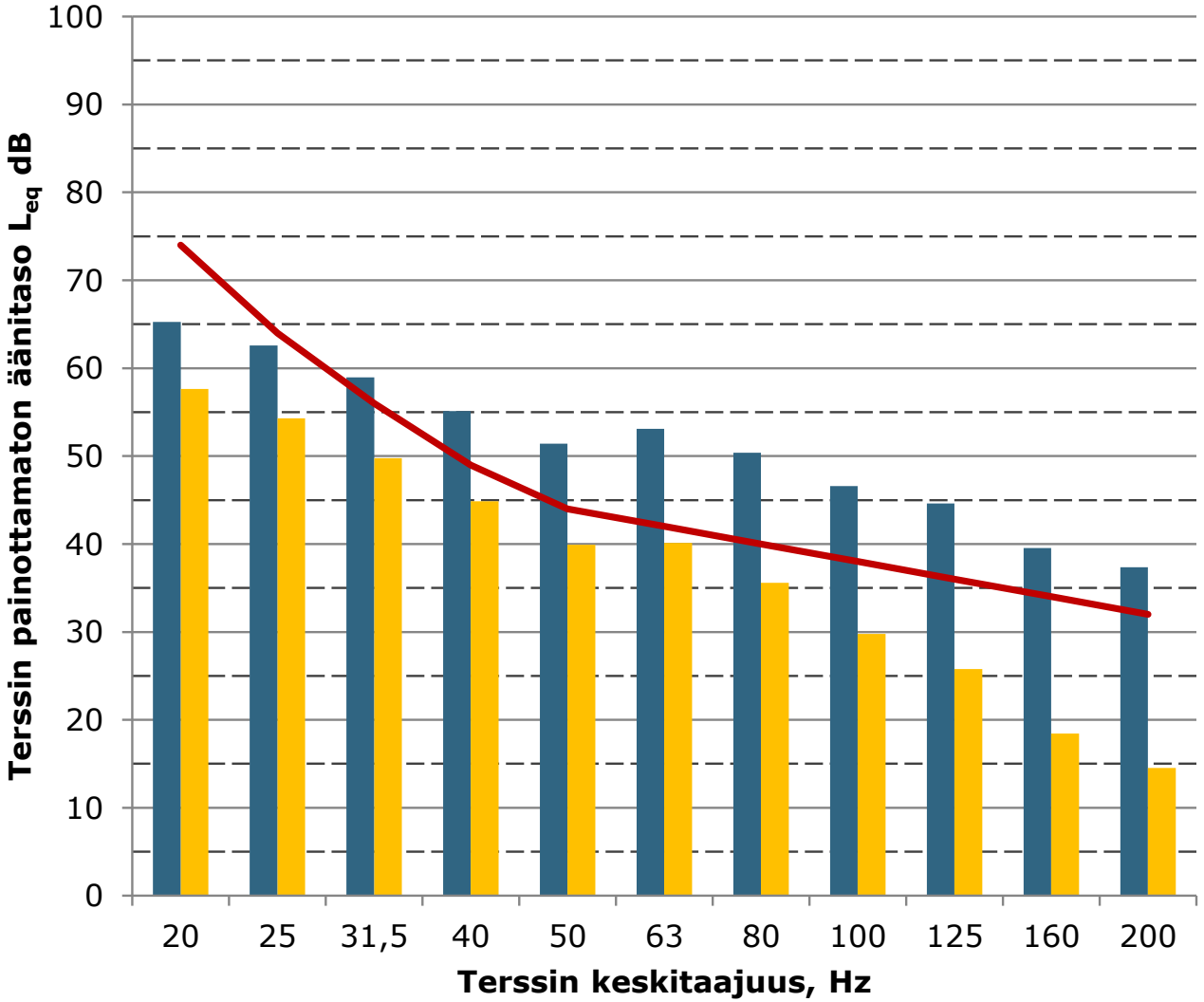


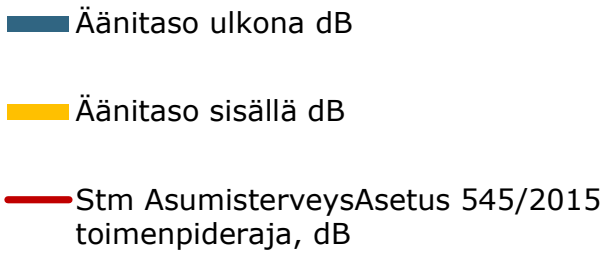
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus E, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



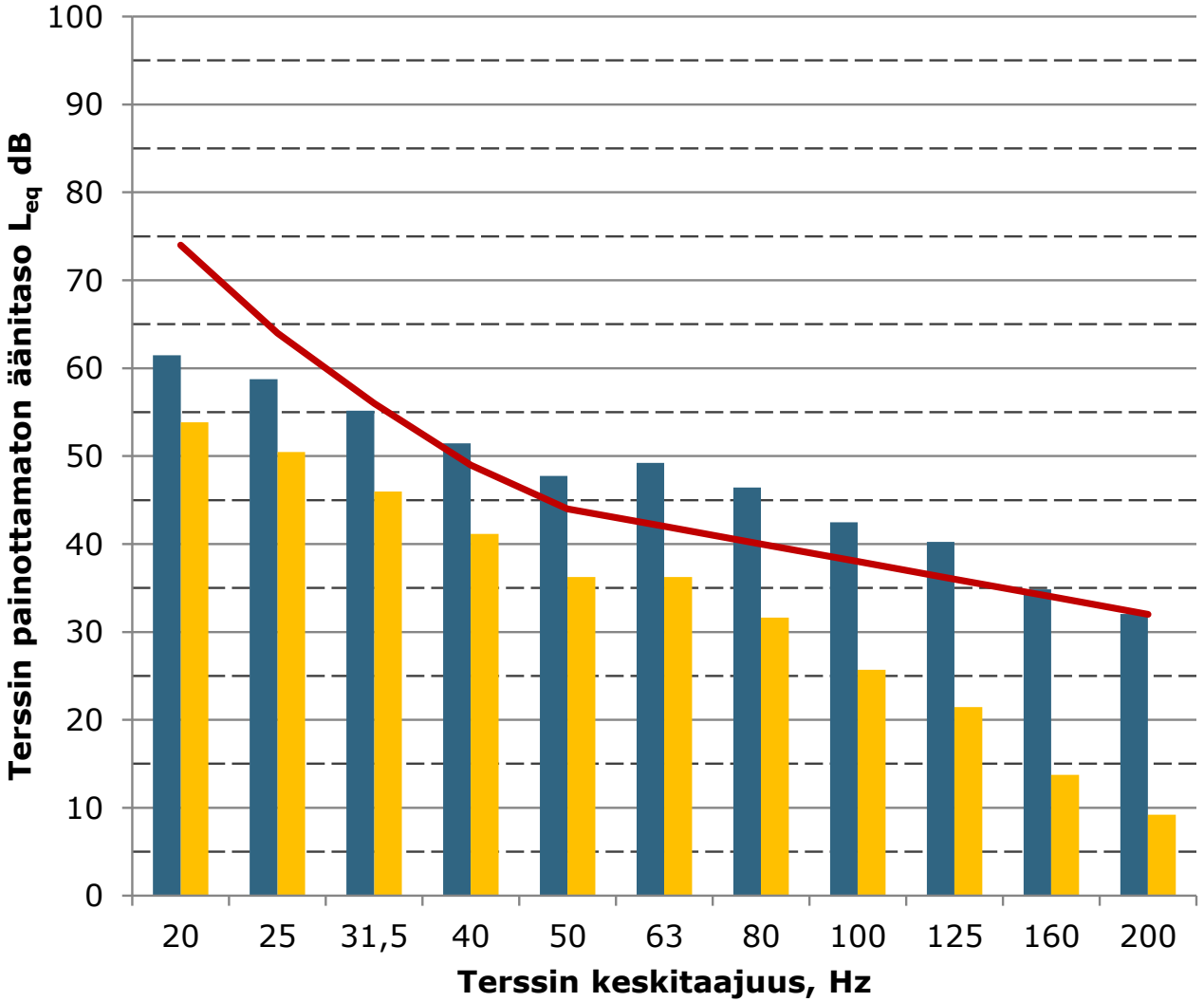


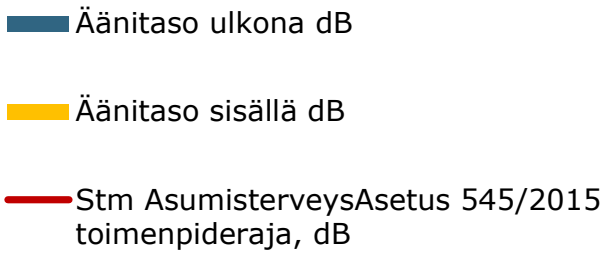
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus F, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



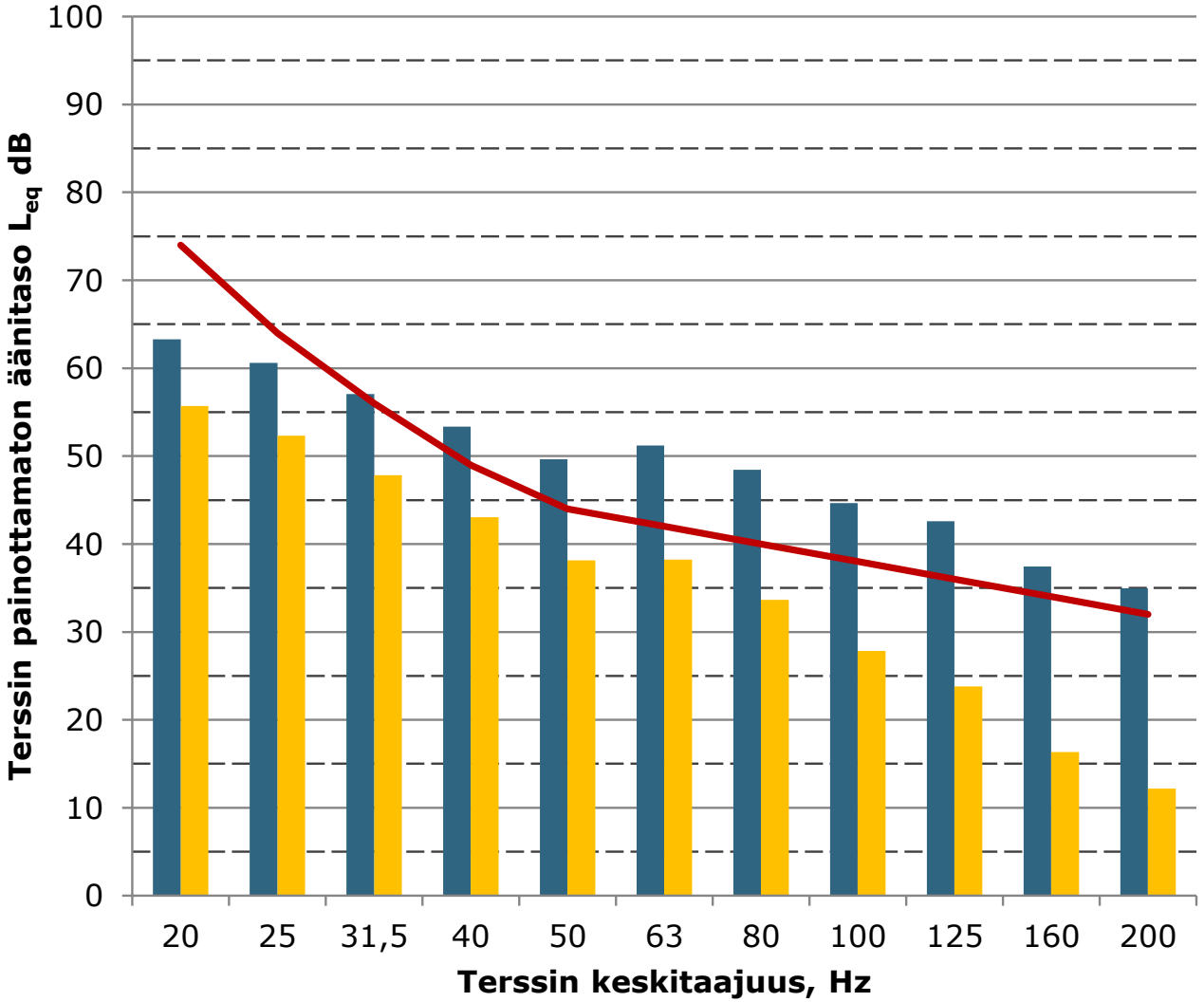


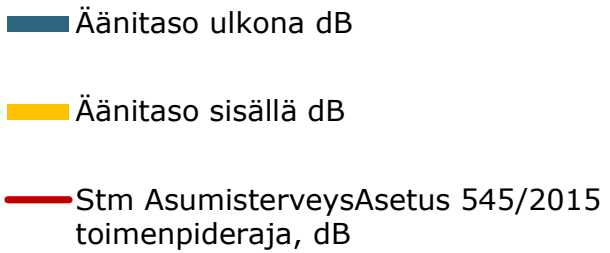
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus G, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



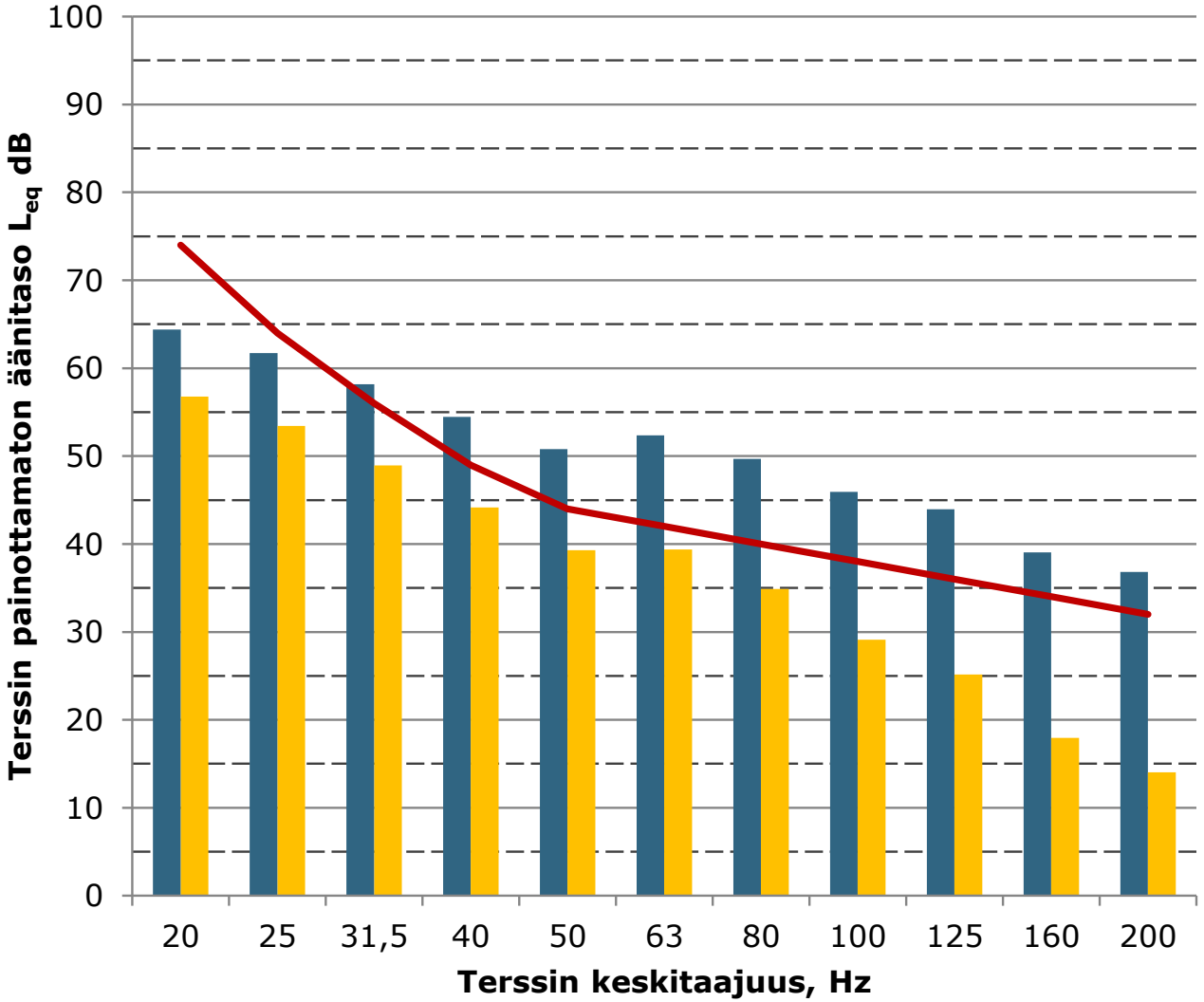


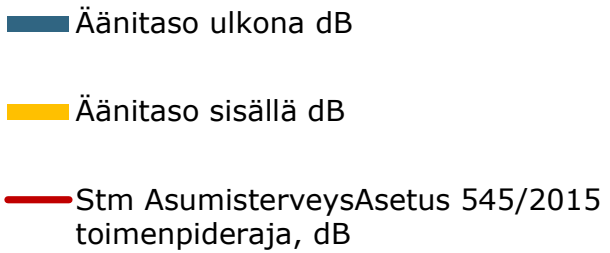
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus H, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



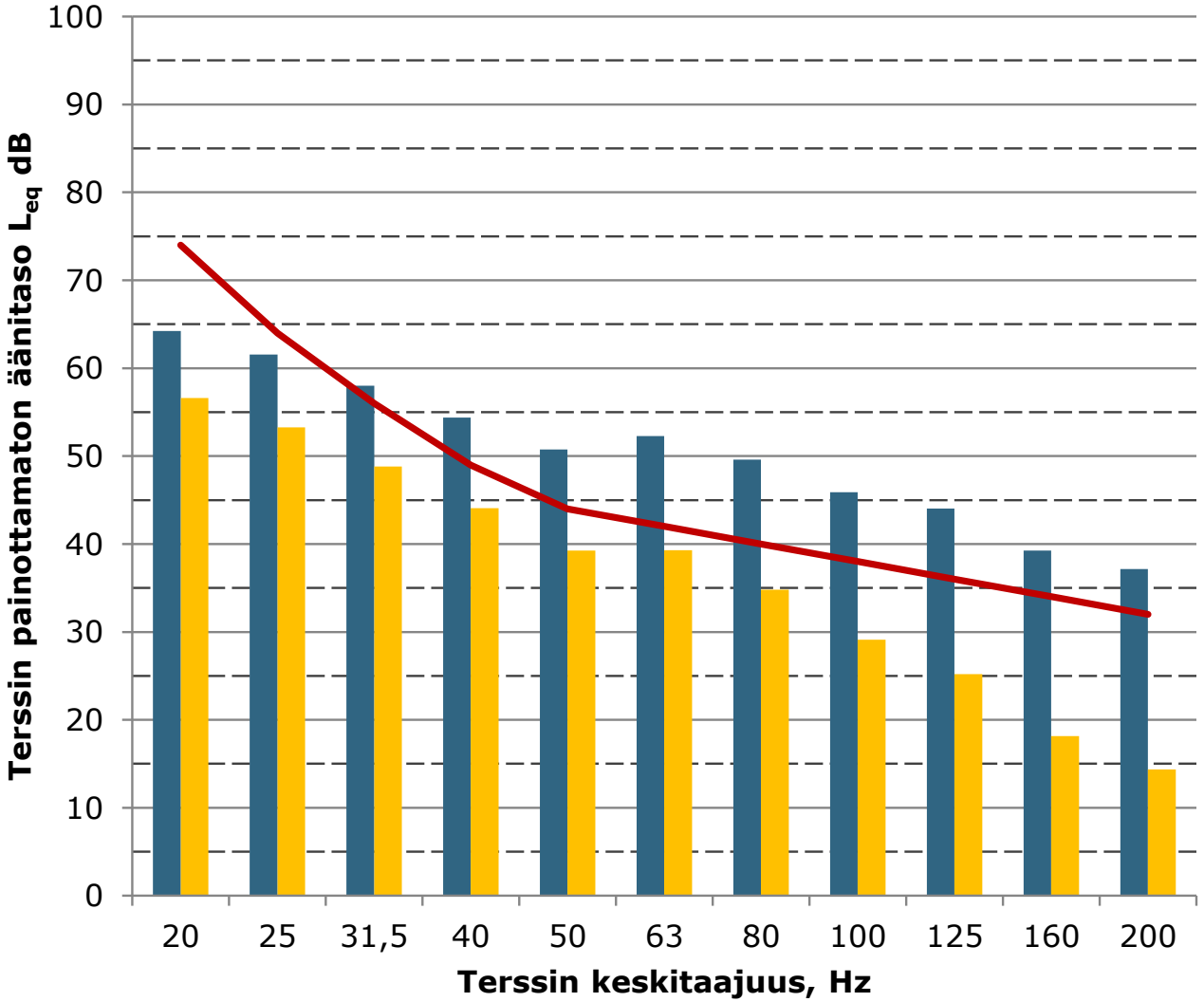


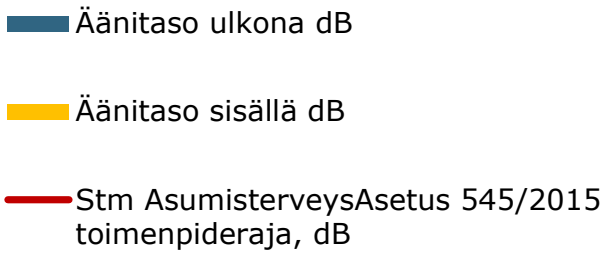
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus I, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



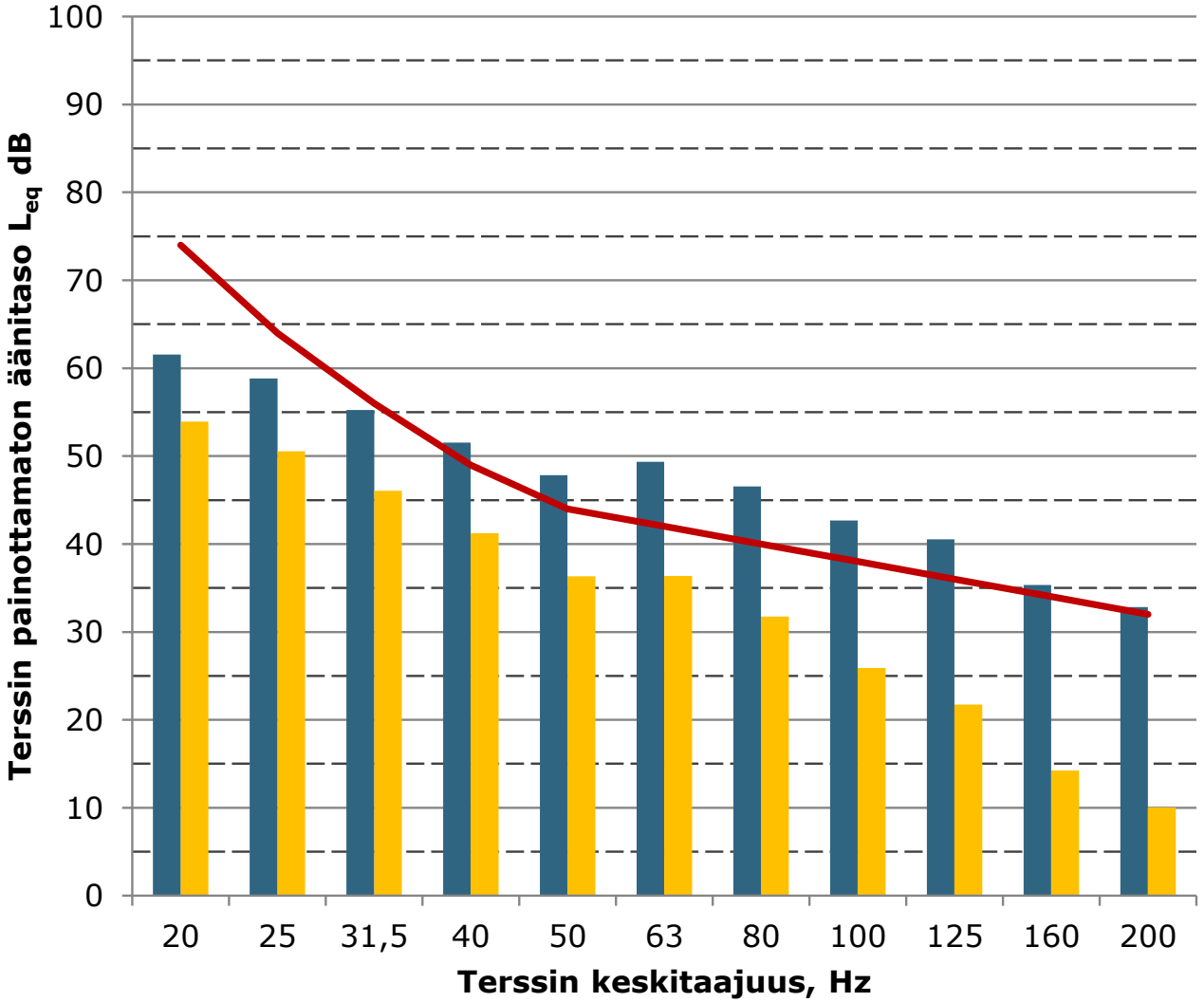


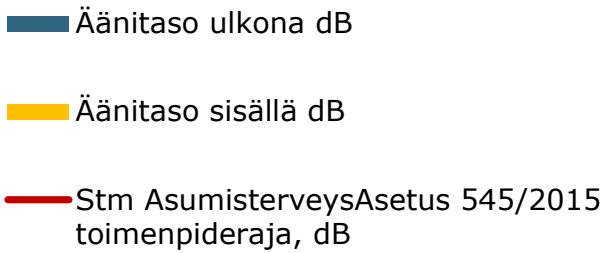
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus J, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



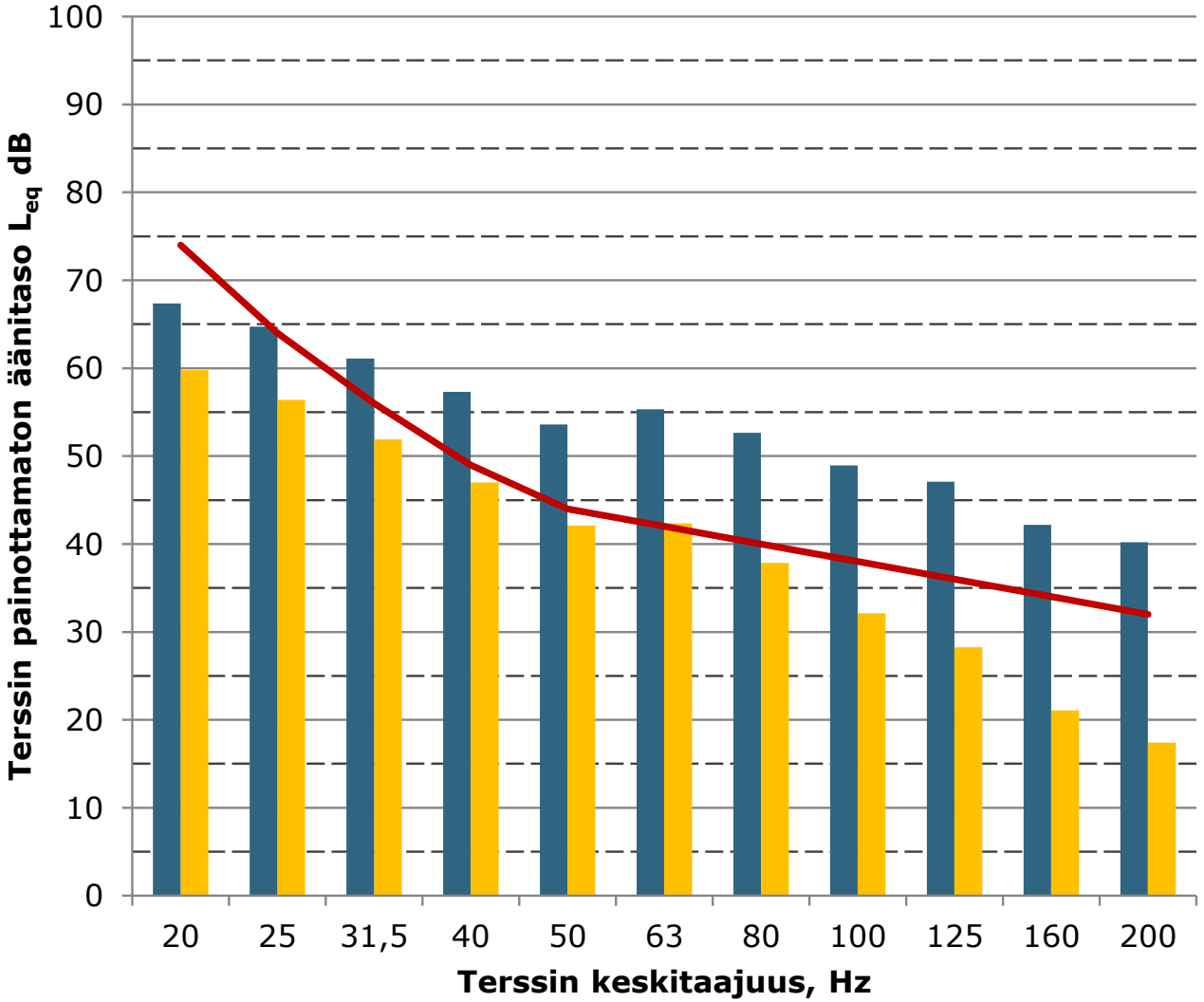


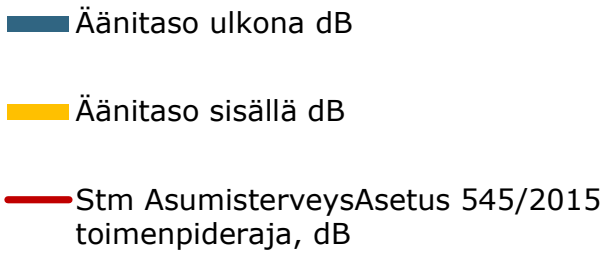
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus K, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



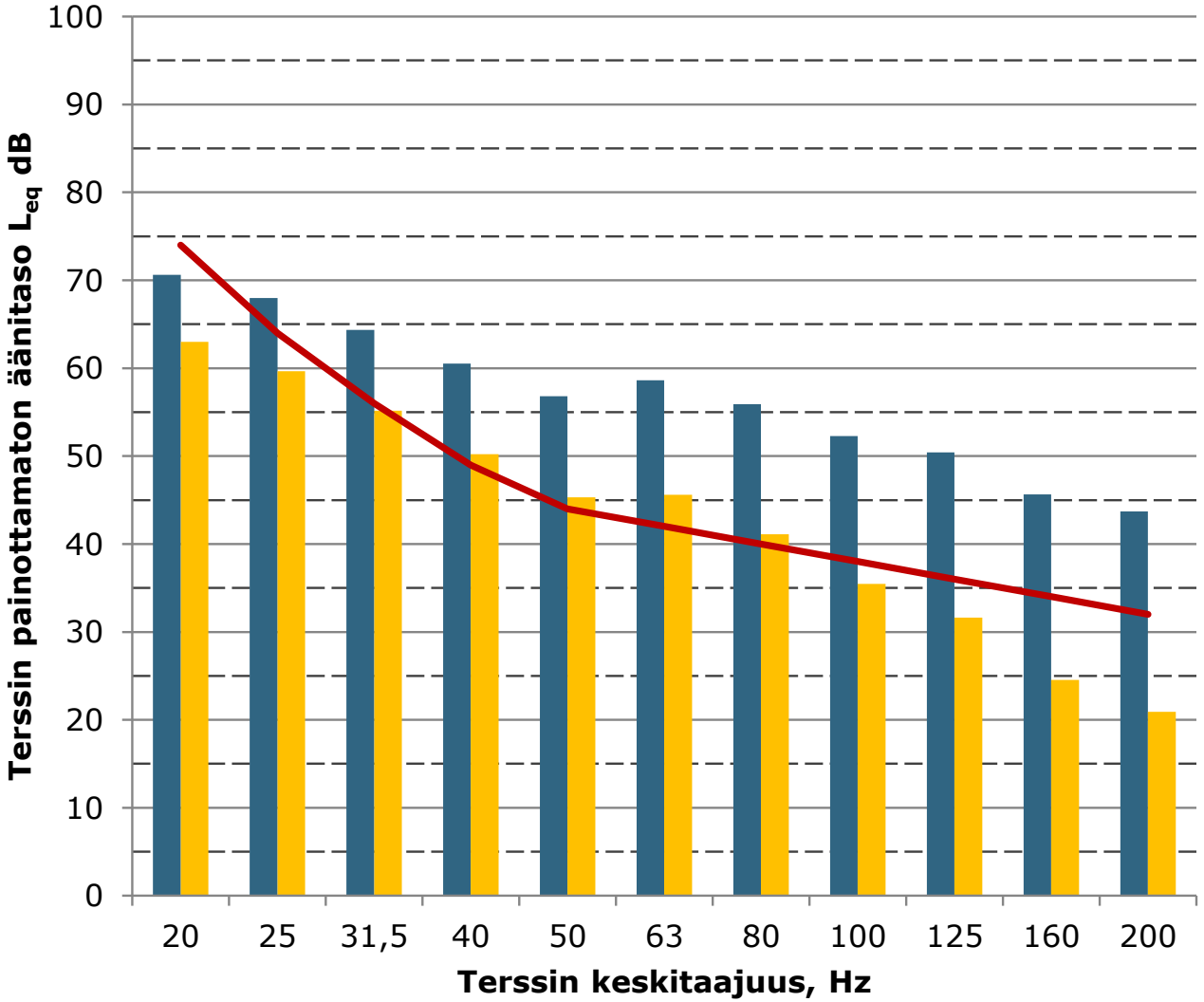


Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus L, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



Äänitaso ulkona dB

Äänitaso sisällä dB

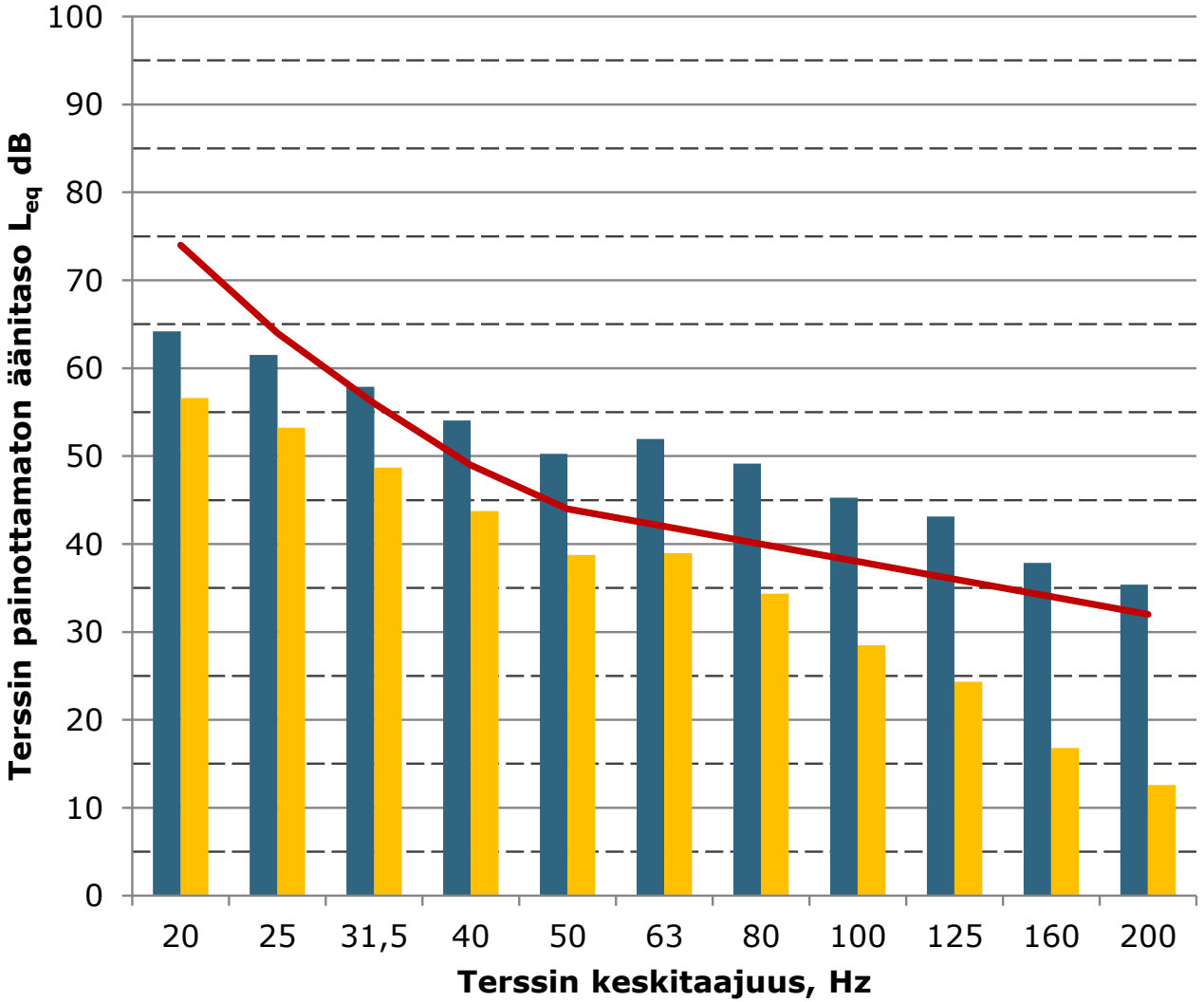
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB

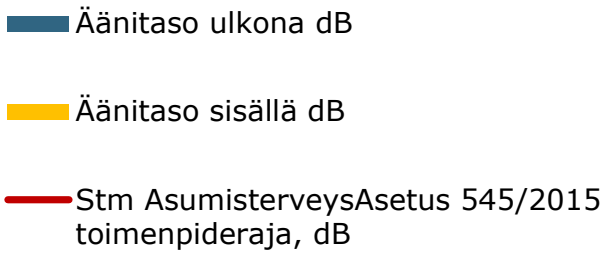
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus M, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



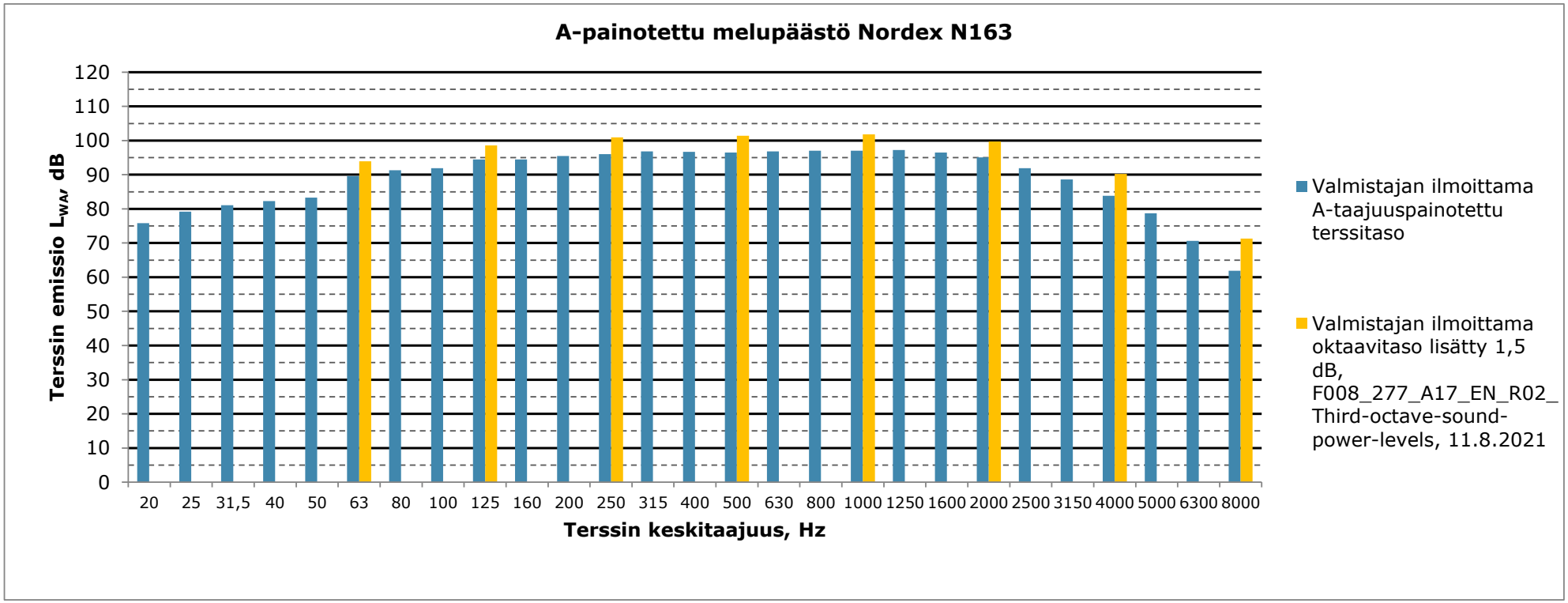


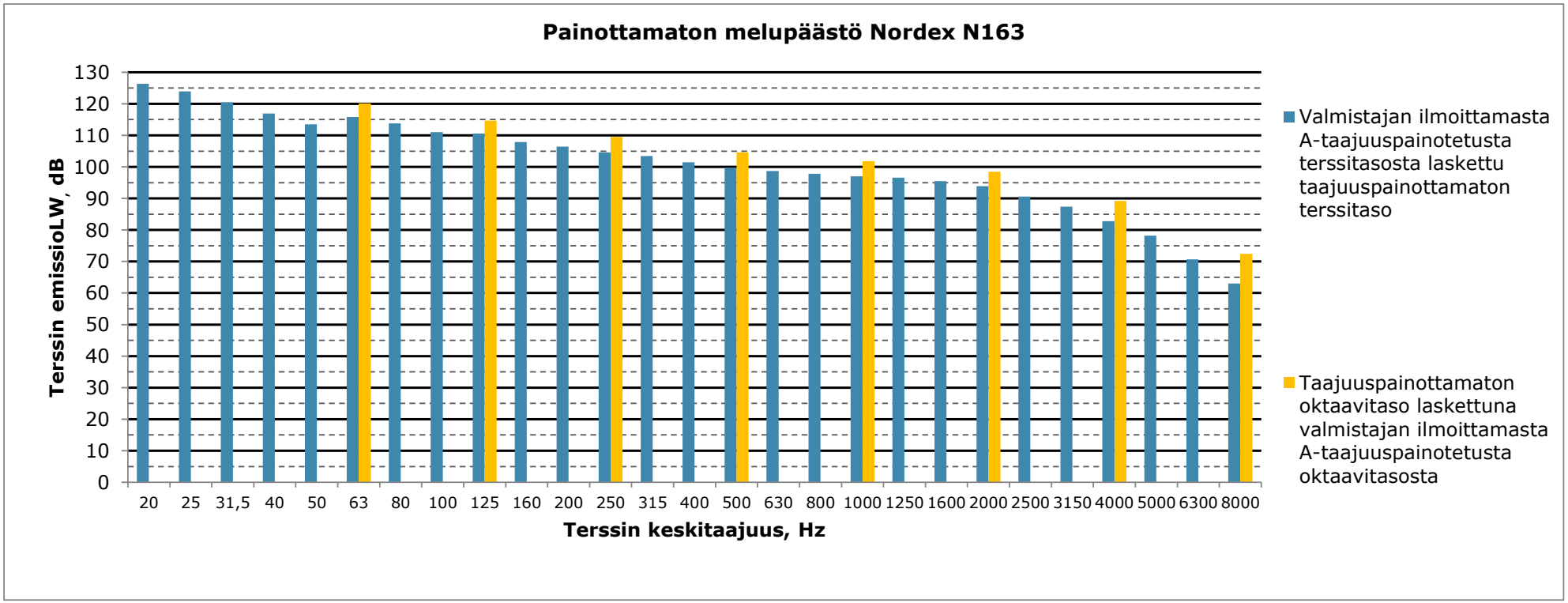
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	51
Generic 10MW	10 MW, 200 m,	67

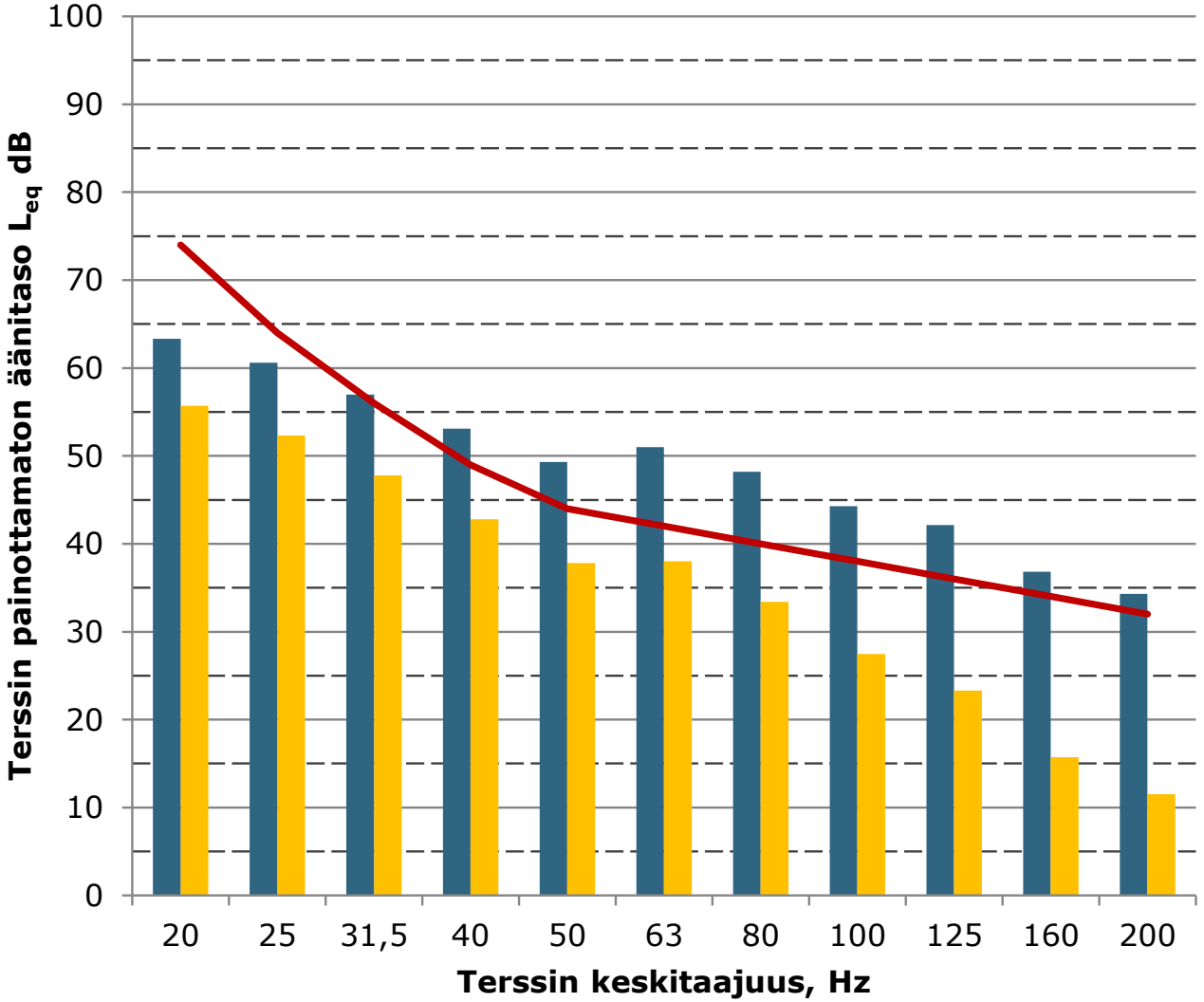
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

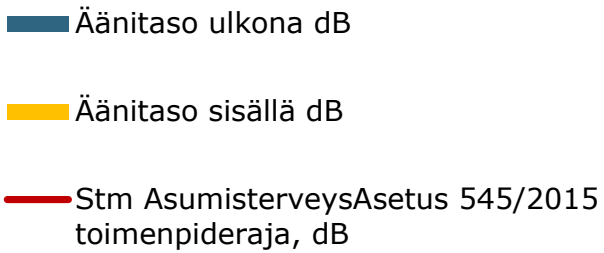
Liite 7. Katajamäen tuulivoimahanke – matalataajuisen melun rakennuskohtaiset arvot VE2 N163 - 6.8 MW.


A-painotettu melupäästö Nordex N163
Terssin emissio L_{WA} dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso lisätty 1,5 dB, F008_277_A17_EN_R02_ Third-octave-sound-power-levels, 11.8.2021


Painottamaton melupäästö Nordex N163
Terssin emissioLW, dB
130
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta

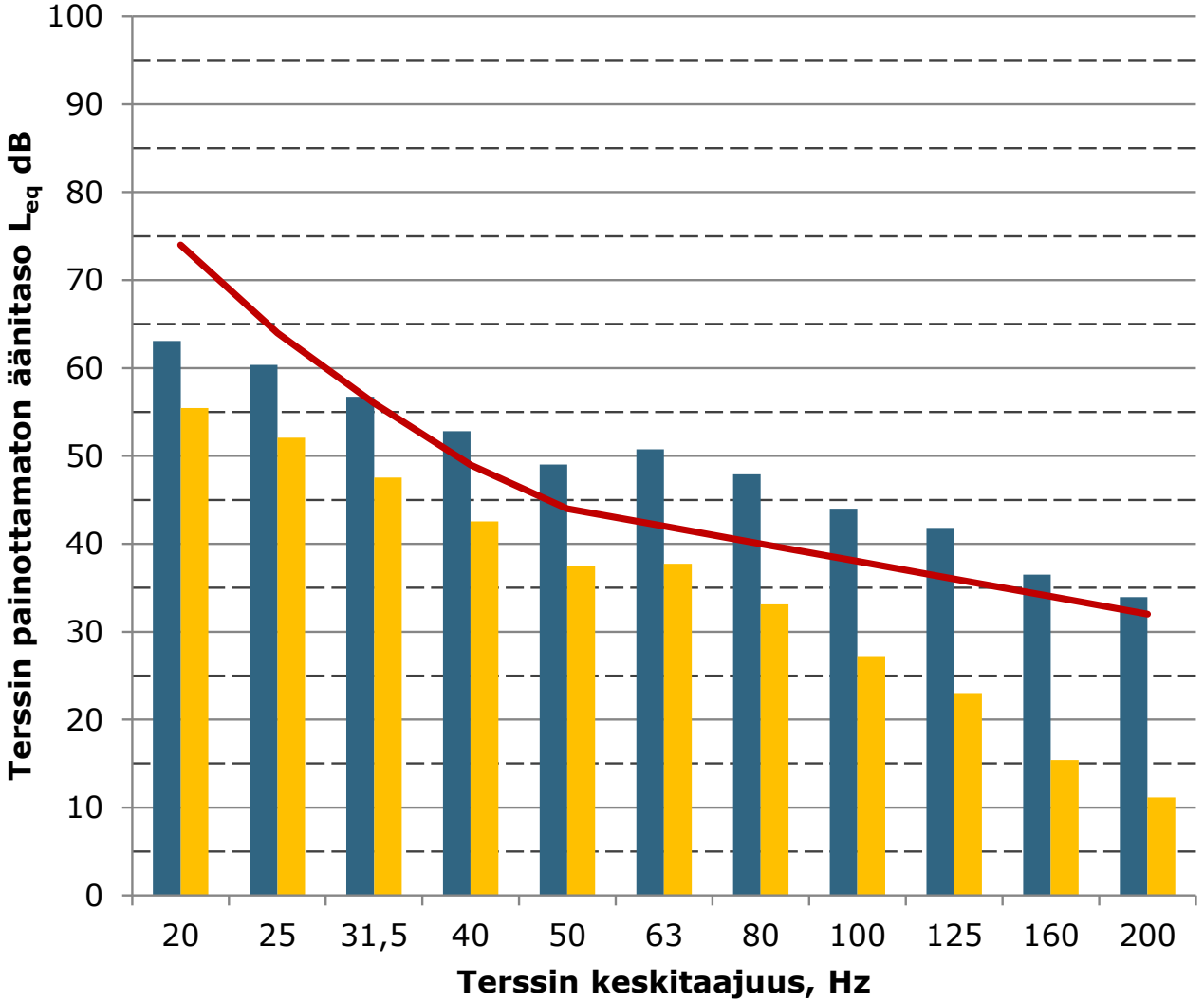
Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus M, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

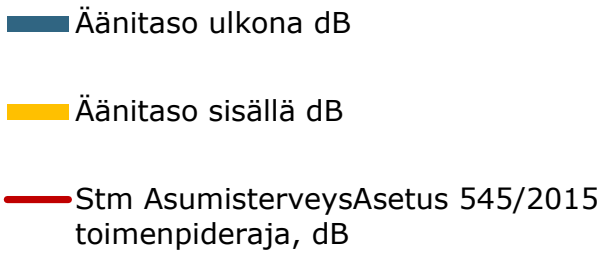




Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

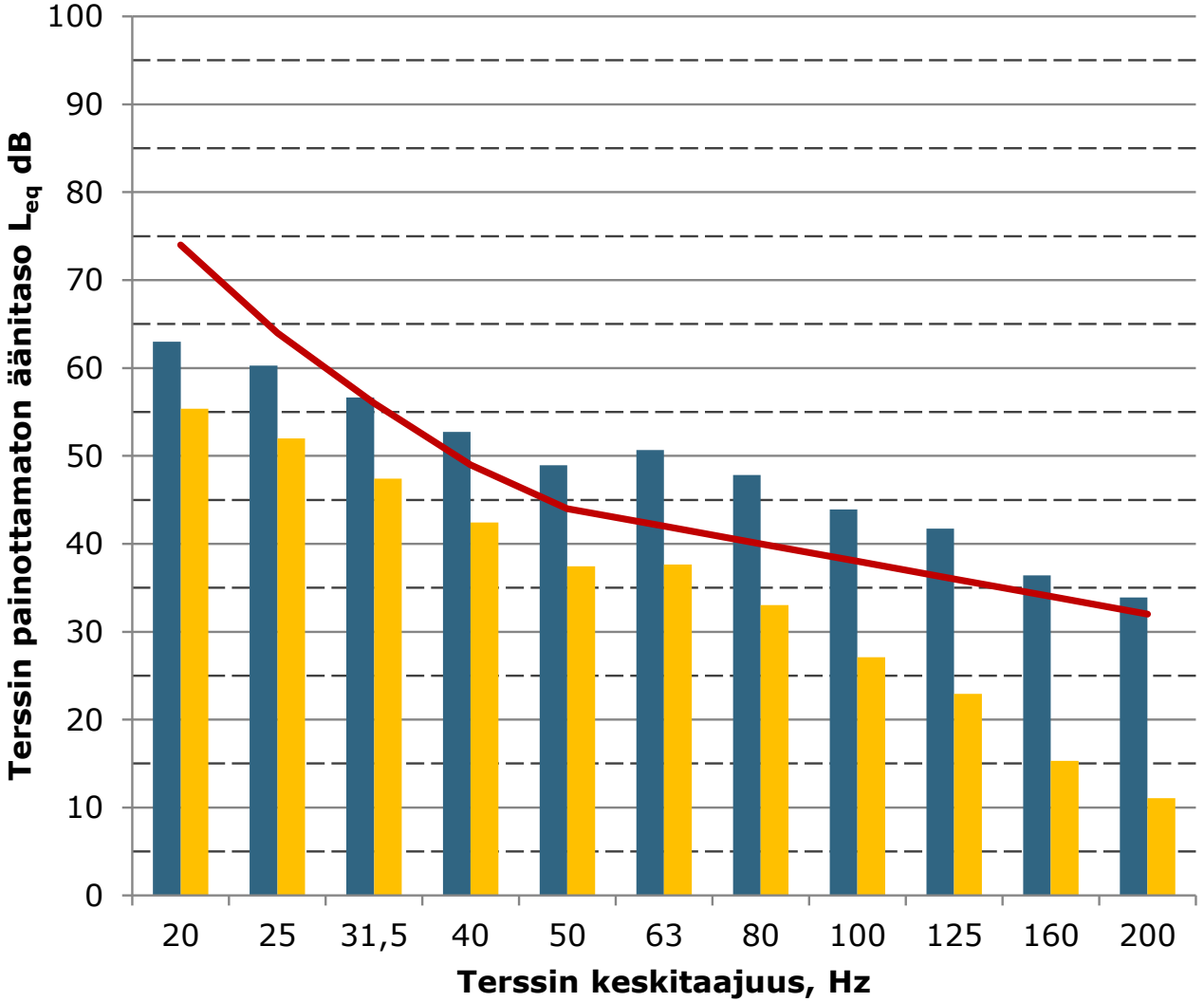
Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus A, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

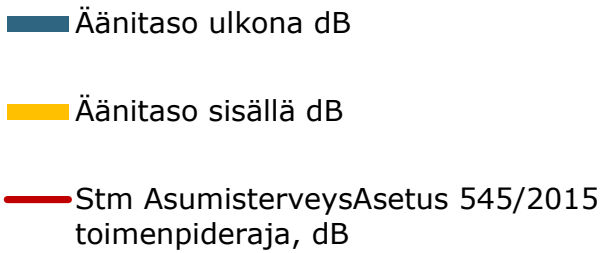




Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

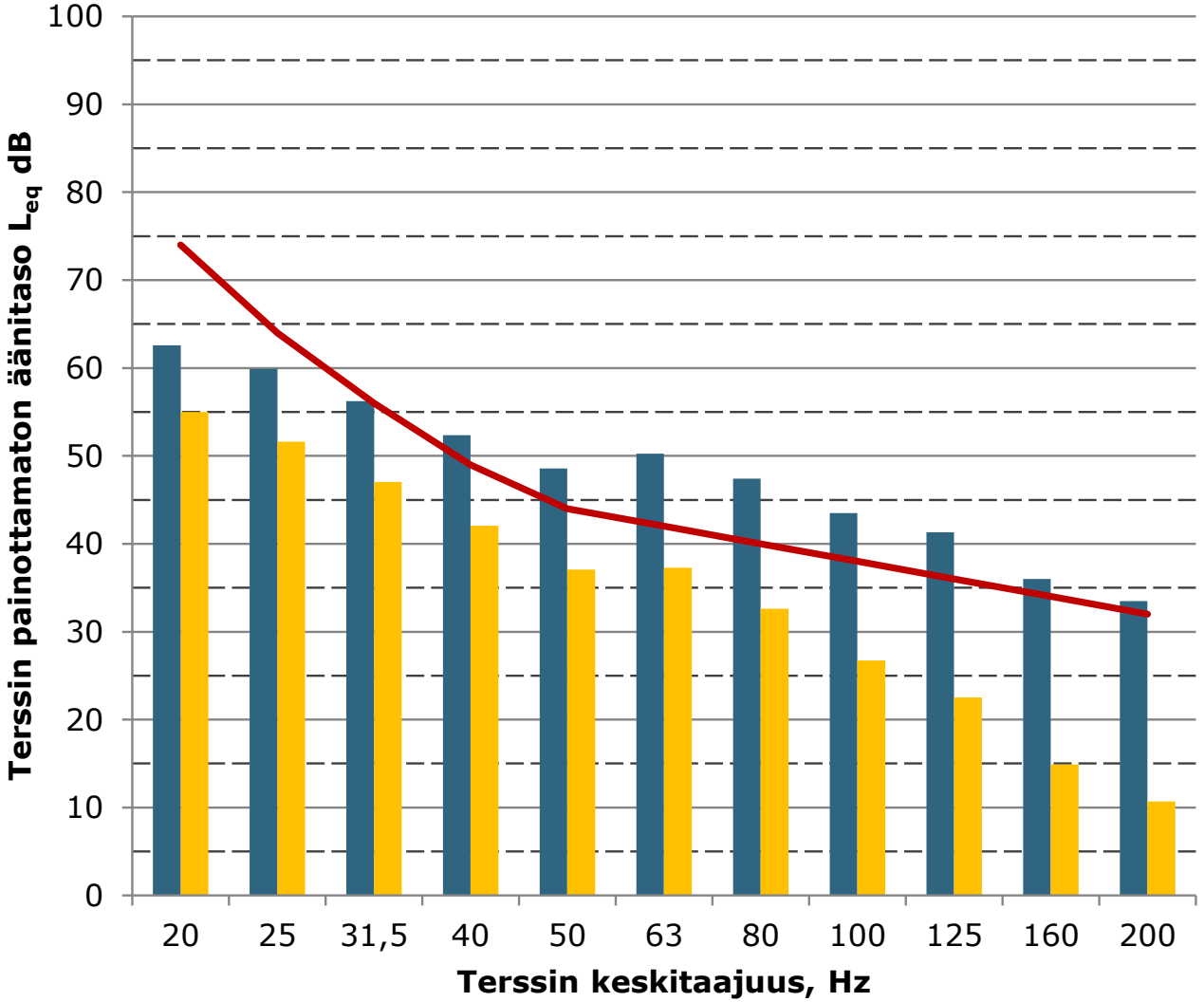
Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus B, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

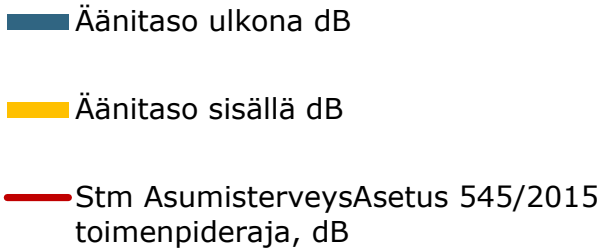




Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

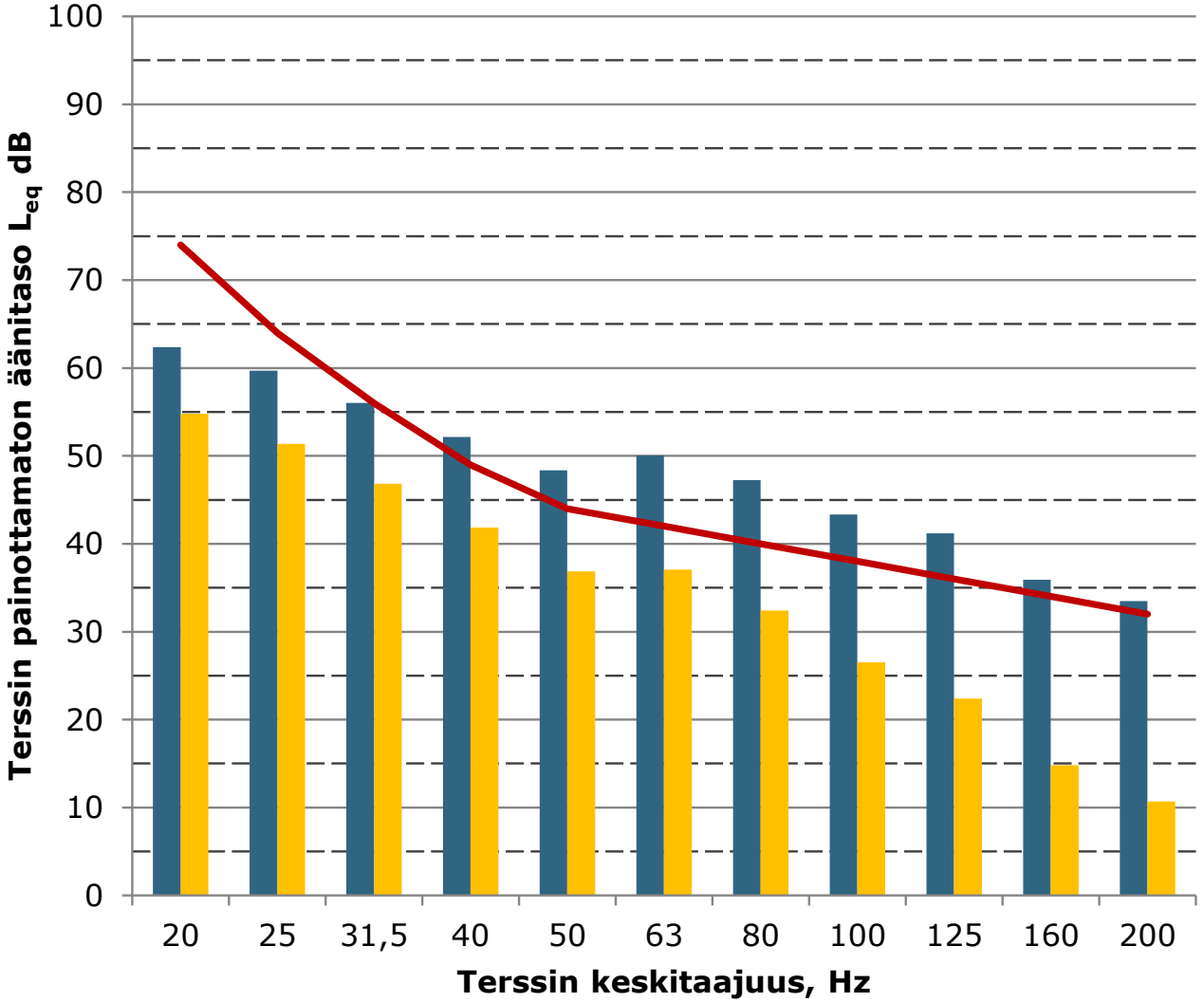
Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus C, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

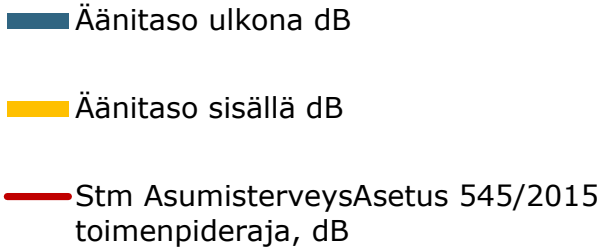




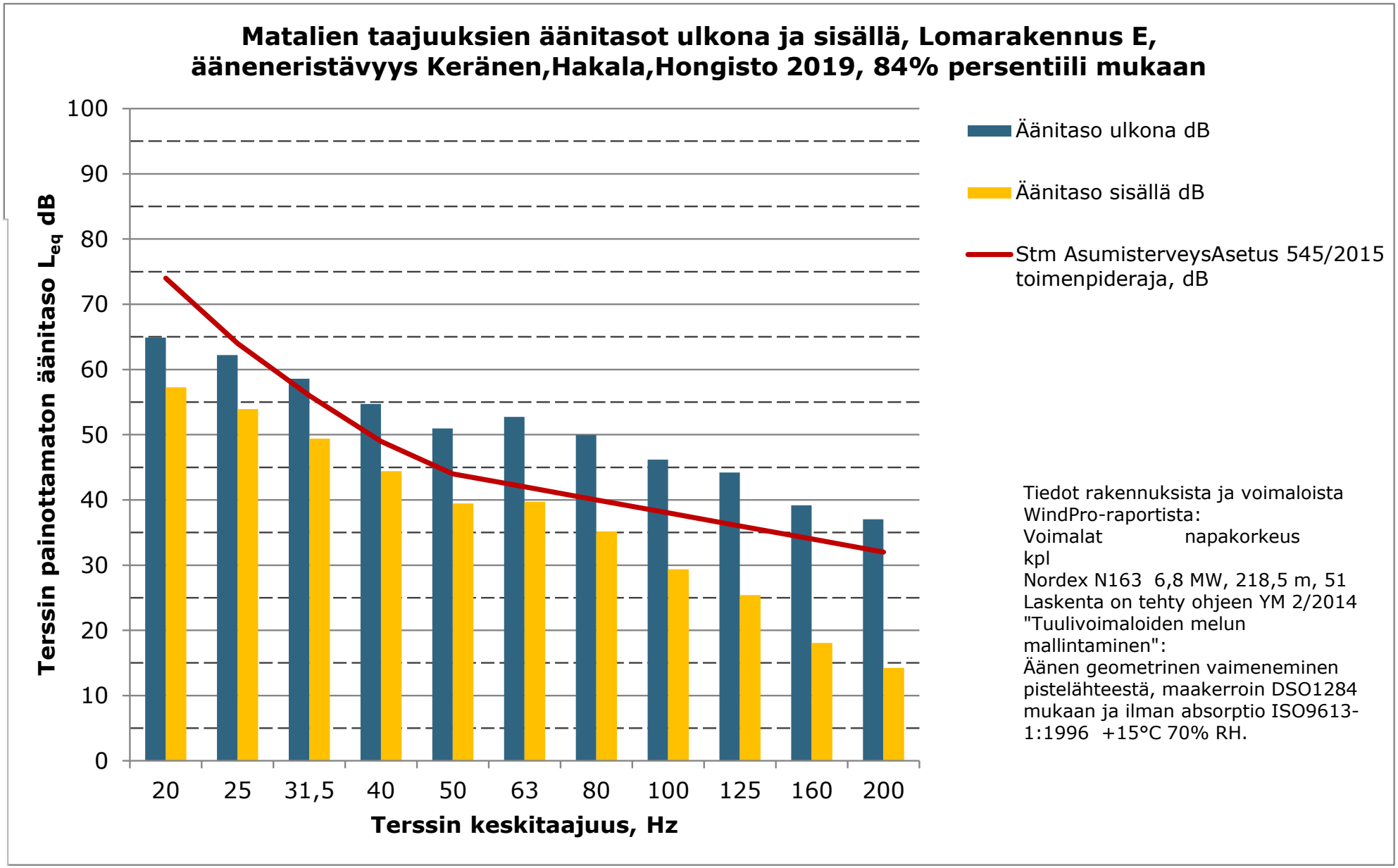
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

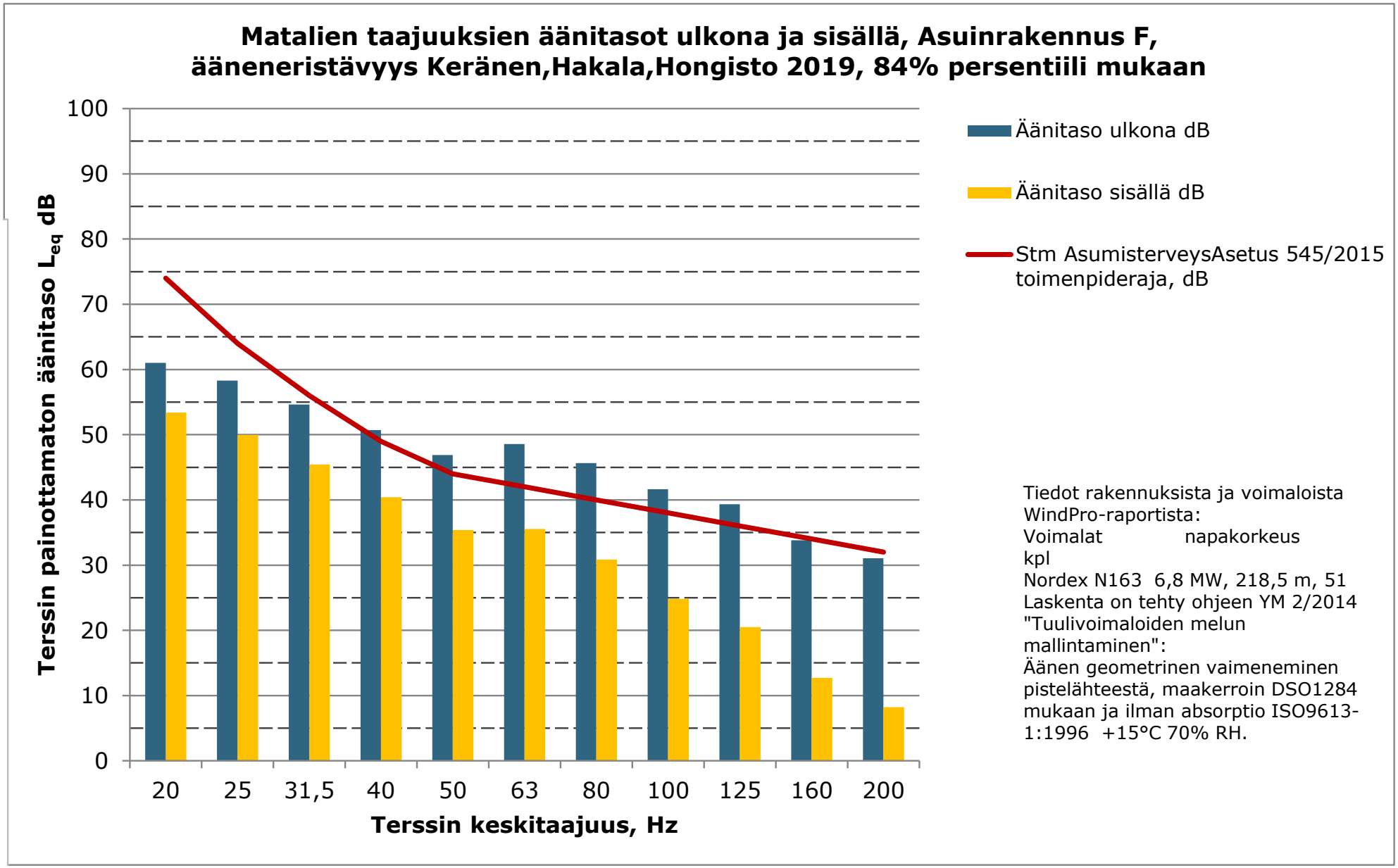
Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus D, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

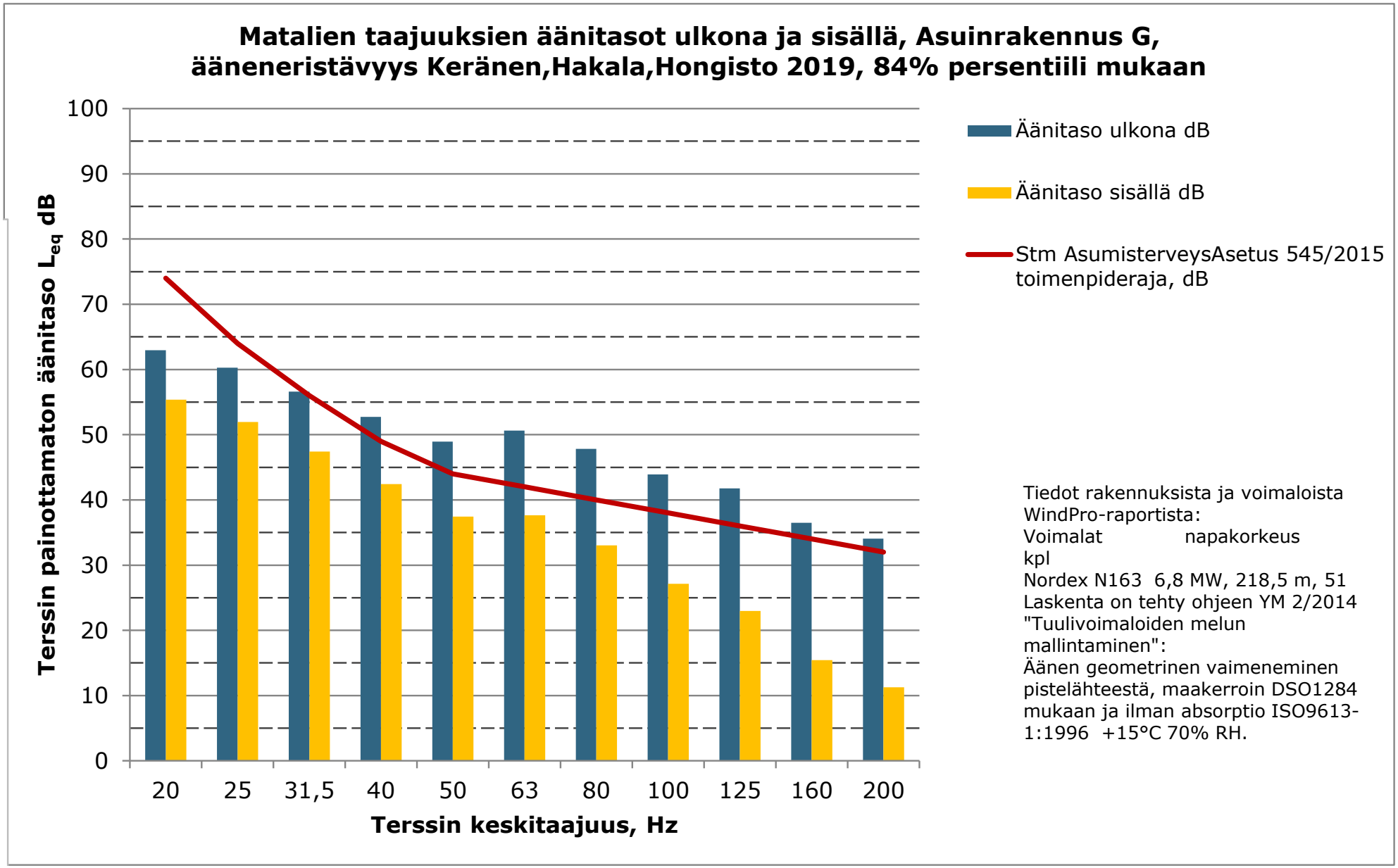




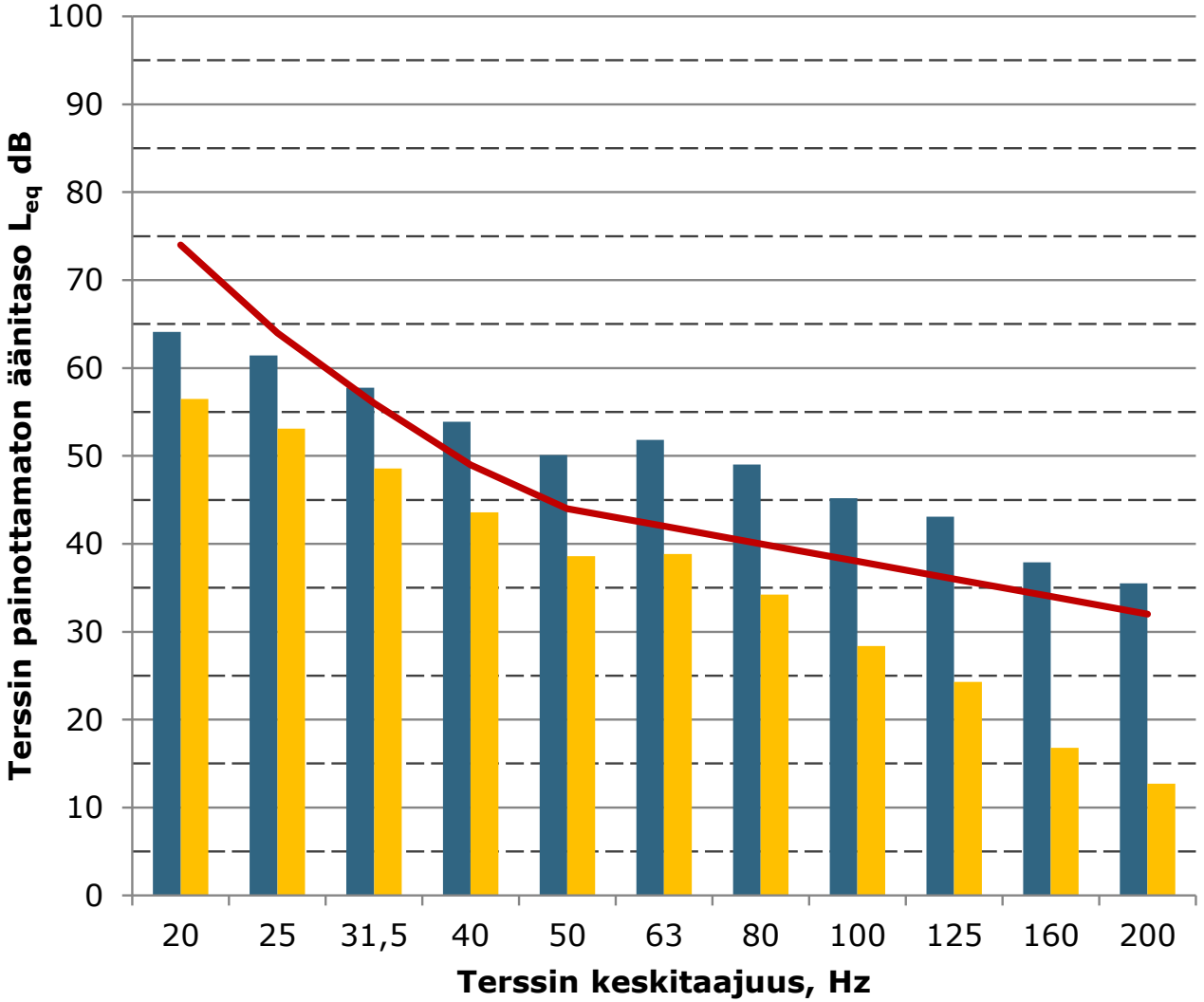
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

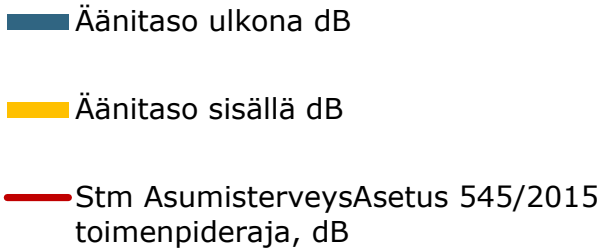

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus E, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan
Terssin painottamaton äänitaso L_{eq} dB
100
90
80
70
60
50
40
30
20
10
0
20
25
31,5
40
50
63
80
100
125
160
200
Terssin keskitaajuus, Hz
Äänitaso ulkona dB
Äänitaso sisällä dB
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.


Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus F, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan
Terssin painottamaton äänitaso L_{eq} dB
100
90
80
70
60
50
40
30
20
10
0
20
25
31,5
40
50
63
80
100
125
160
200
Terssin keskitaajuus, Hz
Äänitaso ulkona dB
Äänitaso sisällä dB
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

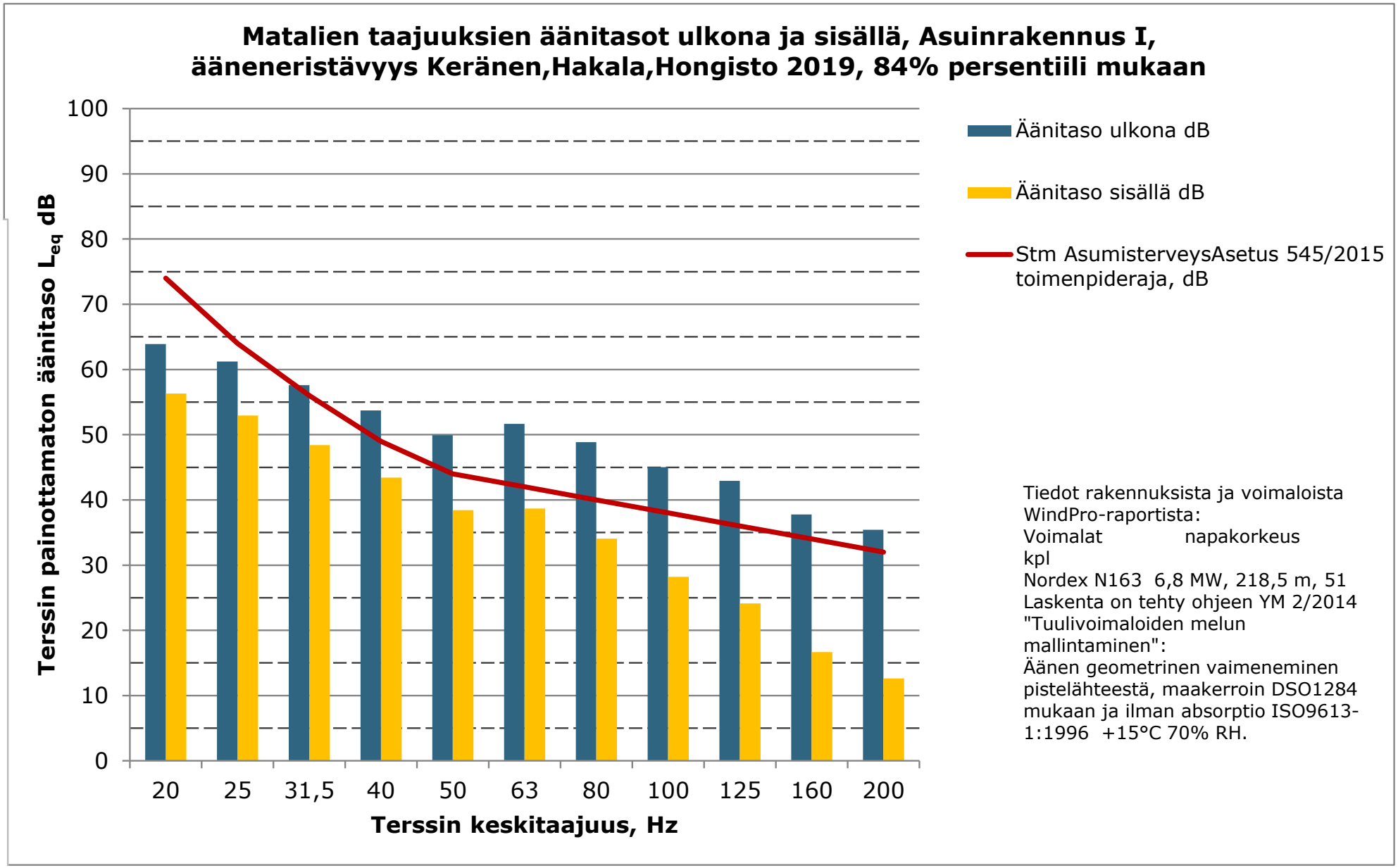

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus G, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan
Terssin painottamaton äänitaso L_{eq} dB
100
90
80
70
60
50
40
30
20
10
0
20
25
31,5
40
50
63
80
100
125
160
200
Terssin keskitaajuus, Hz
Äänitaso ulkona dB
Äänitaso sisällä dB
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus H, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

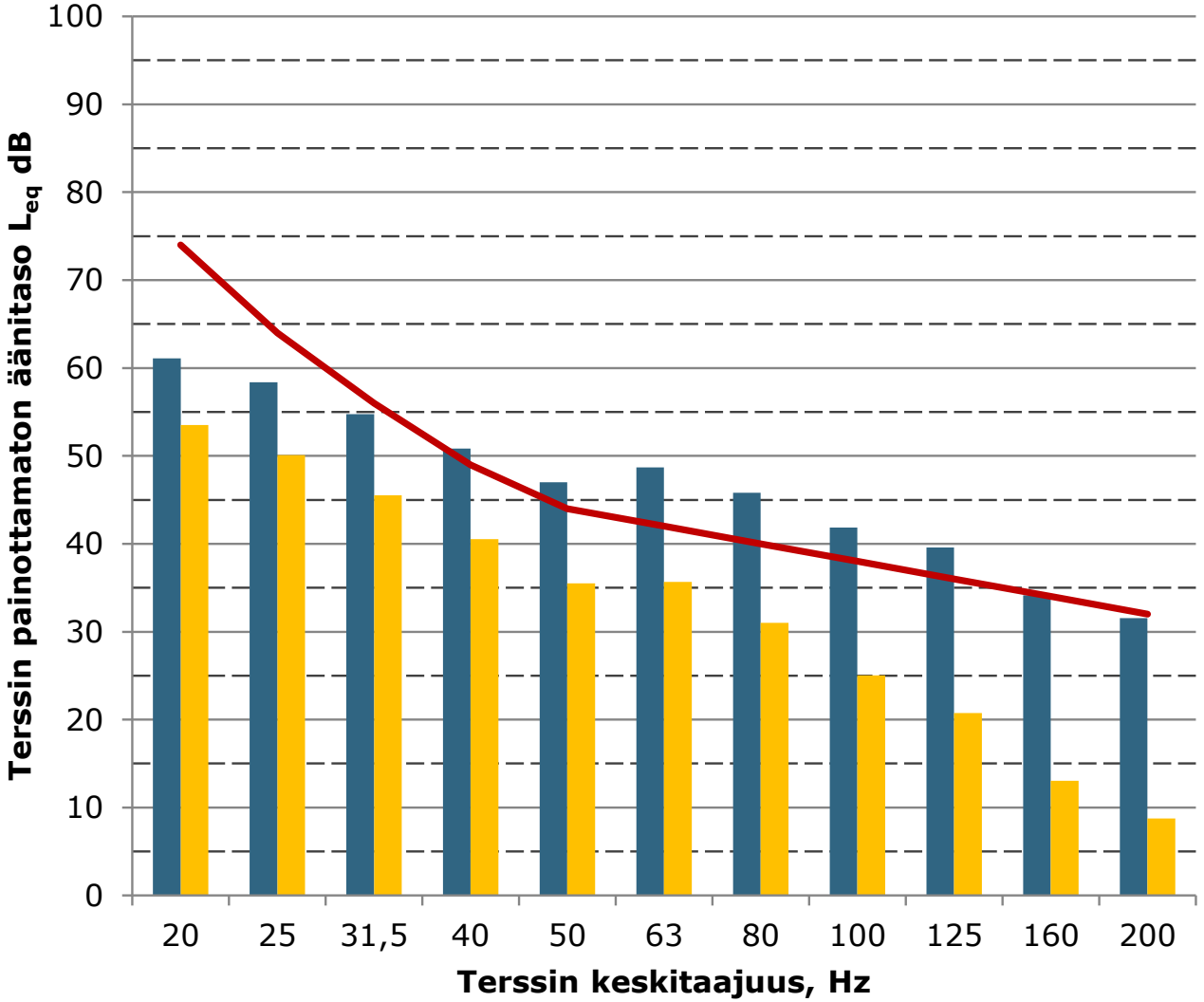


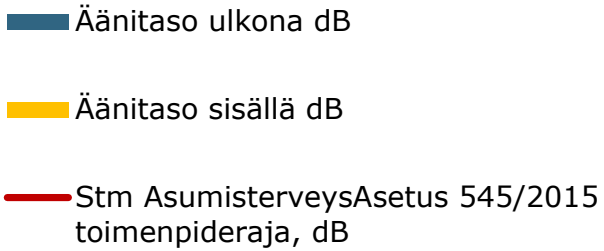


Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.


Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus I, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan
Terssin painottamaton äänitaso L_{eq} dB
100
90
80
70
60
50
40
30
20
10
0
20
25
31,5
40
50
63
80
100
125
160
200
Terssin keskitaajuus, Hz
Äänitaso ulkona dB
Äänitaso sisällä dB
Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

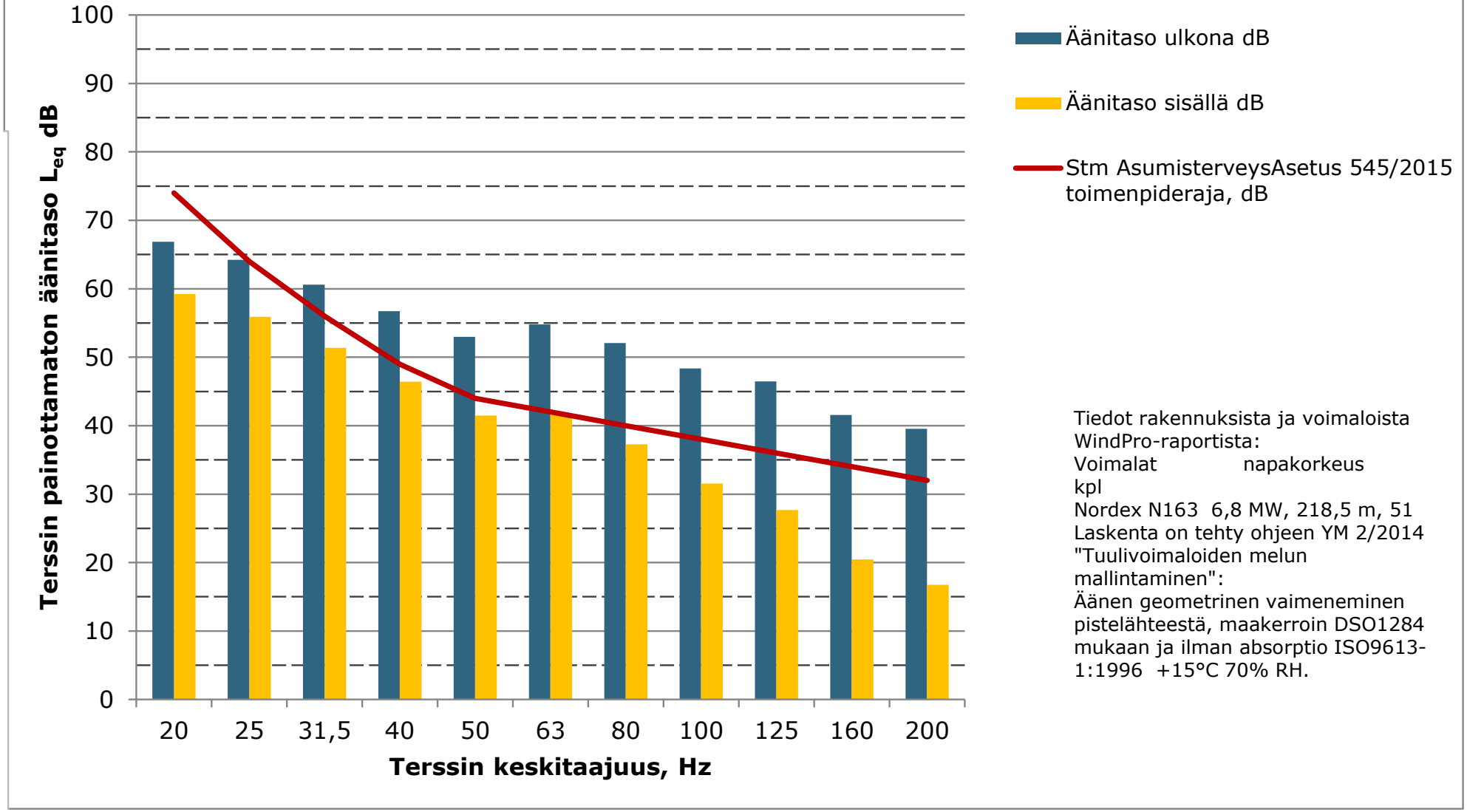
Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus J, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan





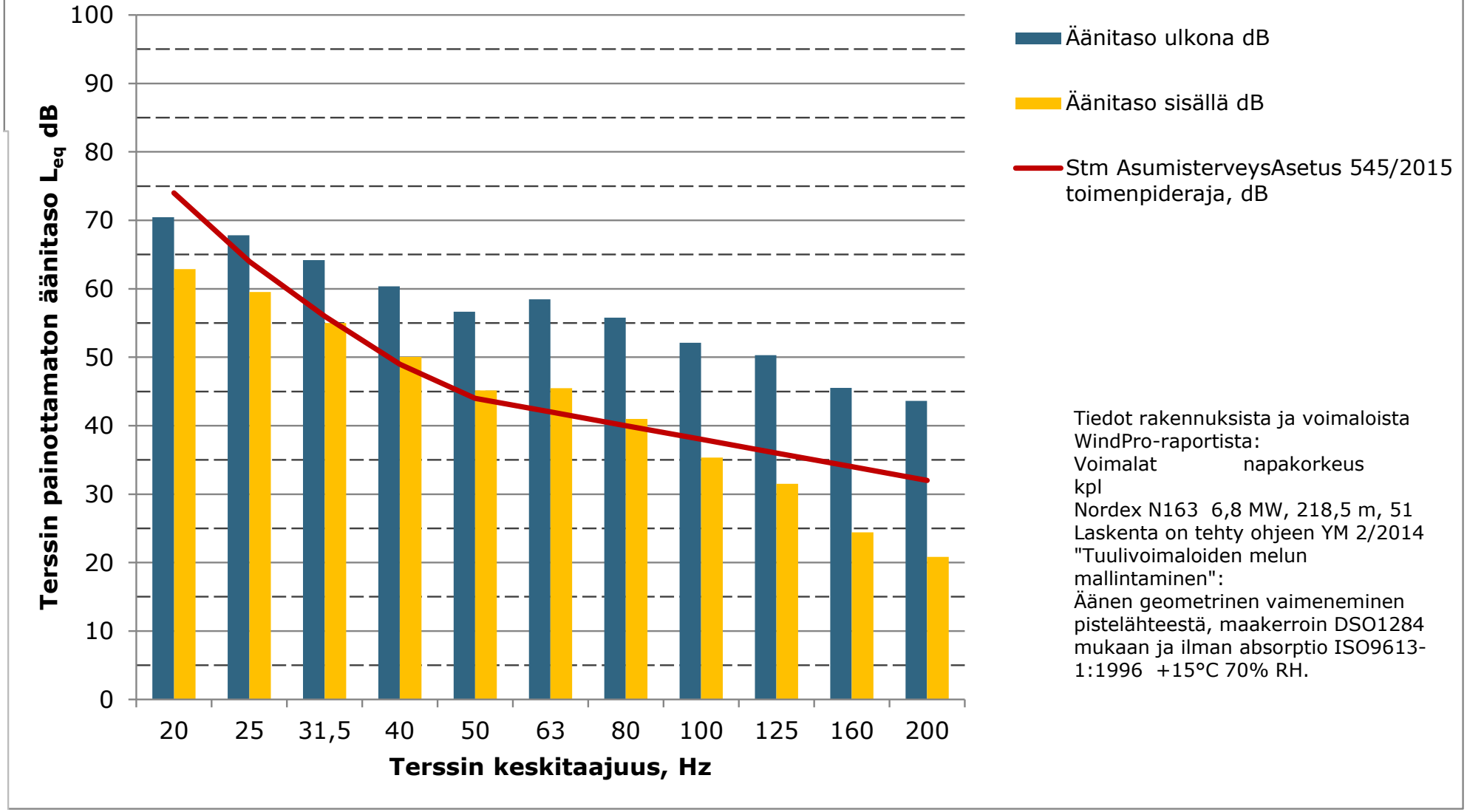
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus K, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



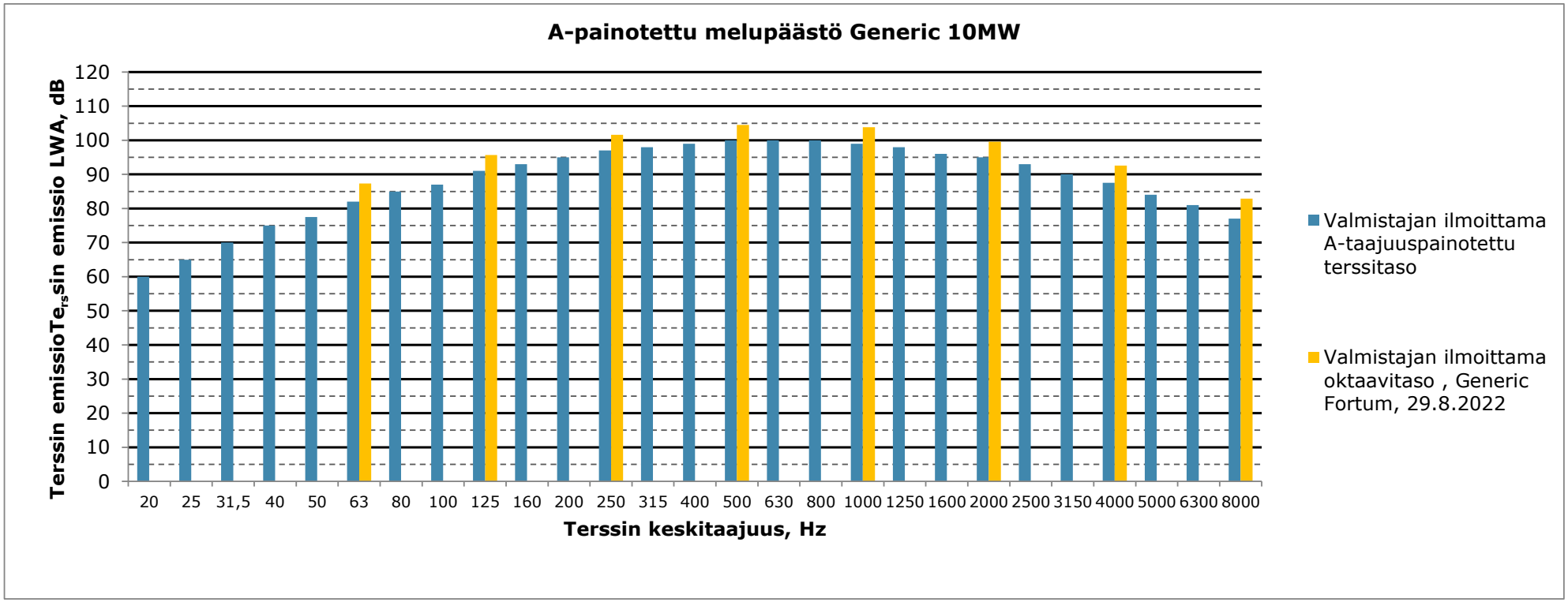
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

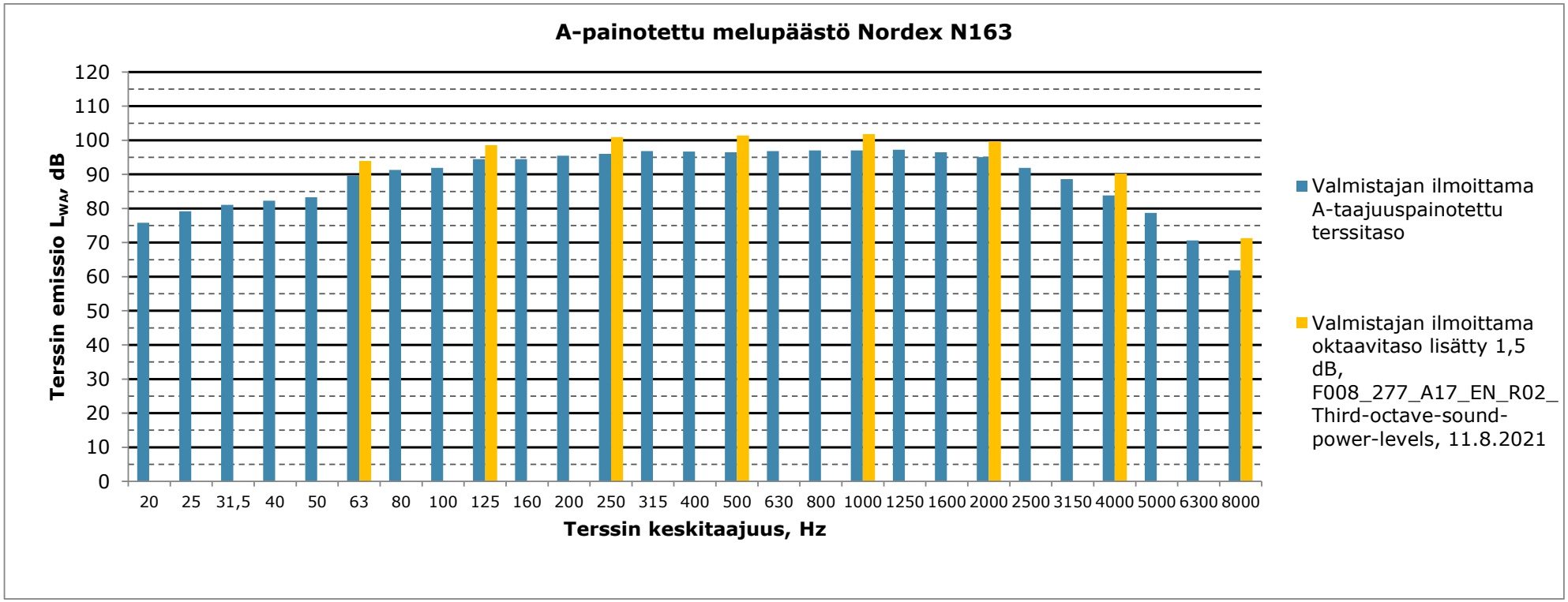
Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus L, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

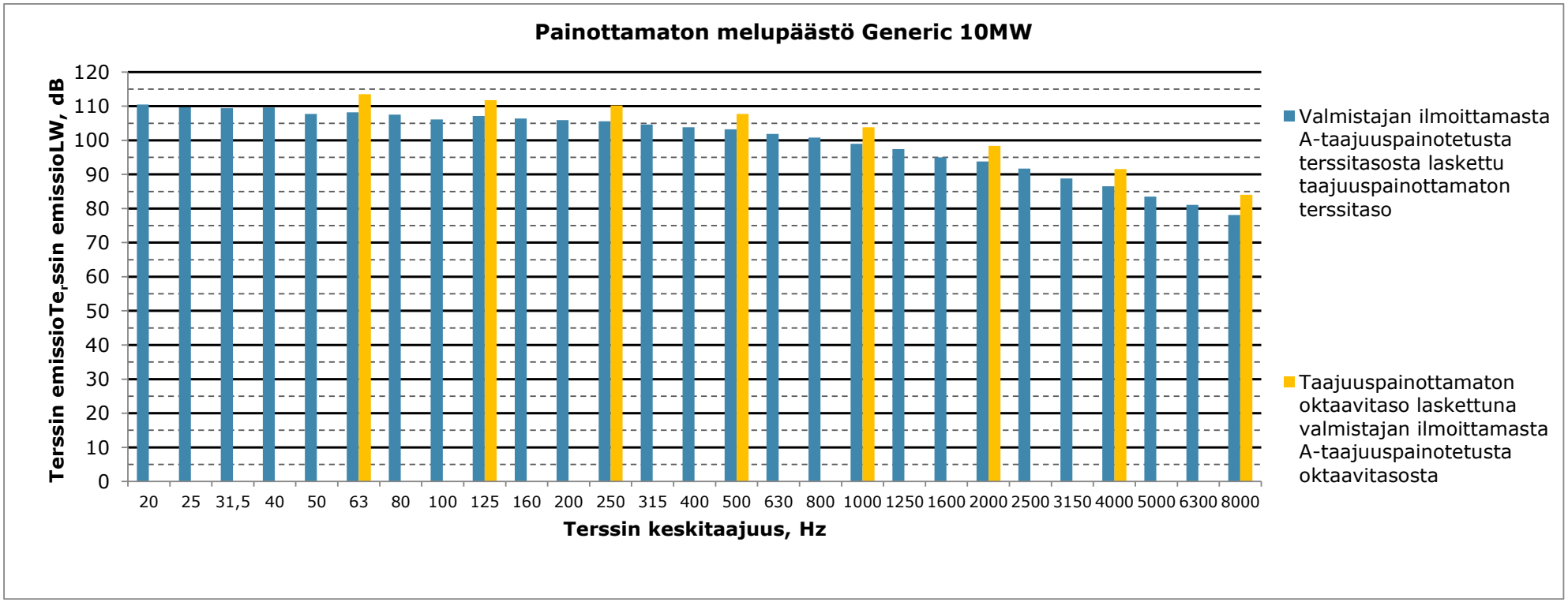


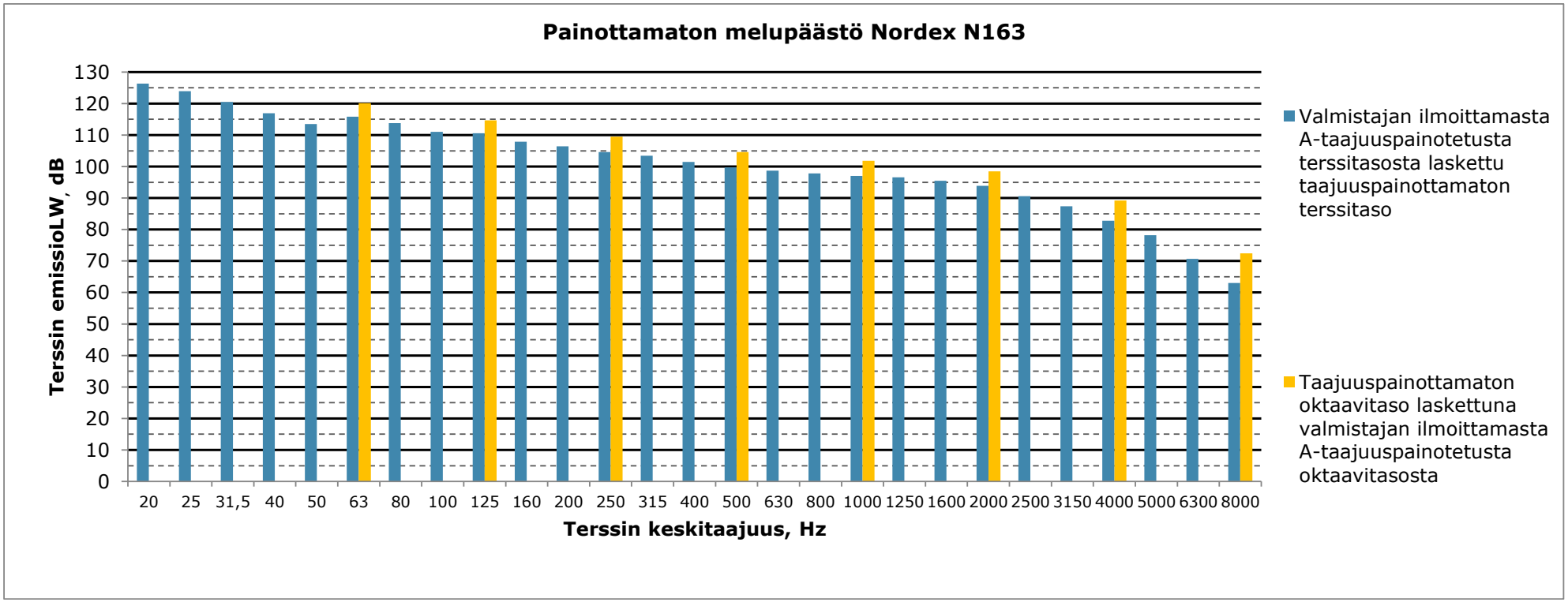
Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus
kpl
Nordex N163 6,8 MW, 218,5 m, 51
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Liite 8. Katajamäen tuulivoimahanke – matalataajuisen melun rakennuskohtaiset arvot VE2 N163 - 6.8 MW. Yhteisvaikutukset Kivikankaan hankkeen kanssa.

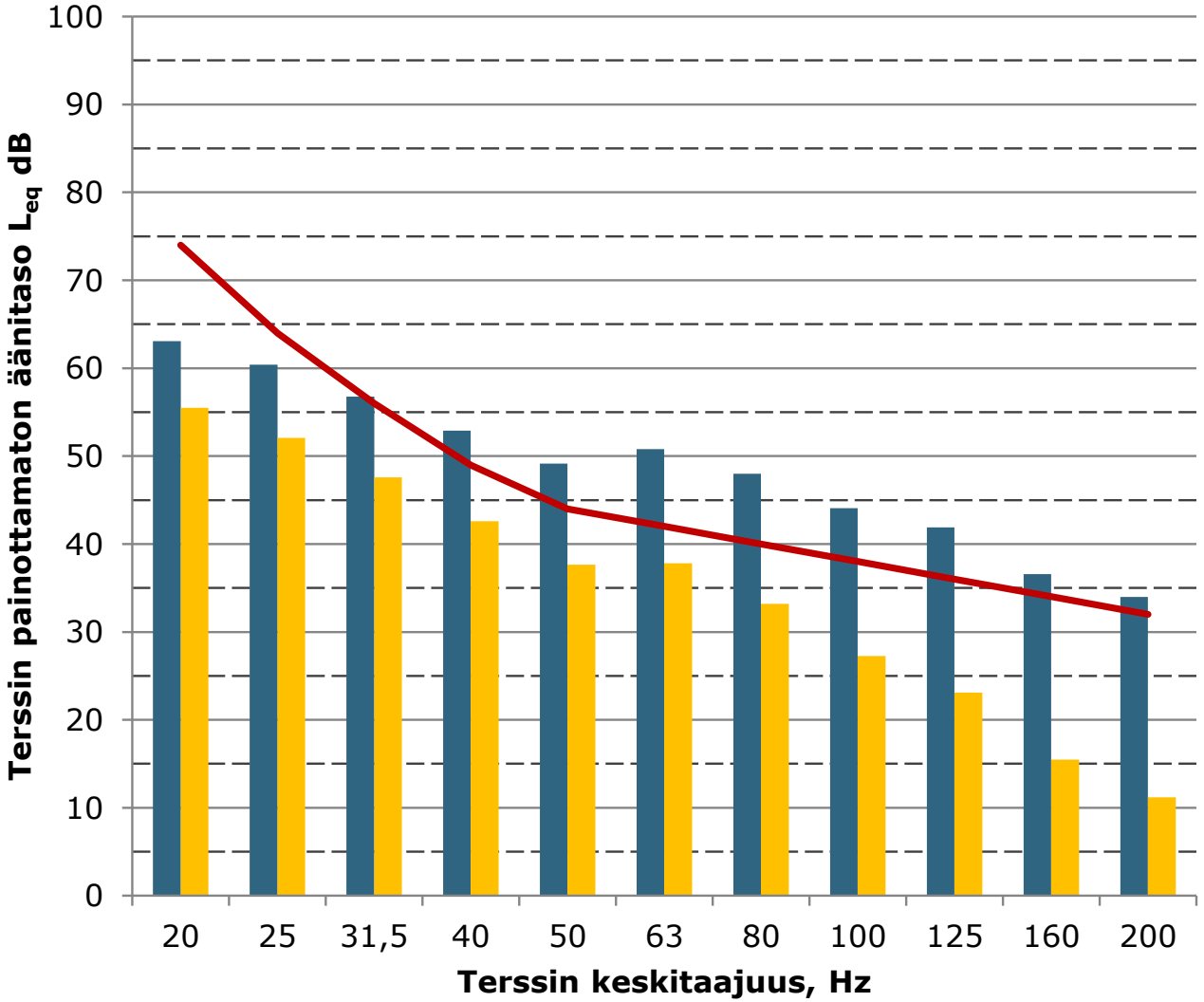

A-painotettu melupäästö Generic 10MW
Terssin emissioTe$_{rs}$sin emissio LWA, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso , Generic Fortum, 29.8.2022

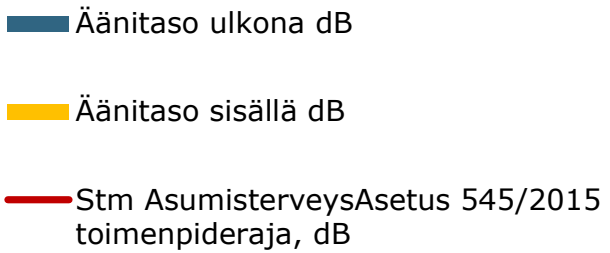

A-painotettu melupäästö Nordex N163
Terssin emissio L_{WA} dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittama A-taajuuspainotettu terssitaso
Valmistajan ilmoittama oktaavitaso lisätty 1,5 dB, F008_277_A17_EN_R02_ Third-octave-sound-power-levels, 11.8.2021


Painottamaton melupäästö Generic 10MW
Terssin emissioTe,ssin emissioLW, dB
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta


Painottamaton melupäästö Nordex N163
Terssin emissioLW, dB
130
120
110
100
90
80
70
60
50
40
30
20
10
0
20 25 31,5 40 50 63 80 100 125 160 200 250 315 400 500 630 800 1000 1250 1600 2000 2500 3150 4000 5000 6300 8000
Terssin keskitaajuus, Hz
Valmistajan ilmoittamasta A-taajuuspainotetusta terssitasosta laskettu taajuuspainottamaton terssitaso
Taajuuspainottamaton oktaavitaso laskettuna valmistajan ilmoittamasta A-taajuuspainotetusta oktaavitasosta

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus A, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



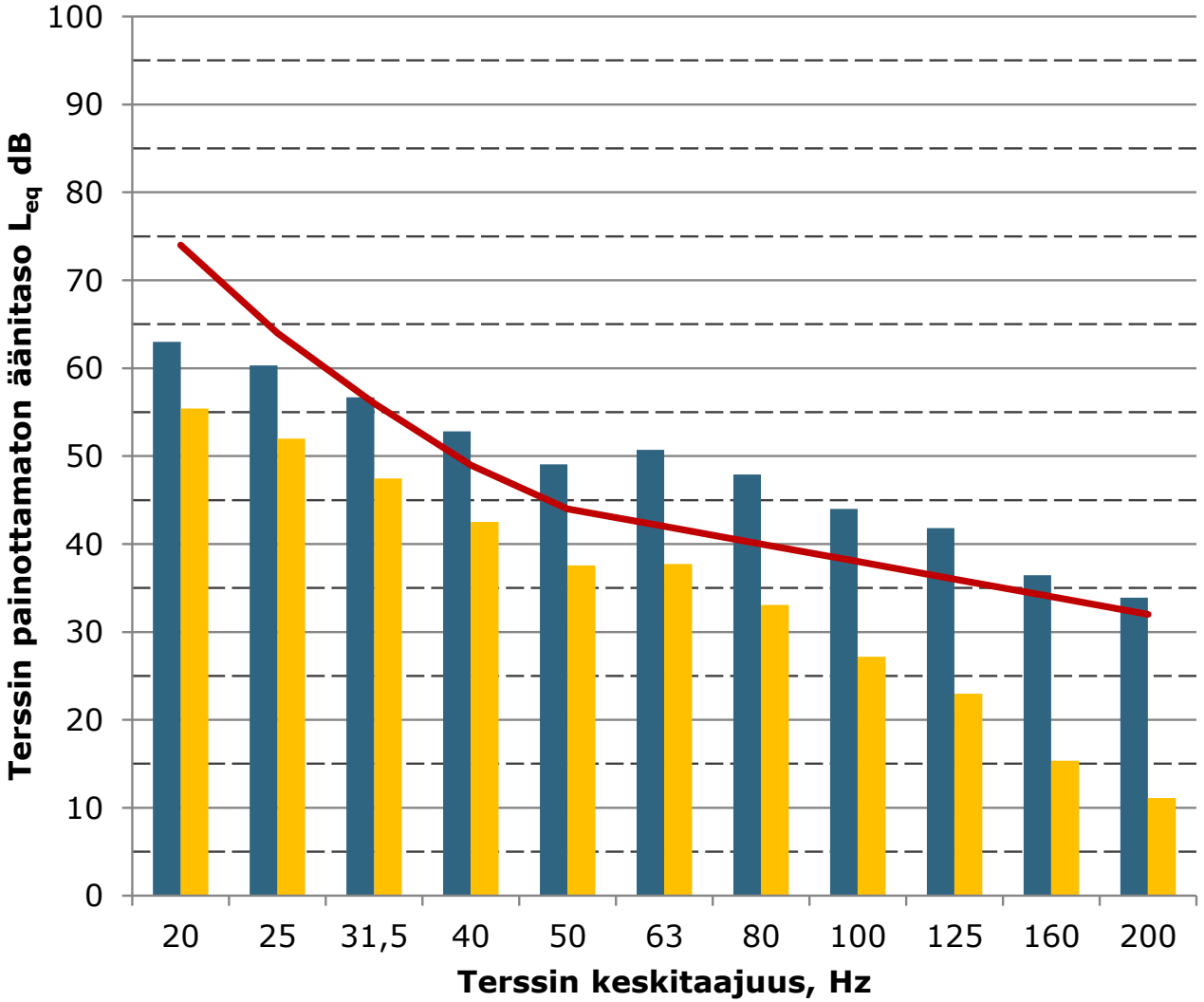


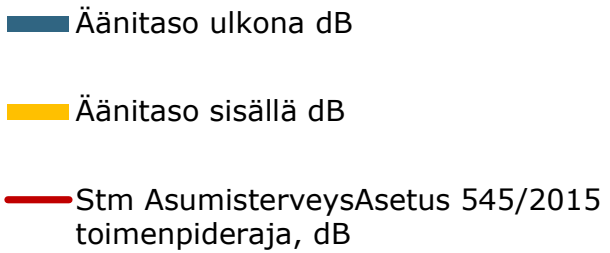
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus B, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



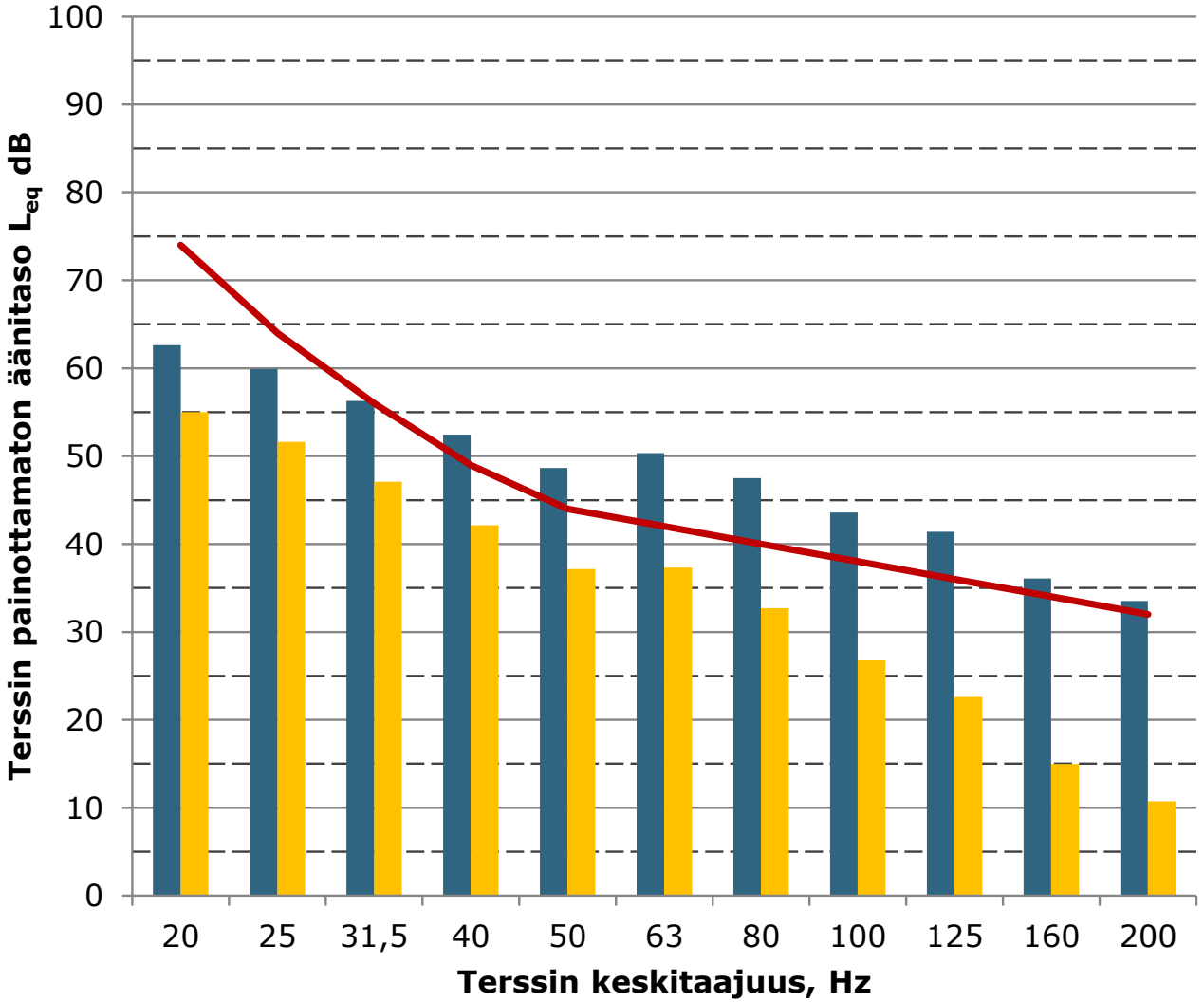


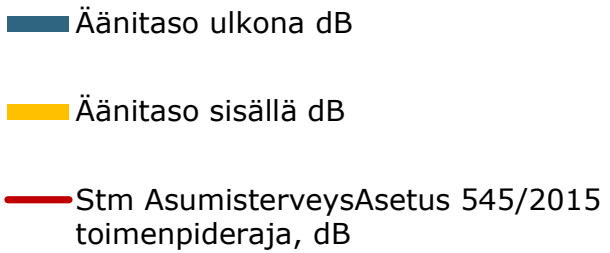
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

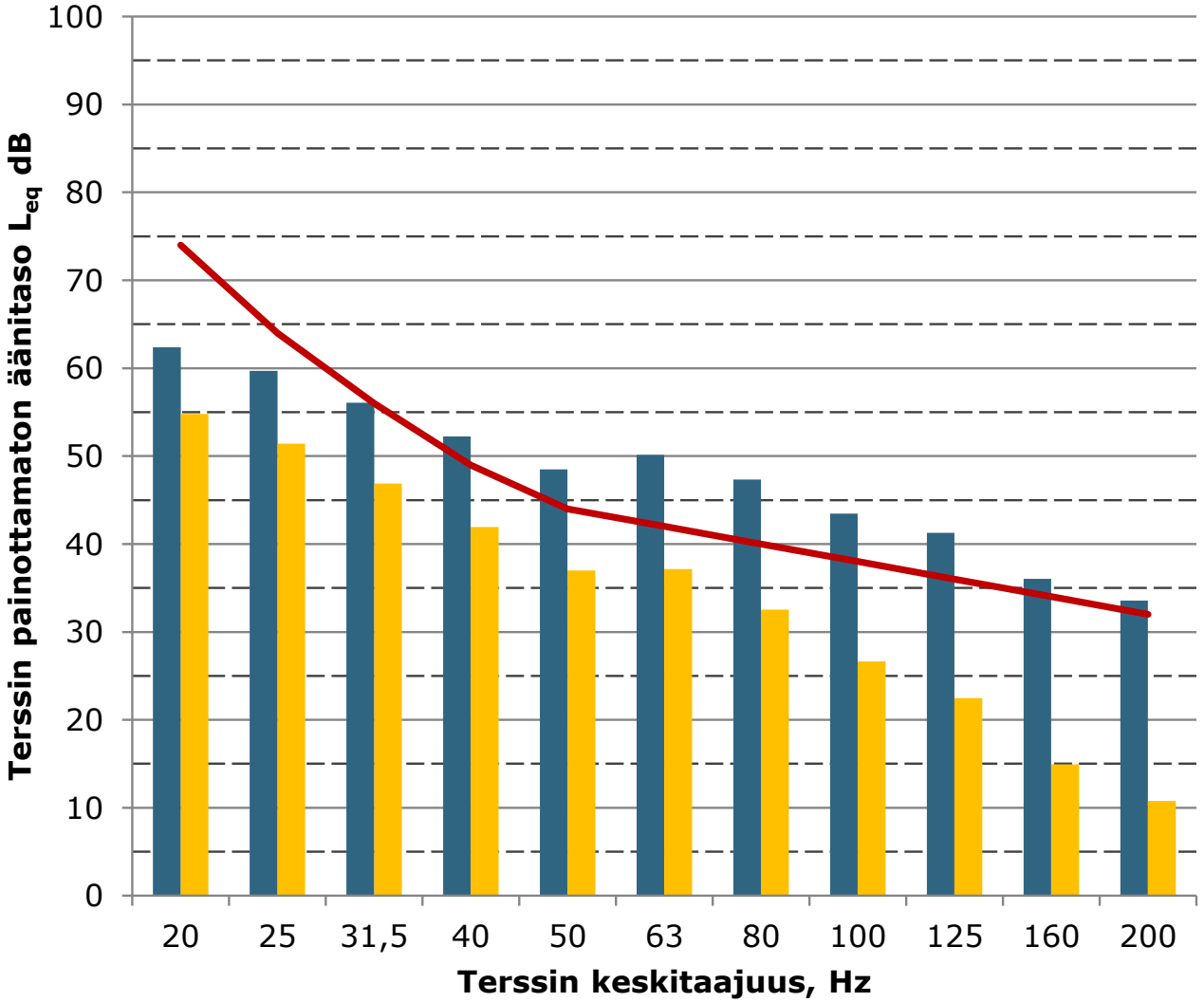
Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus C, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan

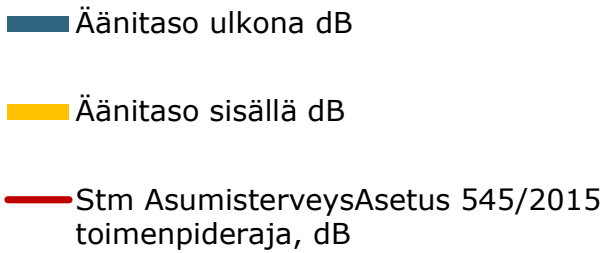




Tiedot rakennuksista ja voimaloista WindPro-raportista:
Voimalat napakorkeus kpl
Nordex N163 6,8 MW, 218,5 m, 46
Generic 10MW 10 MW, 200 m, 67
Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus D, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



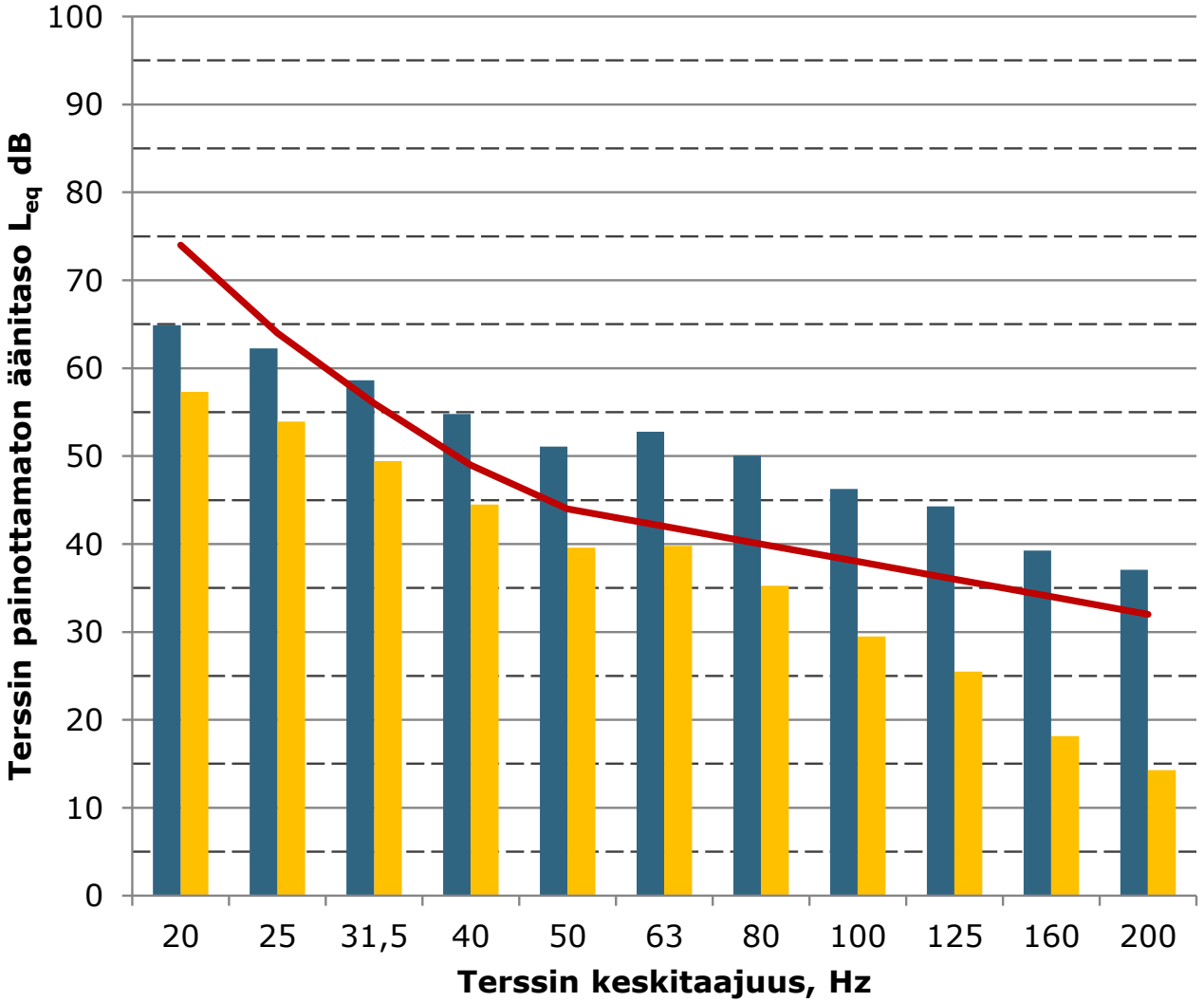


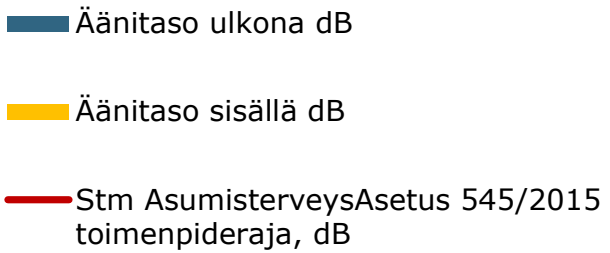
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus E, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



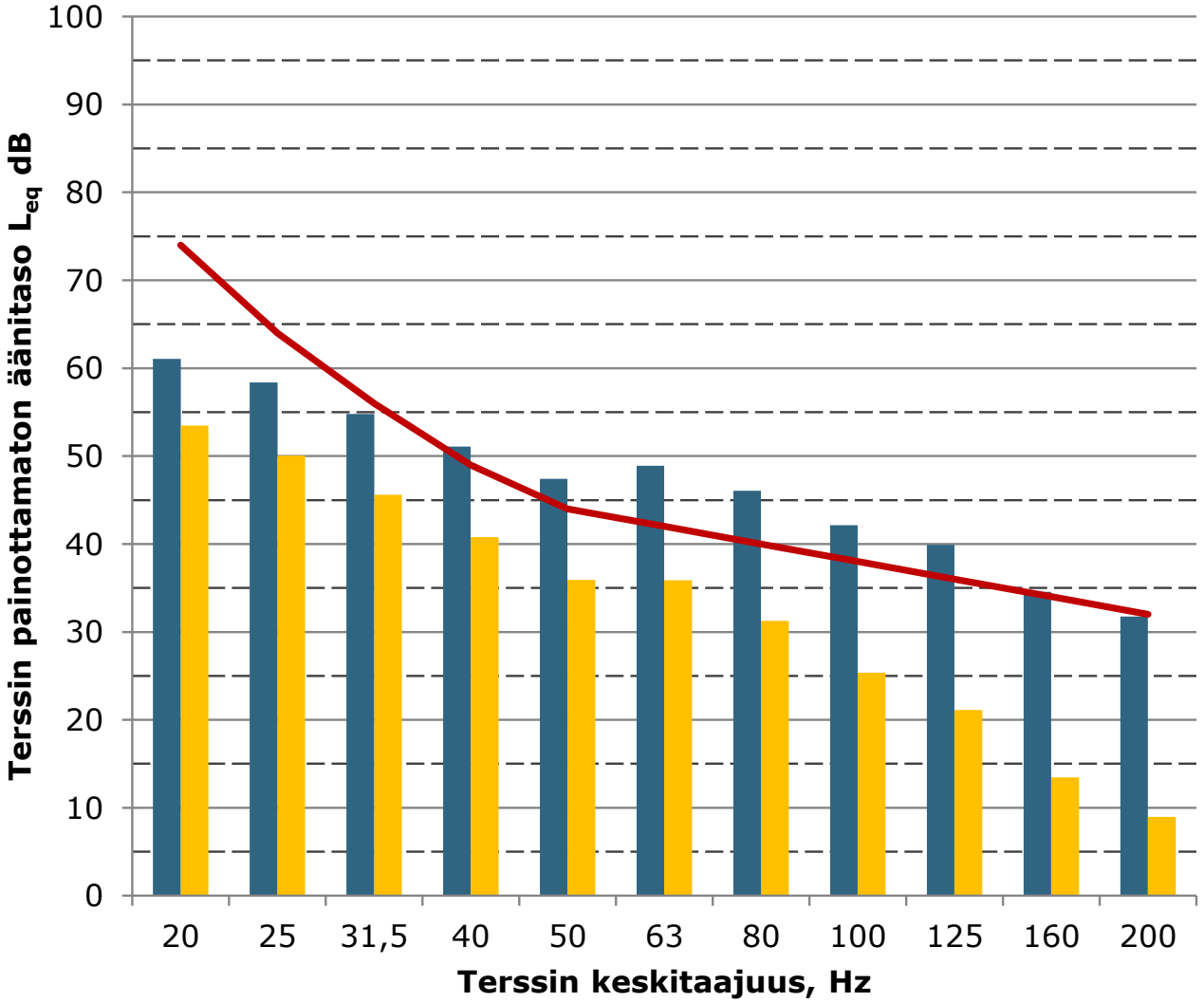


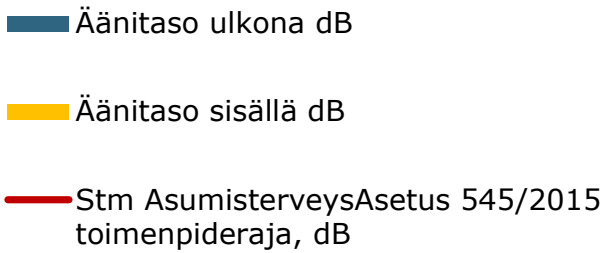
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus F, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



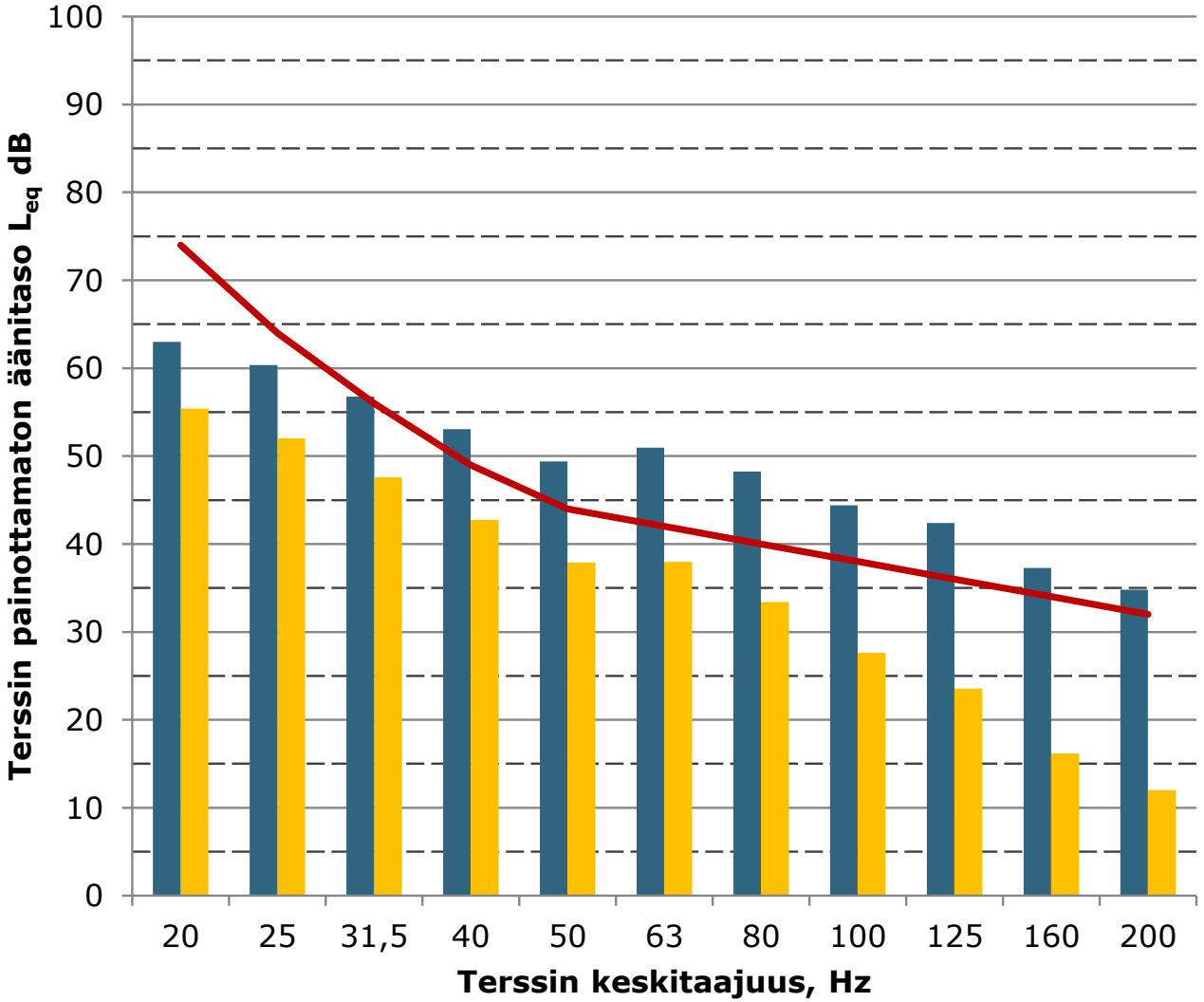


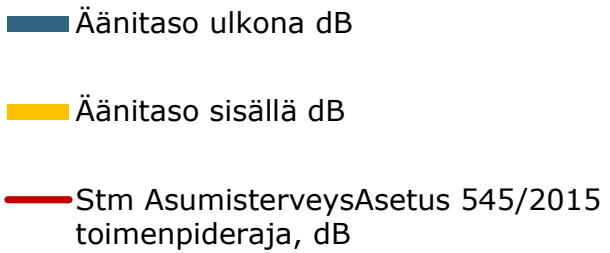
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus G, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



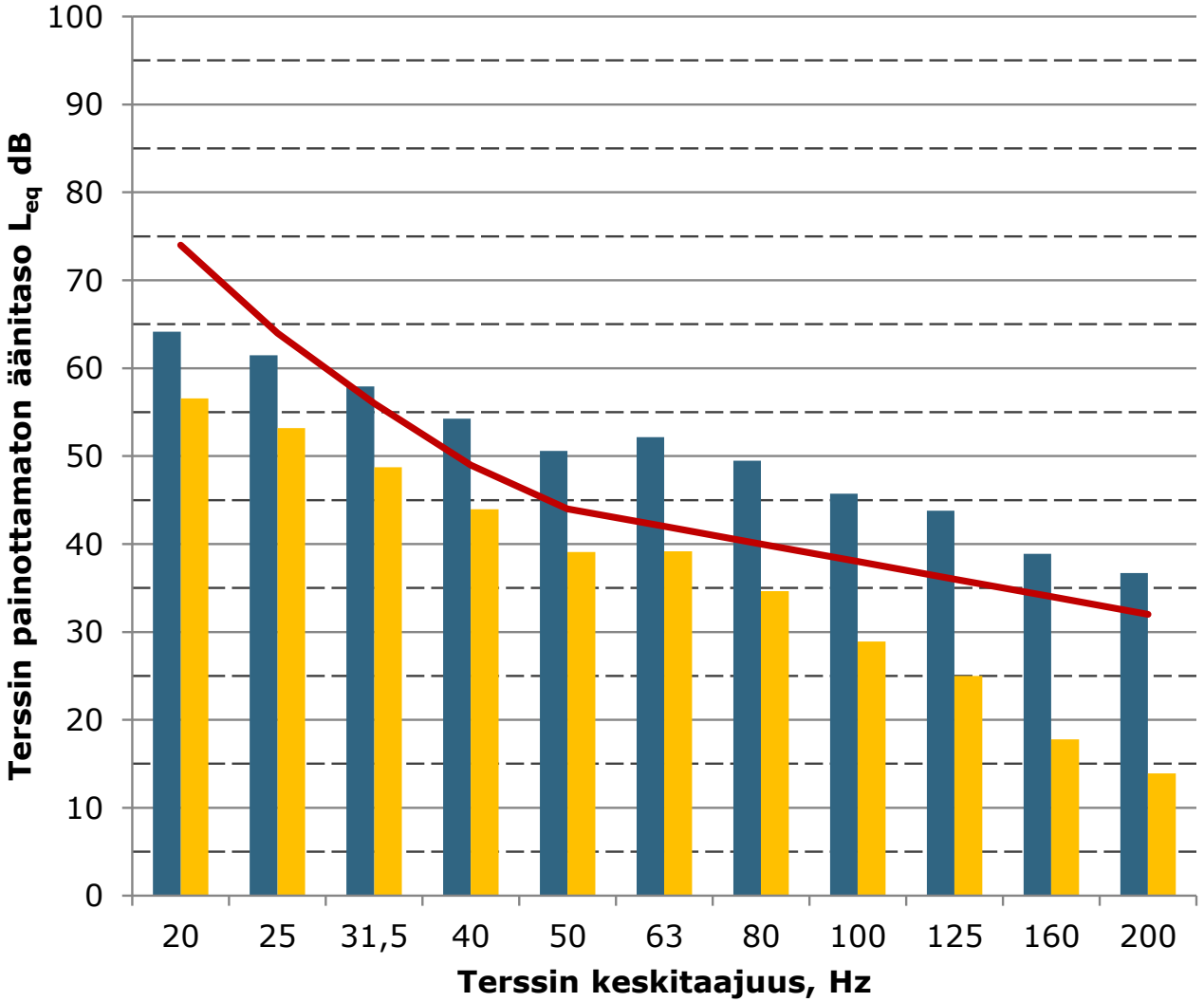


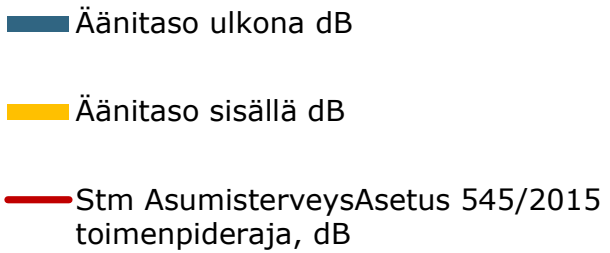
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus H, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



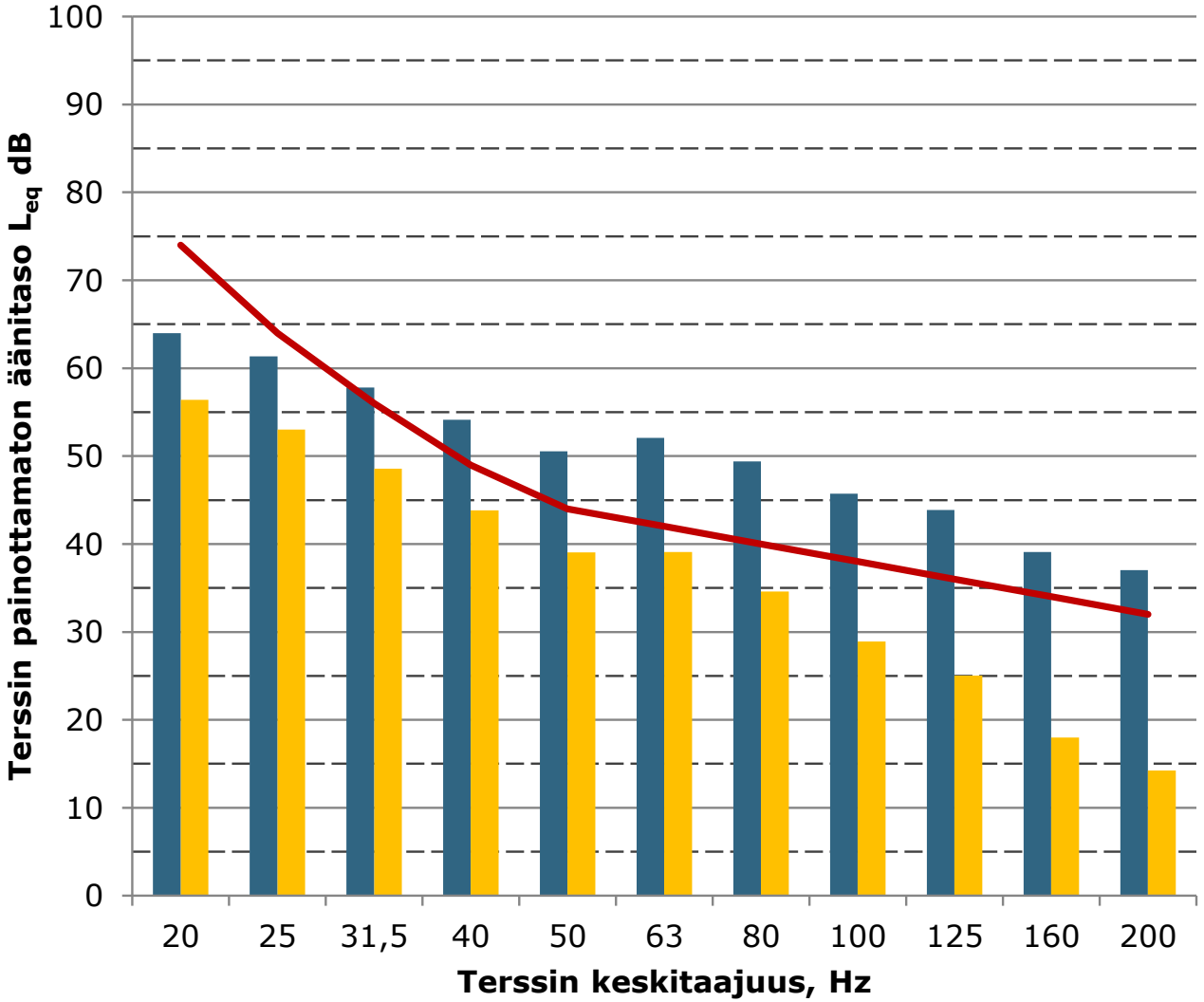


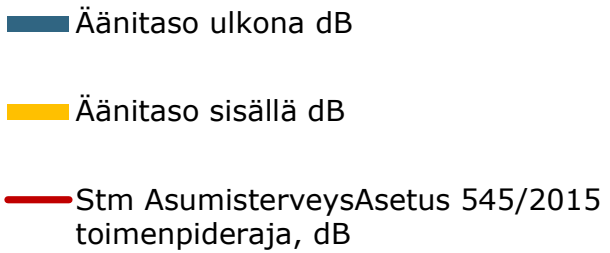
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus I, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan





Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

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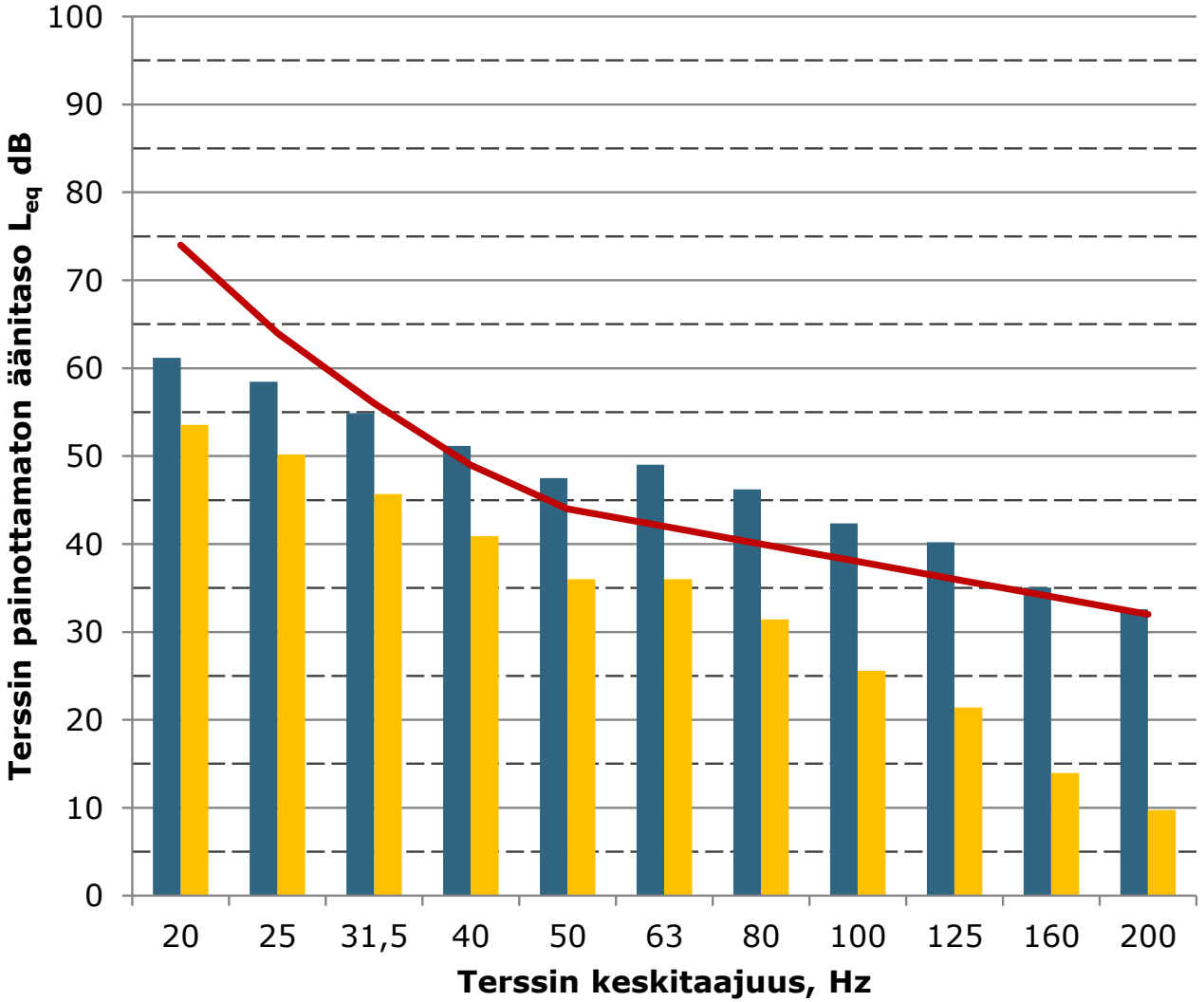
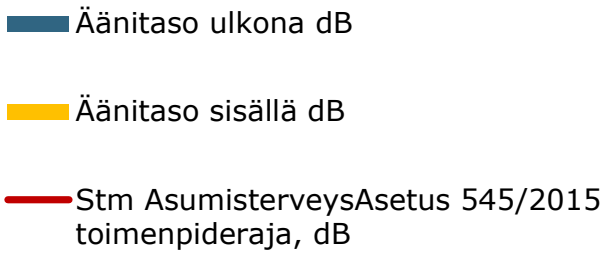
Matalien taajuuksien äänitasot ulkona ja sisällä, Asuinrakennus J, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



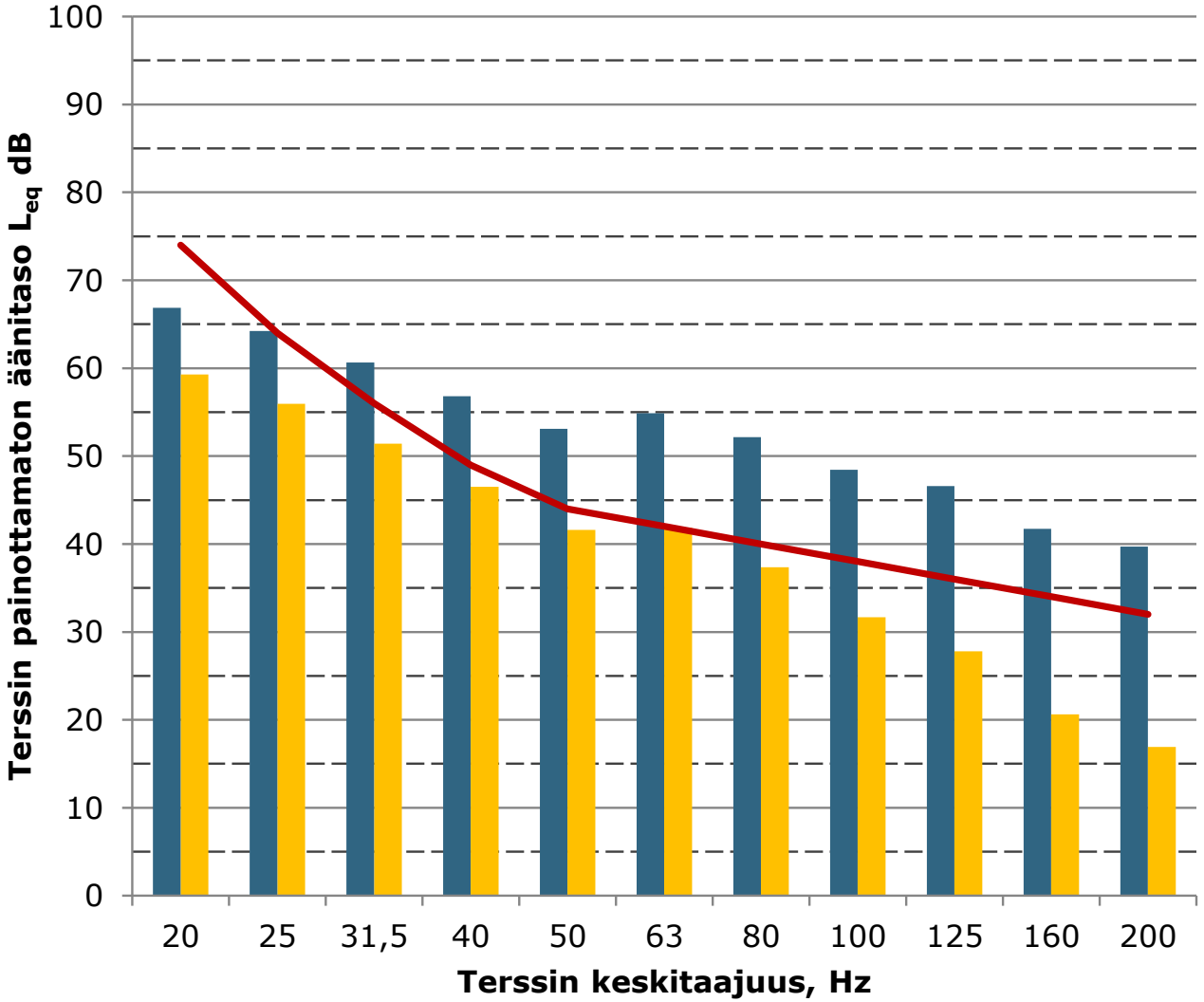


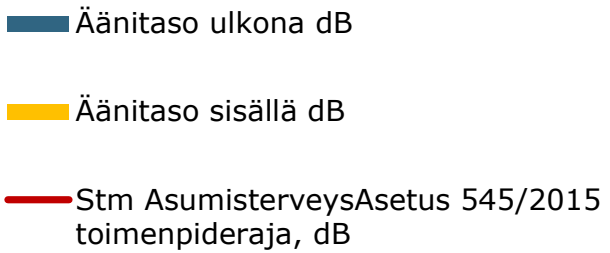
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus K, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



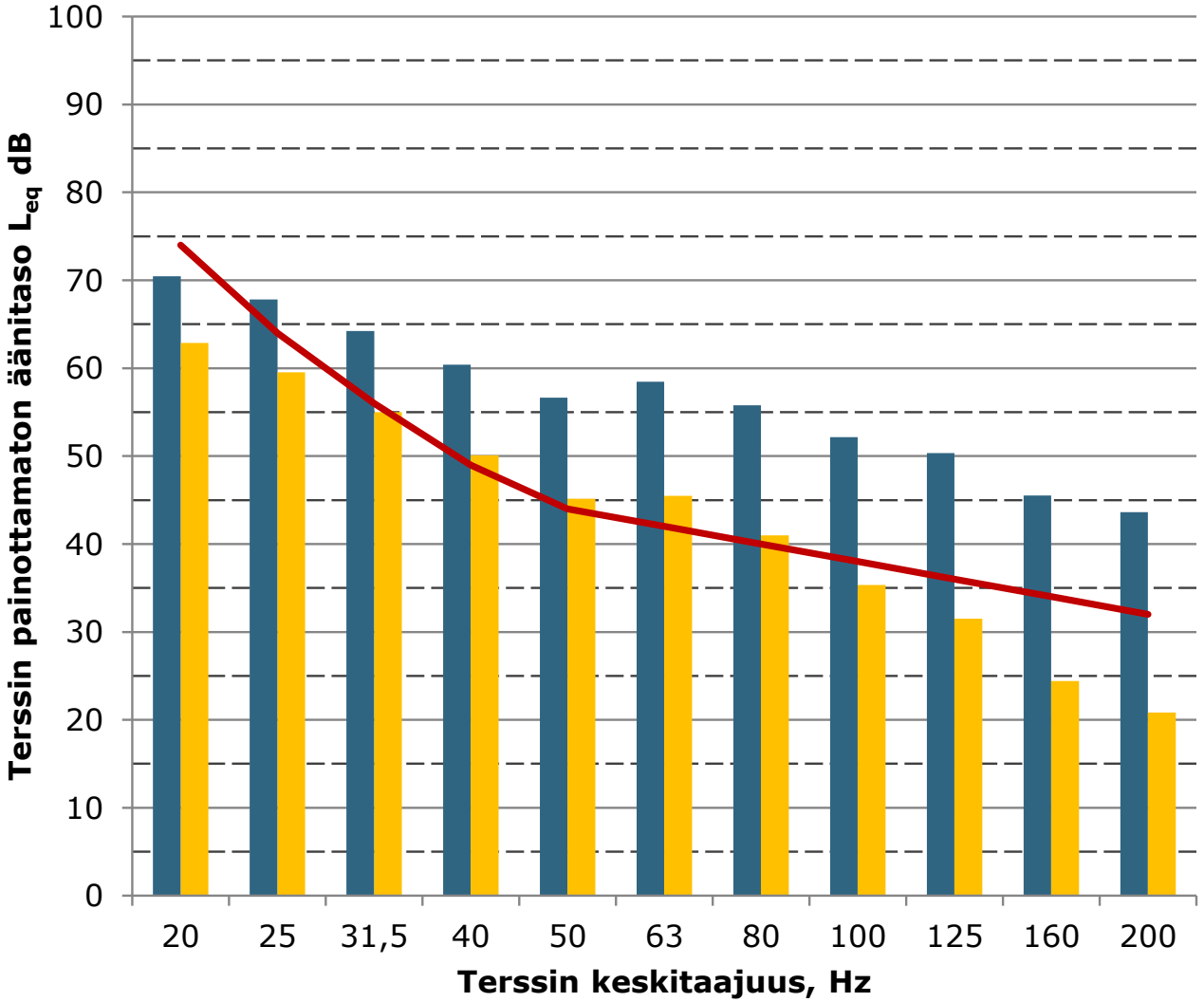


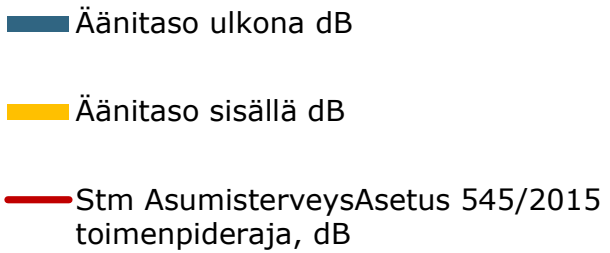
Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus L, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan





Tiedot rakennuksista ja voimaloista WindPro-raportista:

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Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
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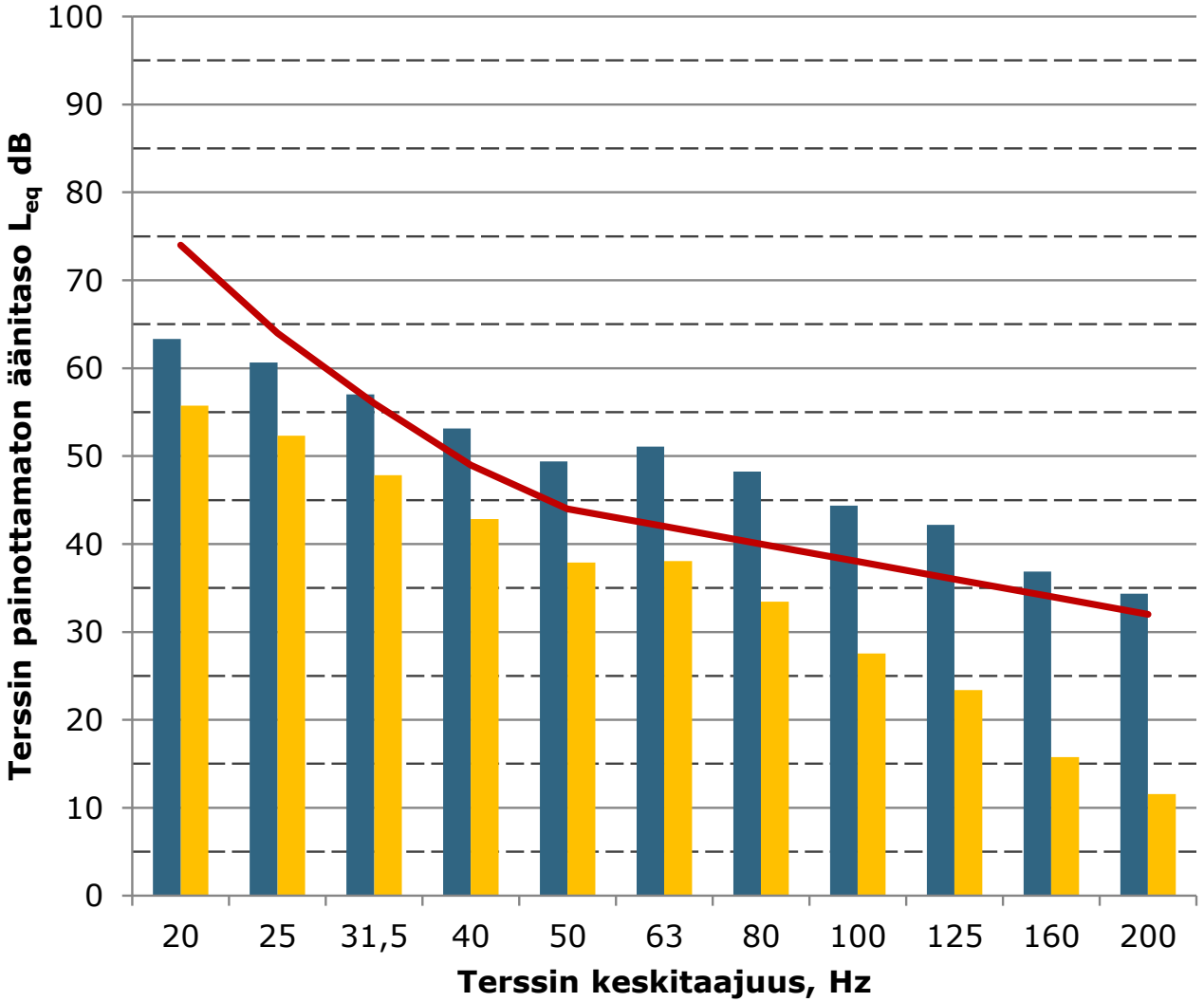
Matalien taajuuksien äänitasot ulkona ja sisällä, Lomarakennus M, ääneneristävyys Keränen,Hakala,Hongisto 2019, 84% persentiili mukaan



Äänitaso ulkona dB

Äänitaso sisällä dB

Stm AsumisterveysAsetus 545/2015 toimenpideraja, dB

Tiedot rakennuksista ja voimaloista WindPro-raportista:

Voimalat	napakorkeus	kpl
Nordex N163	6,8 MW, 218,5 m,	46
Generic 10MW	10 MW, 200 m,	67

Laskenta on tehty ohjeen YM 2/2014 "Tuulivoimaloiden melun mallintaminen":
Äänen geometrinen vaimeneminen pistelähteestä, maakerroin DSO1284 mukaan ja ilman absorptio ISO9613-1:1996 +15°C 70% RH.

Liite 9. Katajamäen tuulivoimahanke – varjostusmallinnuksen tulokset ”real case, no forest” (VE1).

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Calculated:
8.3.2022 13.13/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131

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
0,77	2,38	4,42	6,93	8,81	9,87	9,13	6,84	4,43	2,23	0,93	0,26

Operational hours are calculated from WTGs in calculation and wind distribution:
MERRA_N64,00_E027,335 (4)

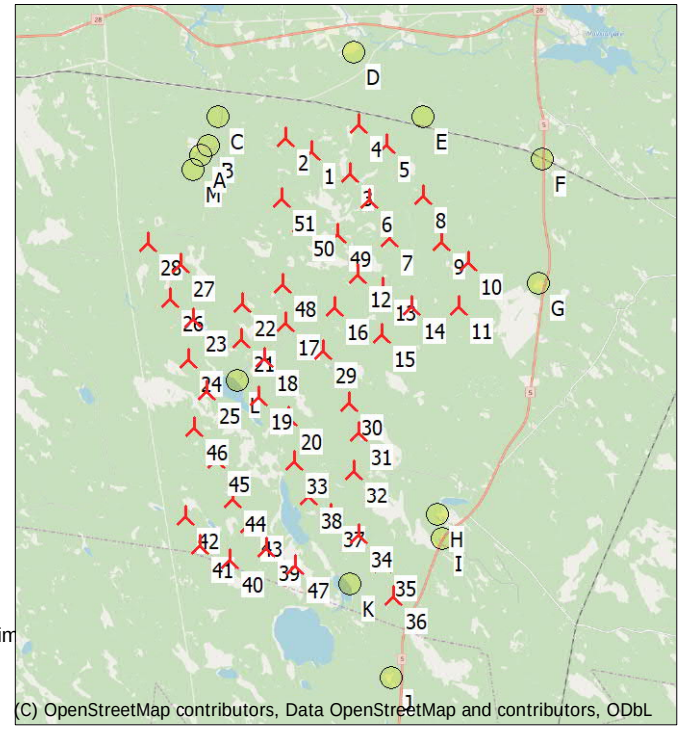
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
519	424	484	521	569	831	1 064	1 068	892	804	724	675	8 574

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Katajamäen tuulivoim
Obstacles used in calculation
Receptor grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:200 000
New WTG
Shadow receptor

WTGs

	East	North	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	515 909	7 106 459	164,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
2	515 210	7 106 831	164,9	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
3	516 931	7 105 901	145,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
4	517 160	7 107 206	142,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
5	517 906	7 106 667	137,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
6	517 446	7 105 214	147,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
7	517 980	7 104 206	148,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
8	518 858	7 105 305	145,9	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
9	519 364	7 104 099	155,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
10	520 088	7 103 598	172,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
11	519 817	7 102 420	156,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
12	517 144	7 103 226	166,6	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
13	517 816	7 102 875	160,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
14	518 583	7 102 417	152,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	517 771	7 101 673	167,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
16	516 534	7 102 343	177,2	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
17	515 249	7 101 935	174,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
18	514 670	7 100 997	170,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
19	514 555	7 099 960	171,1	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
20	515 309	7 099 437	168,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
21	514 070	7 101 510	162,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	514 093	7 102 453	153,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
23	512 778	7 102 030	157,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
24	512 646	7 100 974	160,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
25	513 168	7 100 143	162,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
26	512 181	7 102 585	153,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
27	512 447	7 103 491	147,2	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	511 576	7 104 046	147,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
29	516 239	7 101 210	190,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	516 931	7 099 863	197,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
31	517 213	7 099 034	197,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

To be continued on next page...

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Calculated:
8.3.2022 13.13/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
32	517 075	7 098 024	179,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
33	515 475	7 098 267	165,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	517 226	7 096 320	171,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
35	517 845	7 095 564	168,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	518 144	7 094 686	176,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
37	516 462	7 096 860	173,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
38	515 866	7 097 332	169,4	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
39	514 763	7 095 958	167,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
40	513 785	7 095 645	173,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
41	512 989	7 095 998	185,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
42	512 622	7 096 766	187,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
43	514 288	7 096 590	175,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
44	513 847	7 097 251	182,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
45	513 394	7 098 322	187,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
46	512 819	7 099 163	178,6	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
47	515 539	7 095 480	162,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
48	515 171	7 102 940	162,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
49	516 610	7 104 302	158,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
50	515 639	7 104 571	165,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
51	515 136	7 105 219	160,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Lomarakennus A	512 987	7 106 346	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B	513 159	7 106 642	134,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Lomarakennus C	513 426	7 107 406	131,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D	516 993	7 109 125	130,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E	518 871	7 107 433	147,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Asuinrakennus F	522 013	7 106 307	152,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Asuinrakennus G	521 923	7 103 034	185,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	Asuinrakennus H	519 294	7 096 871	217,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	Asuinrakennus I	519 418	7 096 236	190,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
J	Asuinrakennus J	518 094	7 092 553	194,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
K	Lomarakennus K	516 998	7 095 013	155,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
L	Lomarakennus L	513 968	7 100 391	157,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
M	Lomarakennus M	512 778	7 105 974	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Lomarakennus A	0:00
B	Asuinrakennus B	0:00
C	Lomarakennus C	2:11
D	Asuinrakennus D	1:42
E	Lomarakennus E	7:00
F	Asuinrakennus F	0:00
G	Asuinrakennus G	3:02
H	Asuinrakennus H	1:18
I	Asuinrakennus I	3:51
J	Asuinrakennus J	0:00
K	Lomarakennus K	26:13
L	Lomarakennus L	45:09
M	Lomarakennus M	0:00

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Calculated:
8.3.2022 13.13/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131

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

No.	Name	Expected [h/year]
1	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (215)	0:00
2	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (238)	2:11
3	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (216)	0:00
4	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (244)	4:27
5	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (243)	4:15
6	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (217)	0:00
7	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (218)	0:00
8	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (219)	0:00
9	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (220)	0:00
10	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (221)	3:02
11	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (222)	0:00
12	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (212)	0:00
13	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (213)	0:00
14	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (214)	0:00
15	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (242)	0:00
16	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (225)	0:00
17	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (224)	2:28
18	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (226)	4:51
19	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (227)	13:50
20	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (228)	2:27
21	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (229)	0:00
22	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (230)	0:00
23	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (234)	0:06
24	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (233)	8:03
25	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (232)	11:43
26	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (235)	0:00
27	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (239)	0:00
28	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (240)	0:00
29	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (223)	0:00
30	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (211)	0:00
31	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (210)	0:00
32	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (209)	0:00
33	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (208)	0:00
34	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (205)	0:00
35	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (204)	18:41
36	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (241)	7:05
37	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (206)	0:00
38	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (207)	0:00
39	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (202)	0:00
40	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (203)	0:00
41	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (237)	0:00
42	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (236)	0:00
43	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (201)	0:00
44	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (200)	0:00
45	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (199)	0:00
46	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (231)	2:13
47	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (245)	5:36
48	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)	0:00
49	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (246)	0:00
50	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)	0:00
51	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)	0:00

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

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

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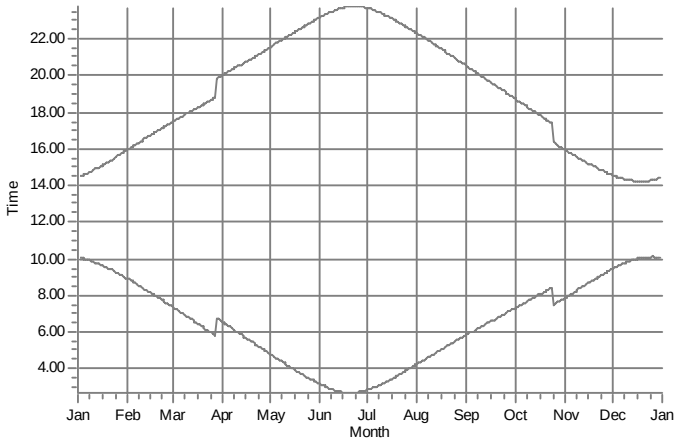
Calculated:
8.3.2022 13.13/3.5.576

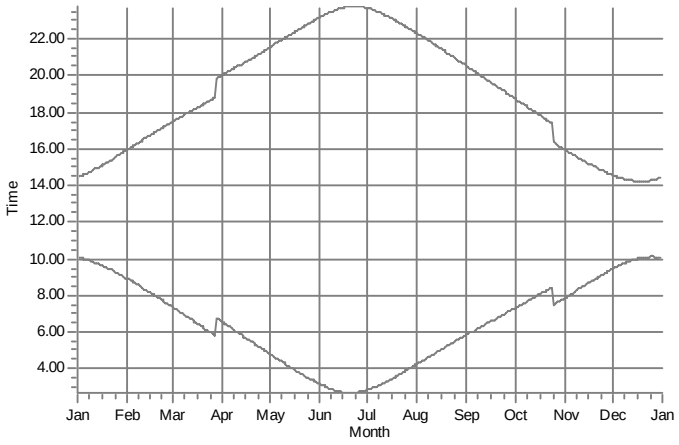
SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131

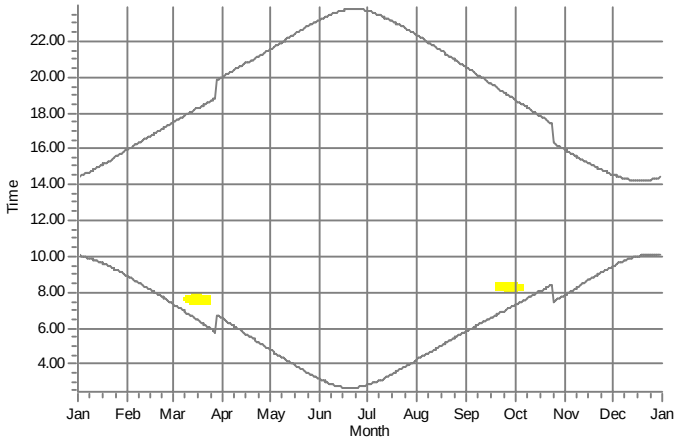
A: Lomarakennus A



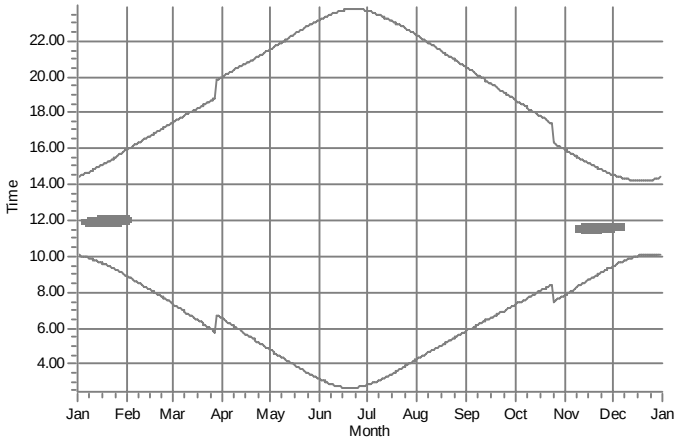
B: Asuinrakennus B



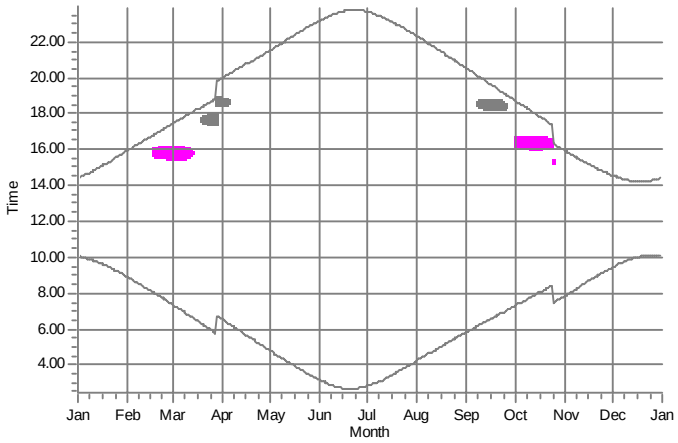
C: Lomarakennus C



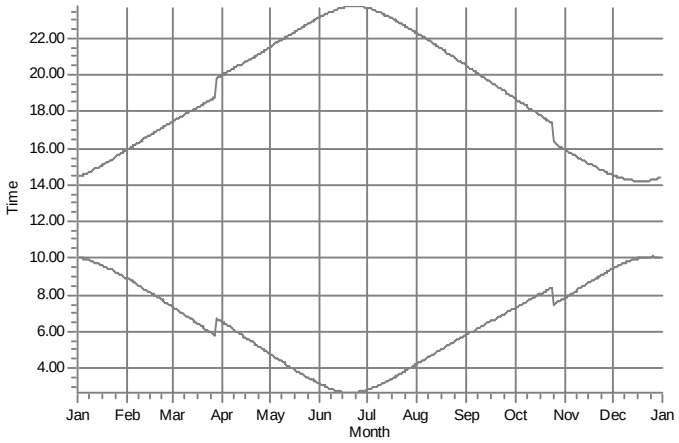
D: Asuinrakennus D



E: Lomarakennus E



F: Asuinrakennus F



WTGs

2: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (238)

4: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (244)

5: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (243)

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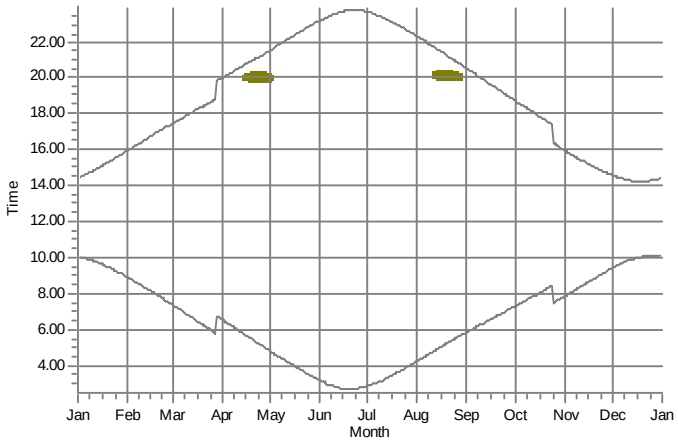
8.3.2022 13.13/3.5.576

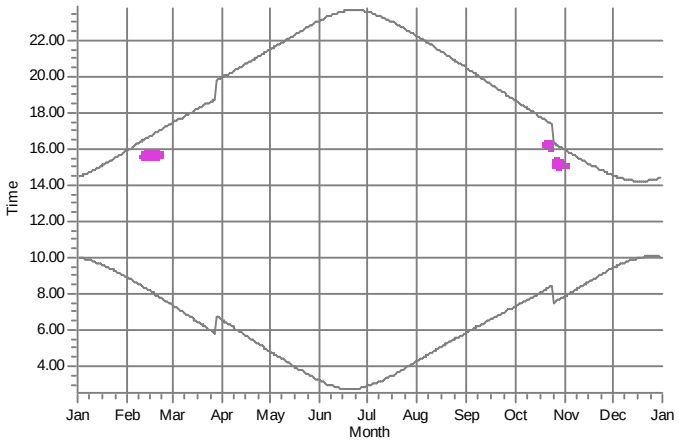
SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131

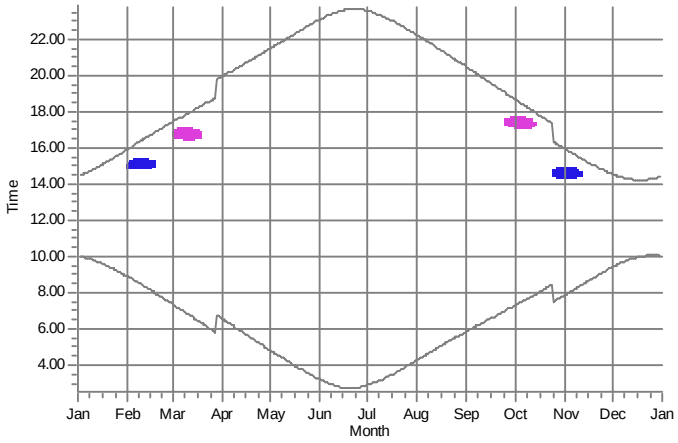
G: Asuinrakennus G



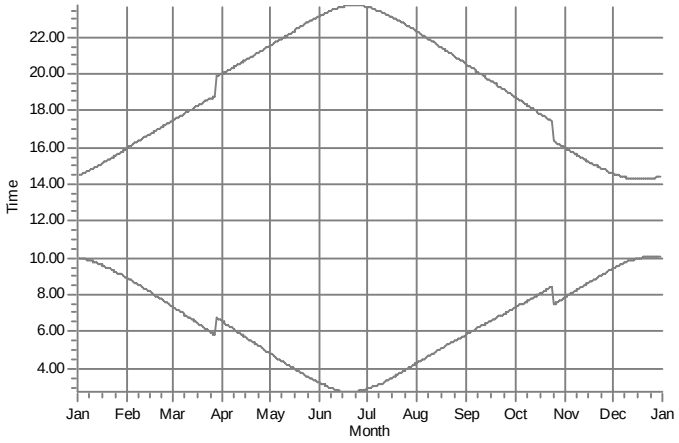
H: Asuinrakennus H



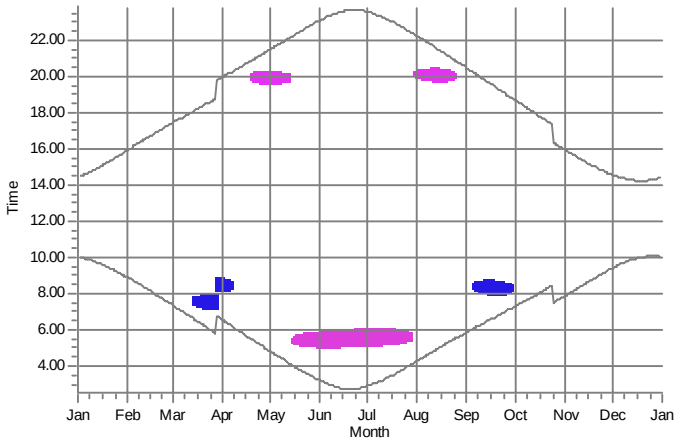
I: Asuinrakennus I



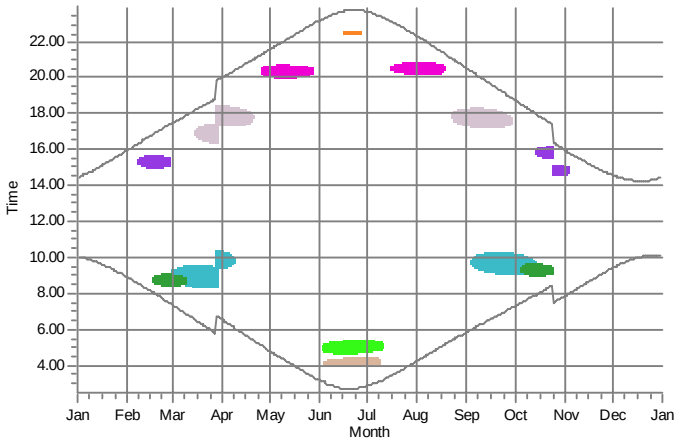
J: Asuinrakennus J



K: Lomarakennus K



L: Lomarakennus L



WTGs

10: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (221)
17: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (224)
18: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (226)
19: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (227)
20: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (228)
23: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (234)
24: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (233)
25: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (232)
35: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (204)
36: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (241)
46: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (231)
47: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (245)

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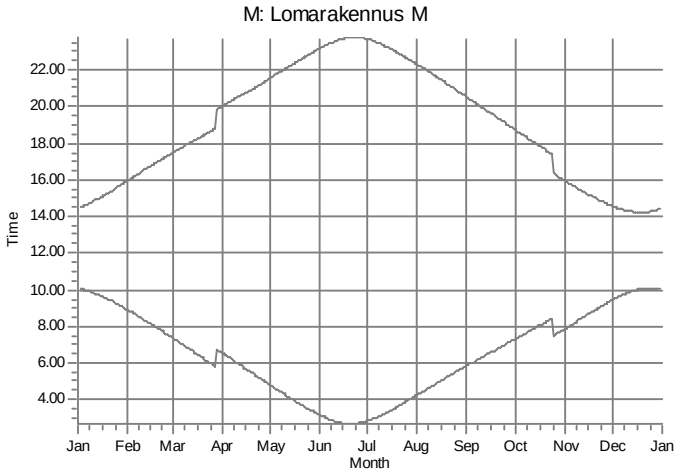
Calculated:
8.3.2022 13.13/3.5.576

SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131



WTGs

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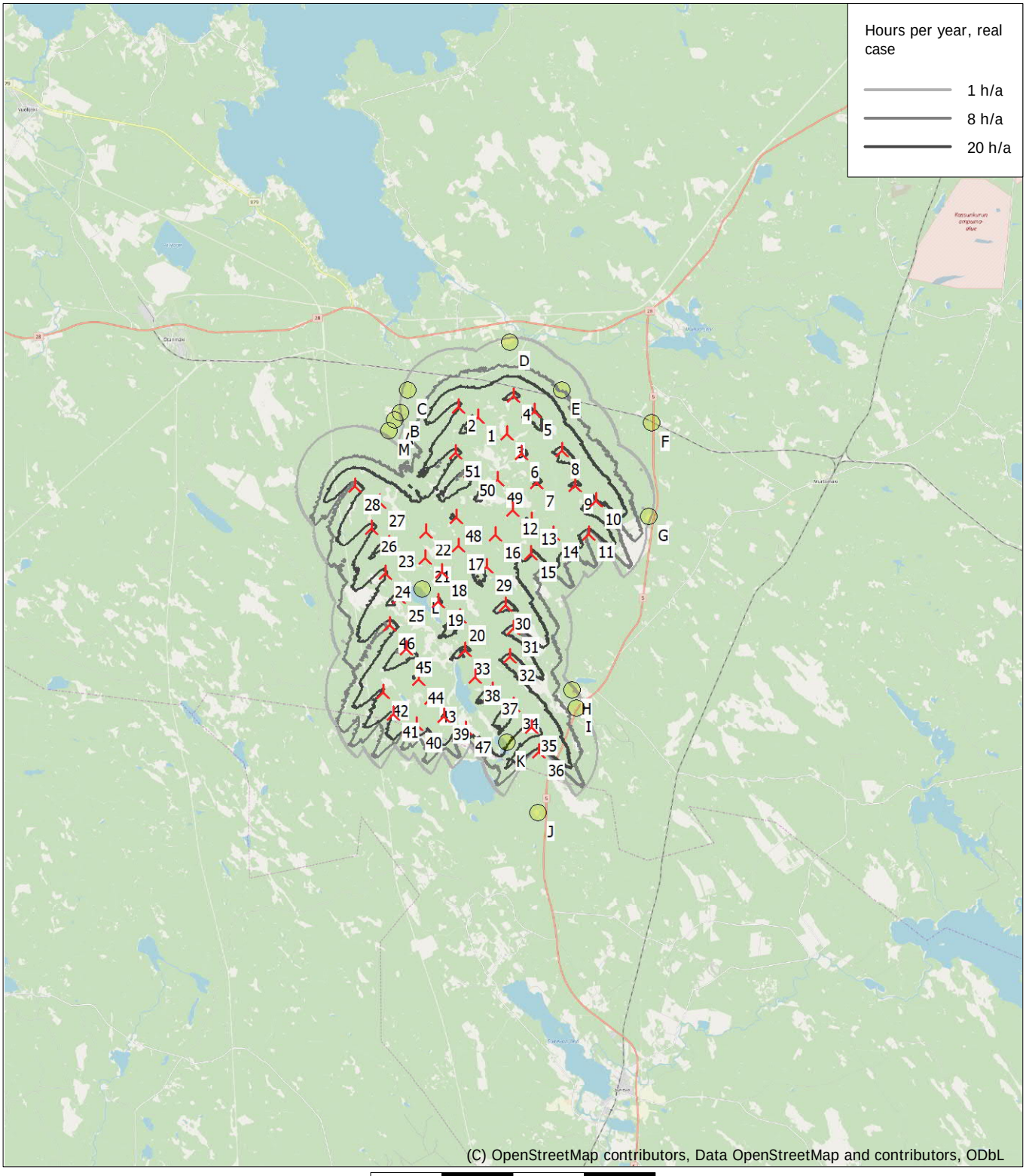
Calculated:
8.3.2022 13.13/3.5.576

SHADOW - Map

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131



Map: EMD OpenStreetMap , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 517 100 North: 7 100 540

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Katajamäen tuulivoimahanke_0.wpo (2)

Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 1,5 m

Liite 10. Katajamäen tuulivoimahanke – varjostusmallinnuksen tulokset ”real case, no forest” (VE1). Yhteisvaikutukset Kivikankaan hankkeen kanssa.

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Calculated:
26.8.2022 13.23/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131+ YV Kivikangas

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
0,77	2,38	4,42	6,93	8,81	9,87	9,13	6,84	4,43	2,23	0,93	0,26

Operational hours are calculated from WTGs in calculation and wind distribution:
MERRA_N64,00_E027,335 (4)

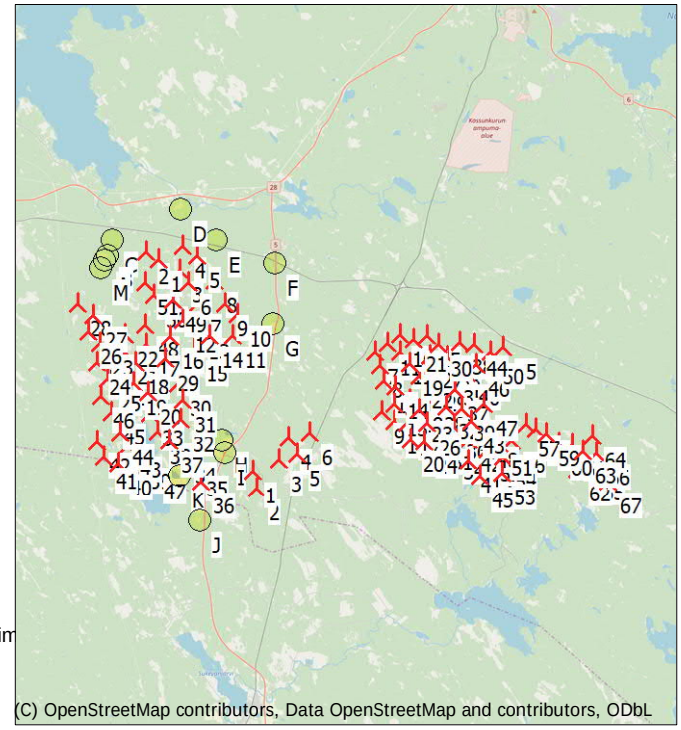
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
519	424	484	521	569	831	1 064	1 068	892	804	724	675	8 574

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Katajamäen tuulivoim
Obstacles used in calculation
Receptor grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:400 000

New WTG Shadow receptor

WTGs

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	520 945	7 095 256	175,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
1	515 909	7 106 459	164,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
2	521 095	7 094 331	164,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
2	515 210	7 106 831	164,9	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
3	522 355	7 095 878	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
3	516 931	7 105 901	145,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
4	522 755	7 097 057	176,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
4	517 160	7 107 206	142,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
5	523 237	7 096 145	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
5	517 906	7 106 667	137,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
6	523 951	7 097 319	165,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
6	517 446	7 105 214	147,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
7	527 400	7 101 633	174,1	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
7	517 980	7 104 206	148,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
8	527 645	7 100 906	176,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
8	518 858	7 105 305	145,9	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
9	527 745	7 098 481	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
9	519 364	7 104 099	155,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
10	527 847	7 100 086	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
10	520 088	7 103 598	172,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
11	528 041	7 102 119	164,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
11	519 817	7 102 420	156,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
12	528 395	7 097 931	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
12	517 144	7 103 226	166,6	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
13	528 420	7 098 881	177,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
13	517 816	7 102 875	160,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
14	528 496	7 099 831	177,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
14	518 583	7 102 417	152,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	517 771	7 101 673	167,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	528 704	7 101 642	170,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
16	528 710	7 102 595	162,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4

To be continued on next page...

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SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131+ YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
16	516 534	7 102 343	177,2	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
17	529 120	7 097 906	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
17	515 249	7 101 935	174,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
18	529 181	7 099 074	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
18	514 670	7 100 997	170,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
19	529 211	7 101 016	183,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
19	514 555	7 099 960	171,1	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
20	529 320	7 097 006	192,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
20	515 309	7 099 437	168,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
21	529 393	7 102 332	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
21	514 070	7 101 510	162,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	529 727	7 100 356	205,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
22	514 093	7 102 453	153,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
23	529 779	7 098 556	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
23	512 778	7 102 030	157,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
24	530 031	7 096 928	171,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
24	512 646	7 100 974	160,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
25	530 120	7 102 556	174,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
25	513 168	7 100 143	162,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
26	530 192	7 097 881	182,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
26	512 181	7 102 585	153,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
27	530 249	7 101 446	190,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
27	512 447	7 103 491	147,2	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	530 402	7 099 101	206,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
28	511 576	7 104 046	147,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
29	530 470	7 100 256	185,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
29	516 239	7 101 210	190,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	516 931	7 099 863	197,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	530 749	7 102 088	177,1	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
31	530 845	7 097 081	167,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
31	517 213	7 099 034	197,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
32	531 170	7 098 806	195,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
32	517 075	7 098 024	179,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
33	531 199	7 101 417	177,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
33	515 475	7 098 267	165,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	517 226	7 096 320	171,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	531 442	7 096 615	167,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
35	531 445	7 100 556	184,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
35	517 845	7 095 564	168,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	531 595	7 097 706	177,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
36	518 144	7 094 686	176,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
37	531 620	7 099 681	192,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
37	516 462	7 096 860	173,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
38	531 848	7 102 200	181,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
38	515 866	7 097 332	169,4	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
39	531 995	7 098 644	192,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
39	514 763	7 095 958	167,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
40	532 195	7 100 506	177,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
40	513 785	7 095 645	173,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
41	532 370	7 095 881	167,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
41	512 989	7 095 998	185,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
42	532 373	7 097 087	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
42	512 622	7 096 766	187,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
43	532 519	7 098 005	172,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
43	514 288	7 096 590	175,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
44	532 627	7 102 078	185,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
44	513 847	7 097 251	182,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
45	532 995	7 095 106	166,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
45	513 394	7 098 322	187,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
46	532 752	7 101 003	186,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
46	512 819	7 099 163	178,6	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
47	533 198	7 098 953	173,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
47	515 539	7 095 480	162,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

To be continued on next page...

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Calculated:
26.8.2022 13.23/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131+ YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
48	533 270	7 097 281	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
48	515 171	7 102 940	162,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
49	533 563	7 095 498	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
49	516 610	7 104 302	158,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
50	533 473	7 101 697	197,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
50	515 639	7 104 571	165,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
51	534 002	7 096 854	195,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
51	515 136	7 105 219	160,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
52	533 383	7 096 525	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
53	534 153	7 095 289	171,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
54	534 246	7 096 135	174,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
55	534 129	7 101 976	207,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
56	534 691	7 096 987	186,2	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
57	535 406	7 097 920	183,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
58	535 963	7 097 629	190,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
59	536 487	7 097 358	208,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
60	537 145	7 096 906	218,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
61	537 870	7 096 856	208,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
62	538 185	7 095 540	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
63	538 465	7 096 494	193,2	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
64	538 995	7 097 356	197,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
65	538 846	7 095 554	189,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
66	539 204	7 096 413	190,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
67	539 802	7 094 885	187,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Lomarakennus A	512 987	7 106 346	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B	513 159	7 106 642	134,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Lomarakennus C	513 426	7 107 406	131,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D	516 993	7 109 125	130,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E	518 871	7 107 433	147,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Asuinrakennus F	522 013	7 106 307	152,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Asuinrakennus G	521 923	7 103 034	185,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	Asuinrakennus H	519 294	7 096 871	217,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	Asuinrakennus I	519 418	7 096 236	190,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
J	Asuinrakennus J	518 094	7 092 553	194,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
K	Lomarakennus K	516 998	7 095 013	155,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
L	Lomarakennus L	513 968	7 100 391	157,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
M	Lomarakennus M	512 778	7 105 974	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Lomarakennus A	0:00
B	Asuinrakennus B	0:00
C	Lomarakennus C	2:11
D	Asuinrakennus D	1:42
E	Lomarakennus E	7:00
F	Asuinrakennus F	0:00
G	Asuinrakennus G	3:02
H	Asuinrakennus H	2:11
I	Asuinrakennus I	6:33
J	Asuinrakennus J	0:00
K	Lomarakennus K	26:13

To be continued on next page...

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SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131+ YV Kivikangas

...continued from previous page

No.	Name	Shadow, expected values Shadow hours per year [h/year]
L	Lomarakennus L	45:09
M	Lomarakennus M	0:00

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

No.	Name	Expected [h/year]
1	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (468)	2:49
1	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (215)	0:00
2	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (469)	0:44
2	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (238)	2:11
3	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (470)	0:00
3	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (216)	0:00
4	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (471)	0:00
4	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (244)	4:27
5	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (472)	0:00
5	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (243)	4:15
6	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (473)	0:00
6	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (217)	0:00
7	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (474)	0:00
7	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (218)	0:00
8	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (475)	0:00
8	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (219)	0:00
9	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (476)	0:00
9	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (220)	0:00
10	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (477)	0:00
10	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (221)	3:02
11	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (478)	0:00
11	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (222)	0:00
12	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (479)	0:00
12	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (212)	0:00
13	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (480)	0:00
13	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (213)	0:00
14	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (481)	0:00
14	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (214)	0:00
15	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (242)	0:00
15	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (482)	0:00
16	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (483)	0:00
16	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (225)	0:00
17	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (484)	0:00
17	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (224)	2:28
18	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (485)	0:00
18	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (226)	4:51
19	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (486)	0:00
19	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (227)	13:50
20	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (487)	0:00
20	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (228)	2:27
21	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (488)	0:00
21	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (229)	0:00
22	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (489)	0:00
22	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (230)	0:00
23	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (490)	0:00
23	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (234)	0:06
24	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (491)	0:00
24	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (233)	8:03
25	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (492)	0:00
25	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (232)	11:43
26	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (493)	0:00
26	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (235)	0:00
27	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (494)	0:00
27	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (239)	0:00
28	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (495)	0:00
28	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (240)	0:00

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SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131+ YV Kivikangas

...continued from previous page

No.	Name	Expected [h/year]
29	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (496)	0:00
29	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (223)	0:00
30	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (211)	0:00
30	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (497)	0:00
31	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (498)	0:00
31	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (210)	0:00
32	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (499)	0:00
32	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (209)	0:00
33	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (500)	0:00
33	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (208)	0:00
34	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (205)	0:00
34	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (501)	0:00
35	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (502)	0:00
35	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (204)	18:41
36	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (503)	0:00
36	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (241)	7:05
37	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (504)	0:00
37	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (206)	0:00
38	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (505)	0:00
38	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (207)	0:00
39	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (506)	0:00
39	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (202)	0:00
40	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (507)	0:00
40	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (203)	0:00
41	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (508)	0:00
41	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (237)	0:00
42	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (509)	0:00
42	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (236)	0:00
43	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (510)	0:00
43	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (201)	0:00
44	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (511)	0:00
44	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (200)	0:00
45	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (512)	0:00
45	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (199)	0:00
46	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (513)	0:00
46	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (231)	2:13
47	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (514)	0:00
47	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (245)	5:36
48	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (515)	0:00
48	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)	0:00
49	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (516)	0:00
49	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (246)	0:00
50	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (517)	0:00
50	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)	0:00
51	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (518)	0:00
51	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)	0:00
52	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (519)	0:00
53	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (520)	0:00
54	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (521)	0:00
55	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (522)	0:00
56	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (523)	0:00
57	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (524)	0:00
58	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (525)	0:00
59	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (526)	0:00
60	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (527)	0:00
61	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (528)	0:00
62	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (529)	0:00
63	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (530)	0:00
64	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (531)	0:00
65	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (532)	0:00
66	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (533)	0:00
67	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (534)	0:00

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

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

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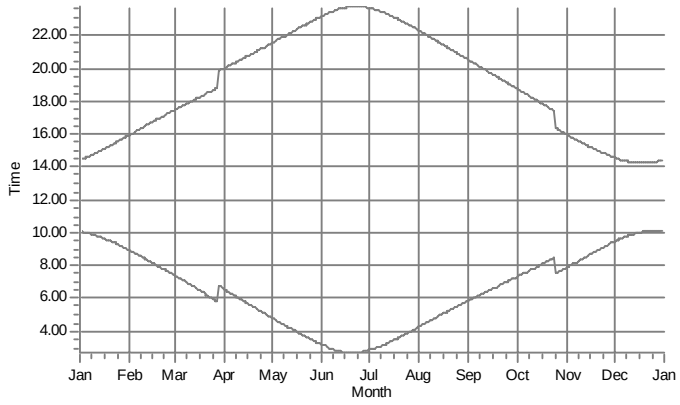
26.8.2022 13.23/3.5.584

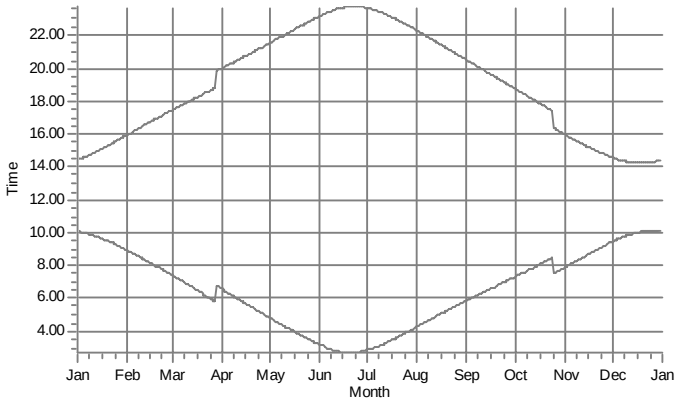
SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131+ YV Kivikangas

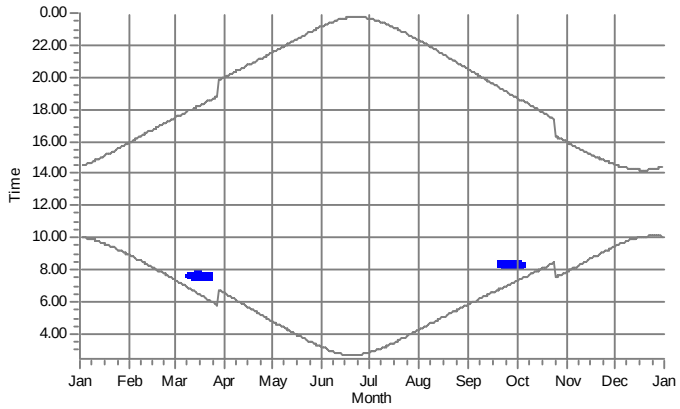
A: Lomarakennus A



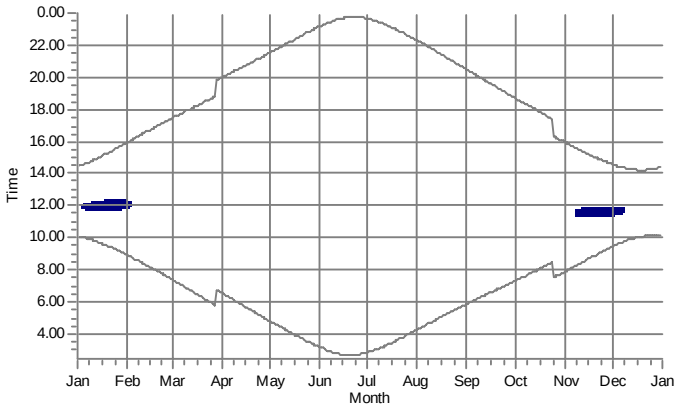
B: Asuinrakennus B



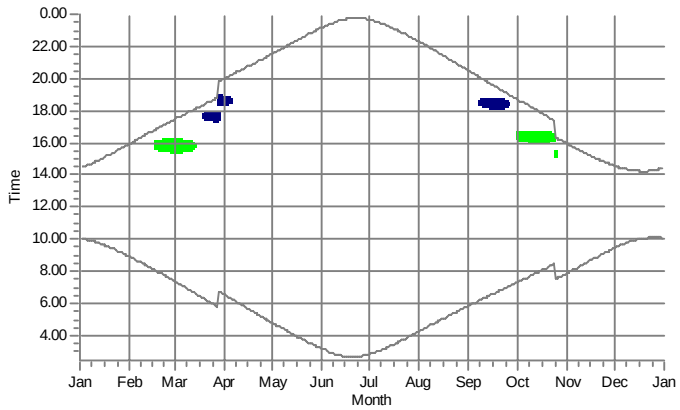
C: Lomarakennus C



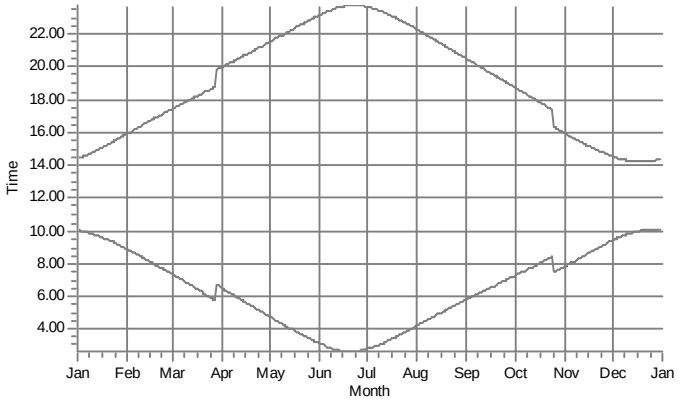
D: Asuinrakennus D



E: Lomarakennus E



F: Asuinrakennus F



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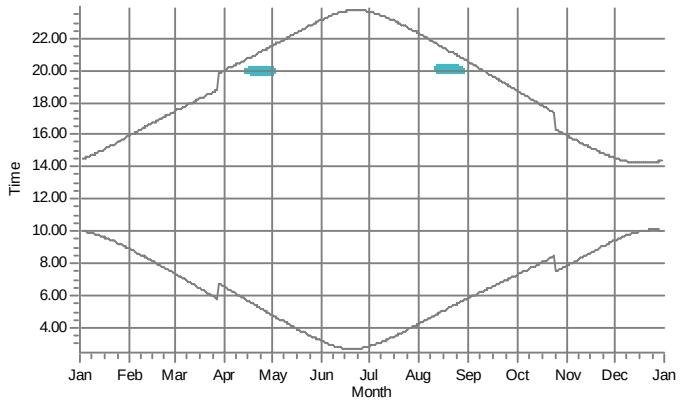
26.8.2022 13.23/3.5.584

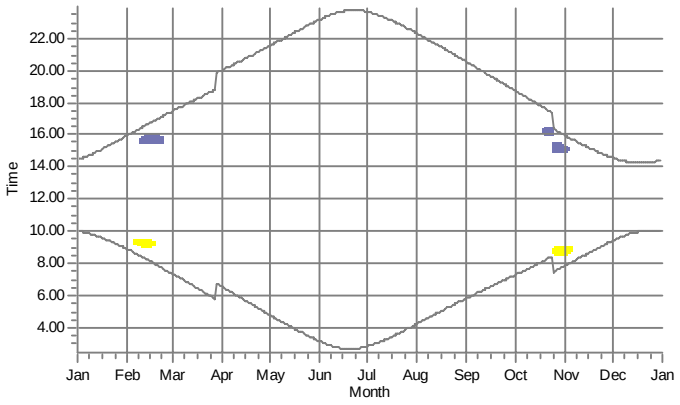
SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131+ YV Kivikangas

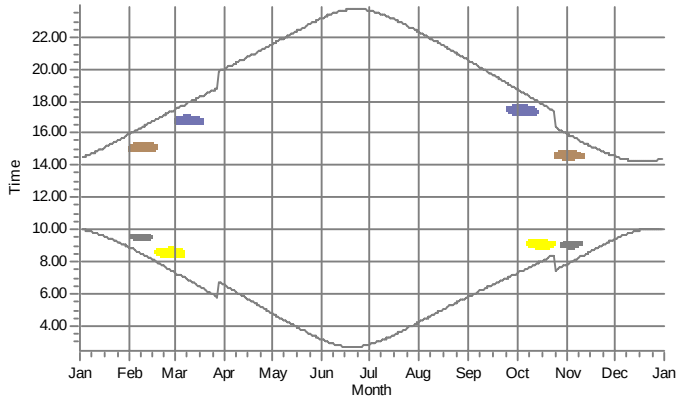
G: Asuinrakennus G



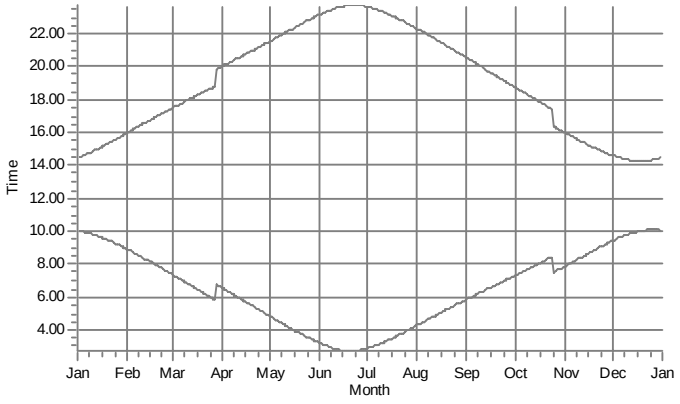
H: Asuinrakennus H



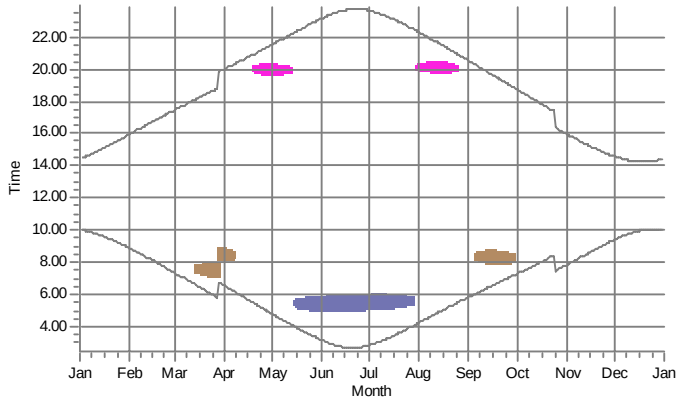
I: Asuinrakennus I



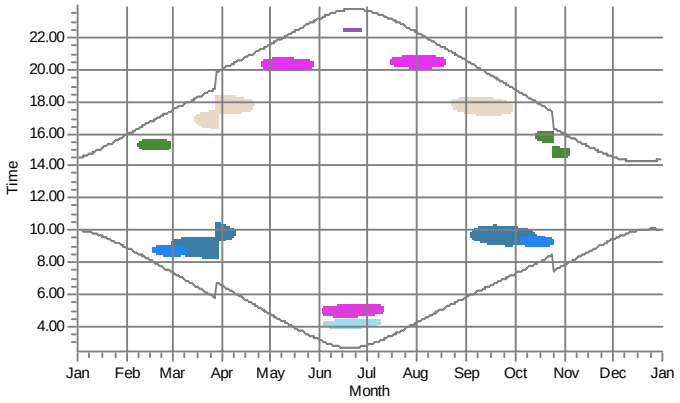
J: Asuinrakennus J

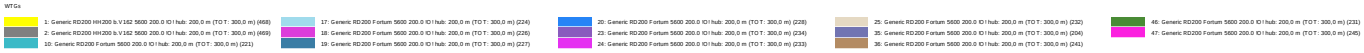


K: Lomarakennus K



L: Lomarakennus L





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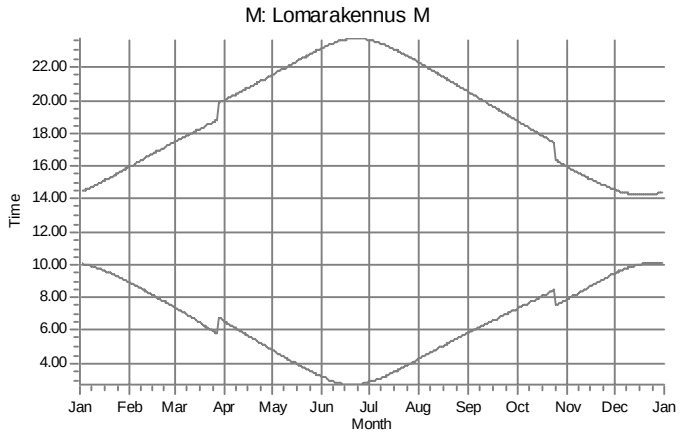
SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131+ YV Kivikangas



WTGs

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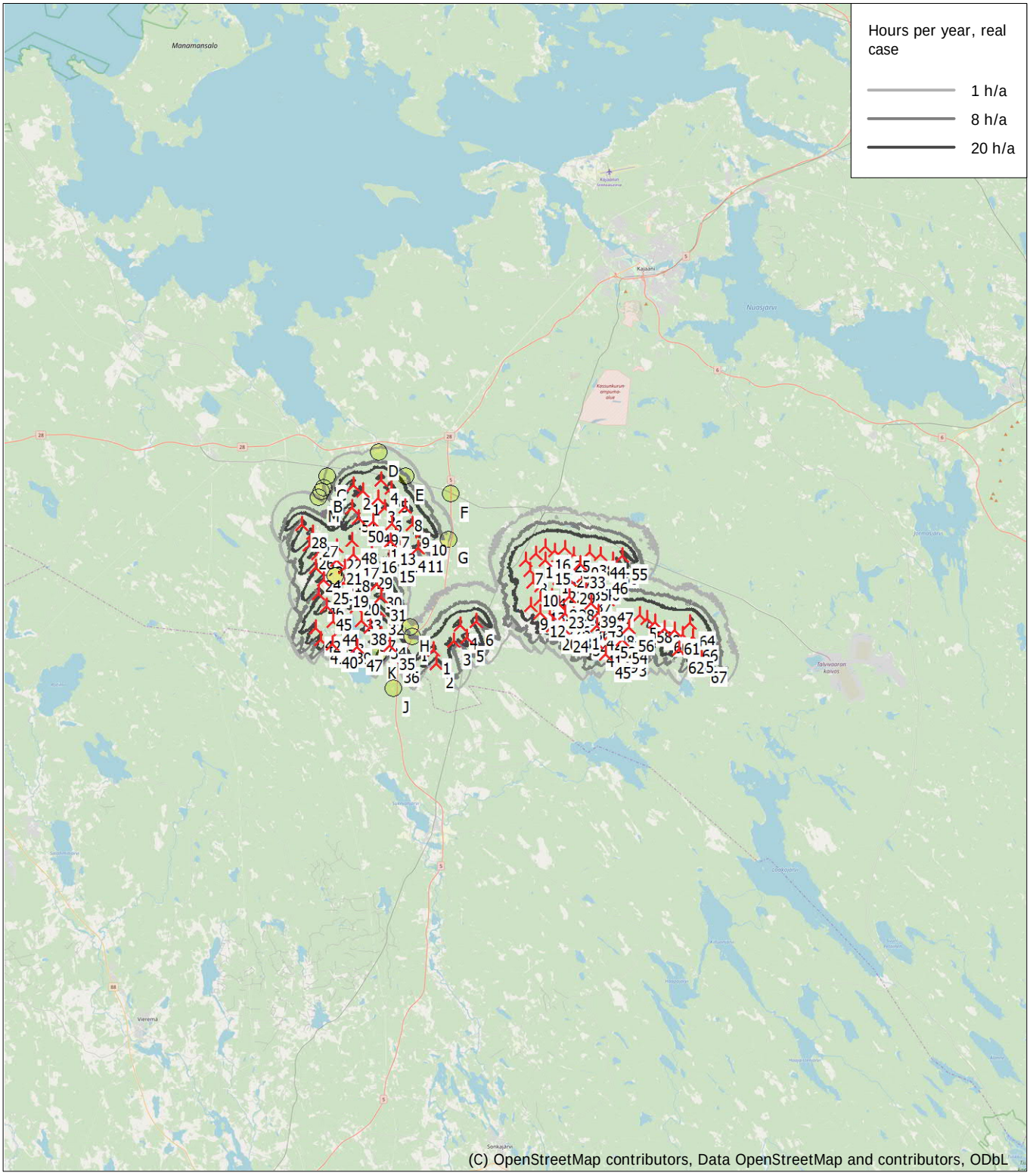
SHADOW - Map

Calculation: Katajamäki VE1 RD200x51HH200_real case, no forest_20220131+ YV Kivikangas



0 5 10 15 20 km

Map: EMD OpenStreetMap , Print scale 1:400 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 526 580 North: 7 099 520

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Katajamäen tuulivoimahanke_0.wpo (2)

Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 1,5 m

Liite 11. Katajamäen tuulivoimahanke – varjostusmallinnuksen tulokset ”real case, no forest” (VE2).

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8.3.2022 13.40/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE2_RD200x46HH200_real case, no forest_20220131

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
0,77	2,38	4,42	6,93	8,81	9,87	9,13	6,84	4,43	2,23	0,93	0,26

Operational hours are calculated from WTGs in calculation and wind distribution:
MERRA_N64,00_E027,335 (4)

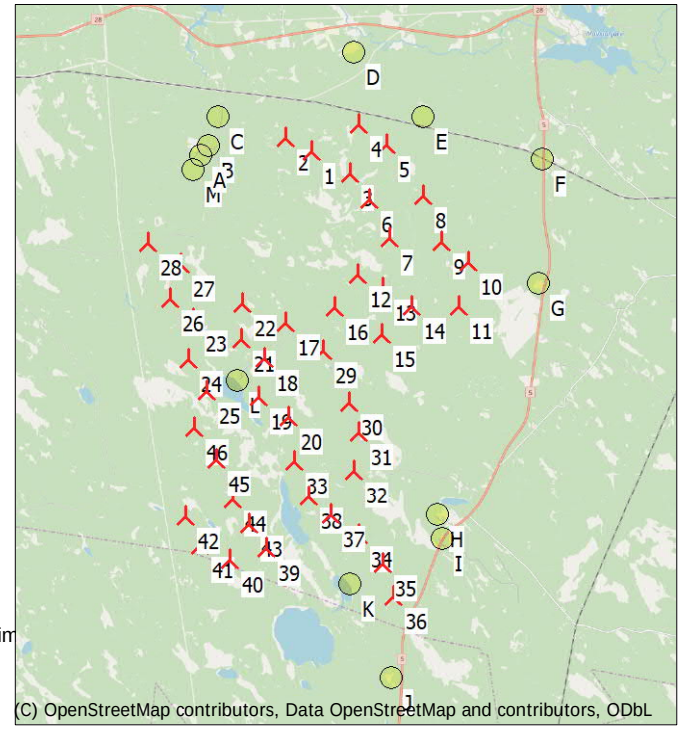
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
519	424	484	521	569	831	1 064	1 068	892	804	724	675	8 574

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Katajamäen tuulivoim
Obstacles used in calculation
Receptor grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:200 000
New WTG
Shadow receptor

WTGs

	East	North	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	515 909	7 106 459	164,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
2	515 210	7 106 831	164,9	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
3	516 931	7 105 901	145,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
4	517 160	7 107 206	142,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
5	517 906	7 106 667	137,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
6	517 446	7 105 214	147,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
7	517 980	7 104 206	148,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
8	518 858	7 105 305	145,9	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
9	519 364	7 104 099	155,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
10	520 088	7 103 598	172,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
11	519 817	7 102 420	156,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
12	517 144	7 103 226	166,6	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
13	517 816	7 102 875	160,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
14	518 583	7 102 417	152,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	517 771	7 101 673	167,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
16	516 534	7 102 343	177,2	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
17	515 249	7 101 935	174,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
18	514 670	7 100 997	170,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
19	514 555	7 099 960	171,1	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
20	515 309	7 099 437	168,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
21	514 070	7 101 510	162,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	514 093	7 102 453	153,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
23	512 778	7 102 030	157,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
24	512 646	7 100 974	160,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
25	513 168	7 100 143	162,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
26	512 181	7 102 585	153,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
27	512 447	7 103 491	147,2	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	511 576	7 104 046	147,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
29	516 239	7 101 210	190,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	516 931	7 099 863	197,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
31	517 213	7 099 034	197,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

To be continued on next page...

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Calculated:
8.3.2022 13.40/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE2_RD200x46HH200_real case, no forest_20220131

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
32	517 075	7 098 024	179,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
33	515 475	7 098 267	165,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	517 226	7 096 320	171,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
35	517 845	7 095 564	168,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	518 144	7 094 686	176,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
37	516 462	7 096 860	173,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
38	515 866	7 097 332	169,4	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
39	514 763	7 095 958	167,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
40	513 785	7 095 645	173,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
41	512 989	7 095 998	185,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
42	512 622	7 096 766	187,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
43	514 288	7 096 590	175,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
44	513 847	7 097 251	182,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
45	513 394	7 098 322	187,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
46	512 819	7 099 163	178,6	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Lomarakennus A	512 987	7 106 346	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B	513 159	7 106 642	134,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Lomarakennus C	513 426	7 107 406	131,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D	516 993	7 109 125	130,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E	518 871	7 107 433	147,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Asuinrakennus F	522 013	7 106 307	152,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Asuinrakennus G	521 923	7 103 034	185,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	Asuinrakennus H	519 294	7 096 871	217,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	Asuinrakennus I	519 418	7 096 236	190,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
J	Asuinrakennus J	518 094	7 092 553	194,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
K	Lomarakennus K	516 998	7 095 013	155,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
L	Lomarakennus L	513 968	7 100 391	157,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
M	Lomarakennus M	512 778	7 105 974	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Lomarakennus A	0:00
B	Asuinrakennus B	0:00
C	Lomarakennus C	2:11
D	Asuinrakennus D	1:42
E	Lomarakennus E	7:00
F	Asuinrakennus F	0:00
G	Asuinrakennus G	3:02
H	Asuinrakennus H	1:18
I	Asuinrakennus I	3:51
J	Asuinrakennus J	0:00
K	Lomarakennus K	20:36
L	Lomarakennus L	45:09
M	Lomarakennus M	0:00

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

No.	Name	Expected [h/year]
1	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (266)	0:00
2	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (289)	2:11
3	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (267)	0:00

To be continued on next page...

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Calculated:
8.3.2022 13.40/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE2_RD200x46HH200_real case, no forest_20220131

...continued from previous page

No.	Name	Expected [h/year]
4	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)	4:27
5	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)	4:15
6	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (268)	0:00
7	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (269)	0:00
8	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (270)	0:00
9	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (271)	0:00
10	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (272)	3:02
11	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (273)	0:00
12	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (263)	0:00
13	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (264)	0:00
14	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (265)	0:00
15	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (293)	0:00
16	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (276)	0:00
17	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (275)	2:28
18	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (277)	4:51
19	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (278)	13:50
20	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (279)	2:27
21	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (280)	0:00
22	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (281)	0:00
23	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (285)	0:06
24	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (284)	8:03
25	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (283)	11:43
26	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (286)	0:00
27	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (290)	0:00
28	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (291)	0:00
29	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (274)	0:00
30	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)	0:00
31	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)	0:00
32	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)	0:00
33	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)	0:00
34	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)	0:00
35	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)	18:41
36	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)	7:05
37	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)	0:00
38	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)	0:00
39	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (253)	0:00
40	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)	0:00
41	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (288)	0:00
42	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (287)	0:00
43	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (252)	0:00
44	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (251)	0:00
45	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (250)	0:00
46	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (282)	2:13

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

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

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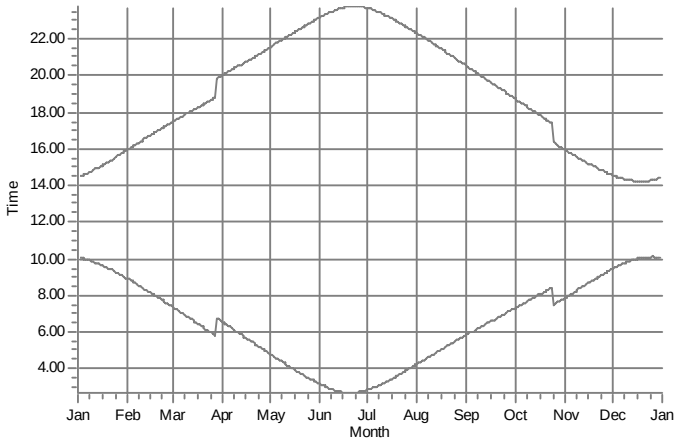
Calculated:
8.3.2022 13.40/3.5.576

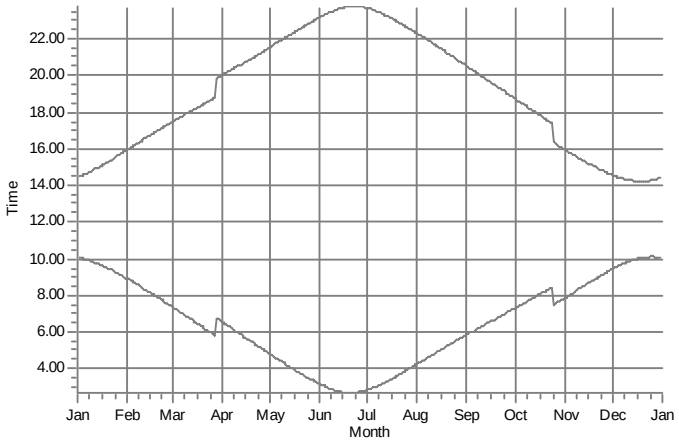
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2_RD200x46HH200_real case, no forest_20220131

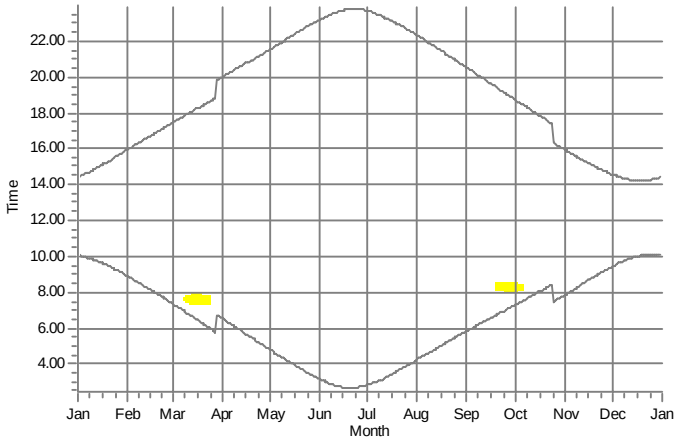
A: Lomarakennus A



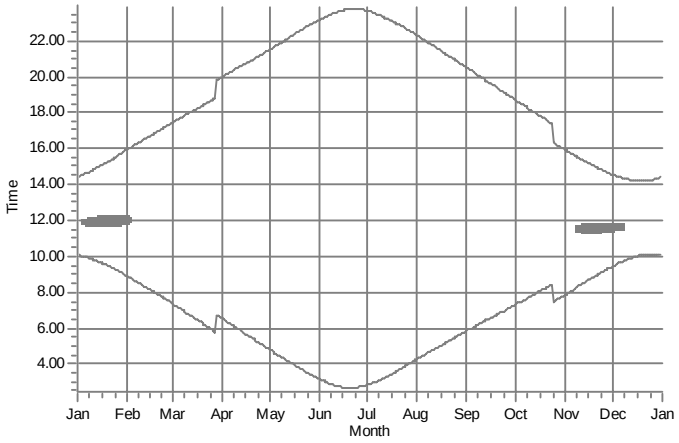
B: Asuinrakennus B



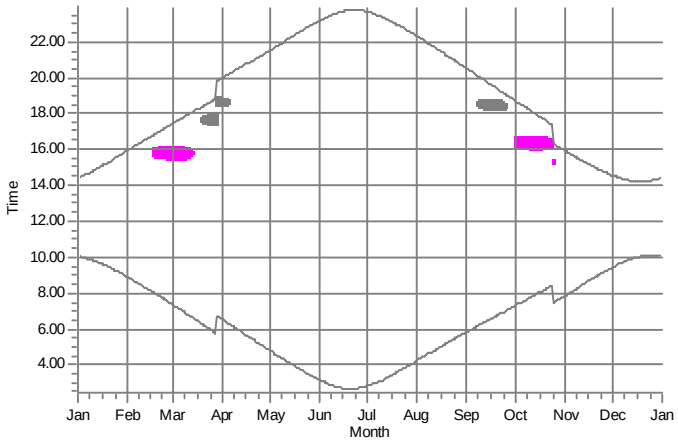
C: Lomarakennus C



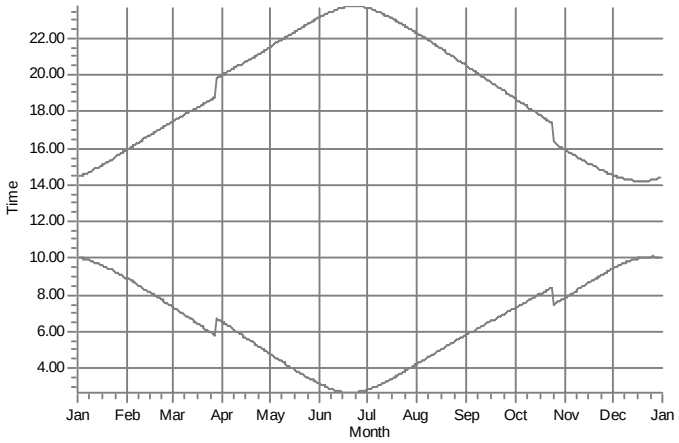
D: Asuinrakennus D



E: Lomarakennus E



F: Asuinrakennus F



WTGs

2: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (289)

4: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)

5: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)

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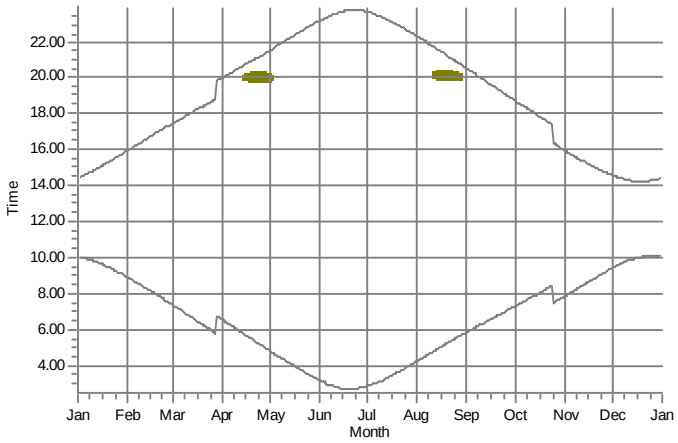
Calculated:
8.3.2022 13.40/3.5.576

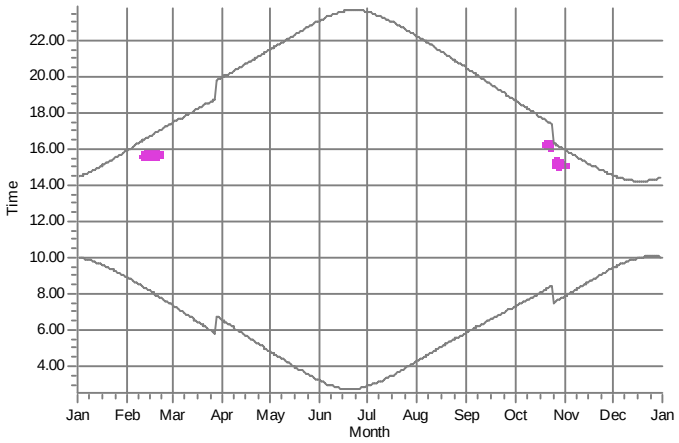
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2_RD200x46HH200_real case, no forest_20220131

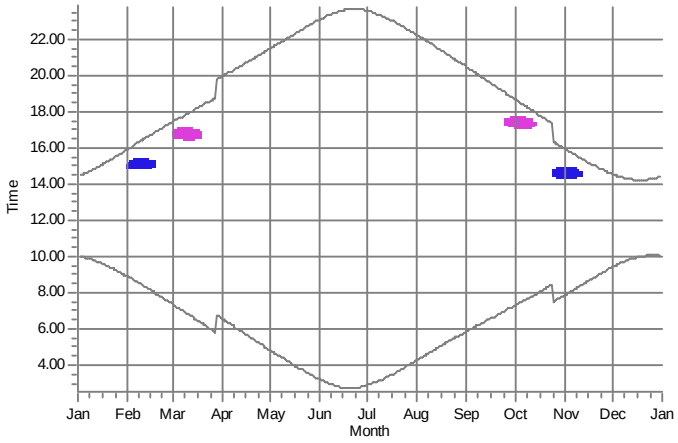
G: Asuinrakennus G



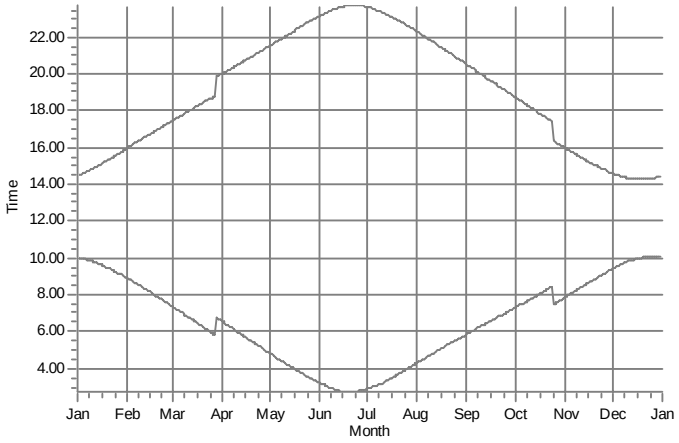
H: Asuinrakennus H



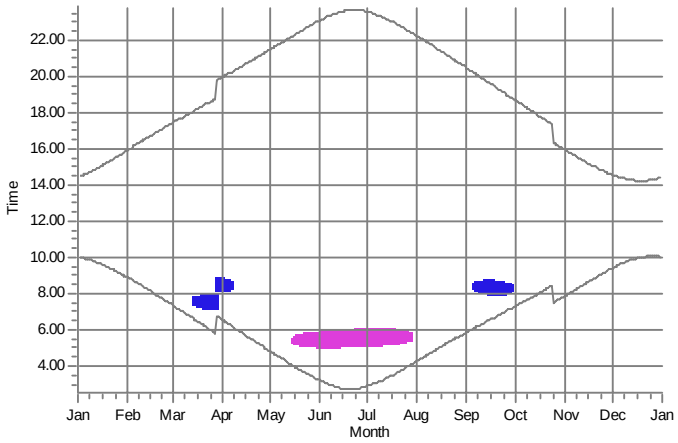
I: Asuinrakennus I



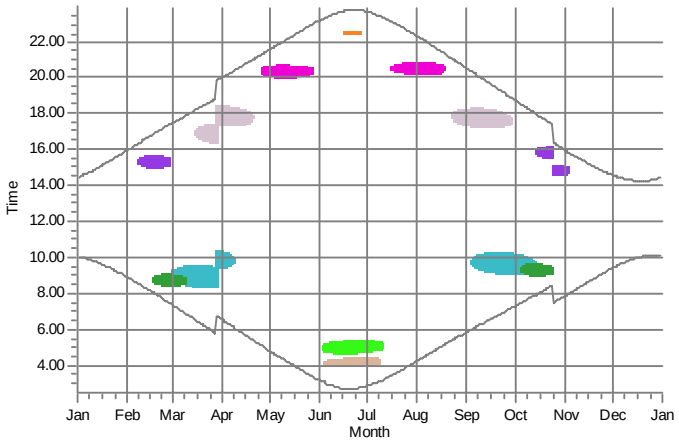
J: Asuinrakennus J



K: Lomarakennus K



L: Lomarakennus L



WTGs

10: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (272)
17: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (275)
18: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (277)
19: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (278)
20: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (279)
23: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (285)
24: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (284)
25: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (283)
35: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)
36: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)
46: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (282)

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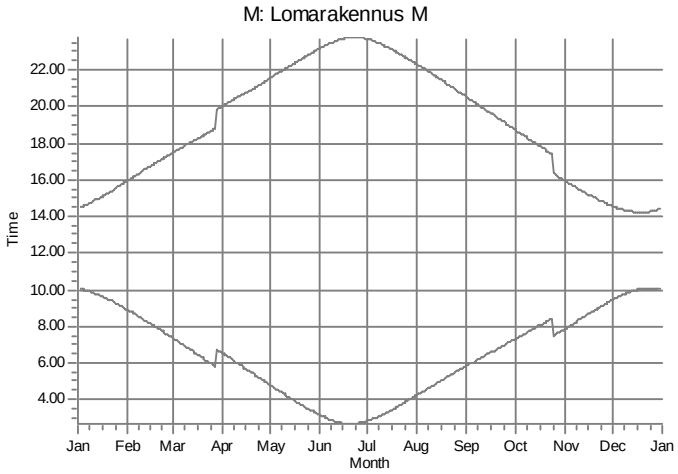
8.3.2022 13.40/3.5.576

SHADOW - Calendar, graphical

Calculation: Katajamäki VE2_RD200x46HH200_real case, no forest_20220131



WTGs

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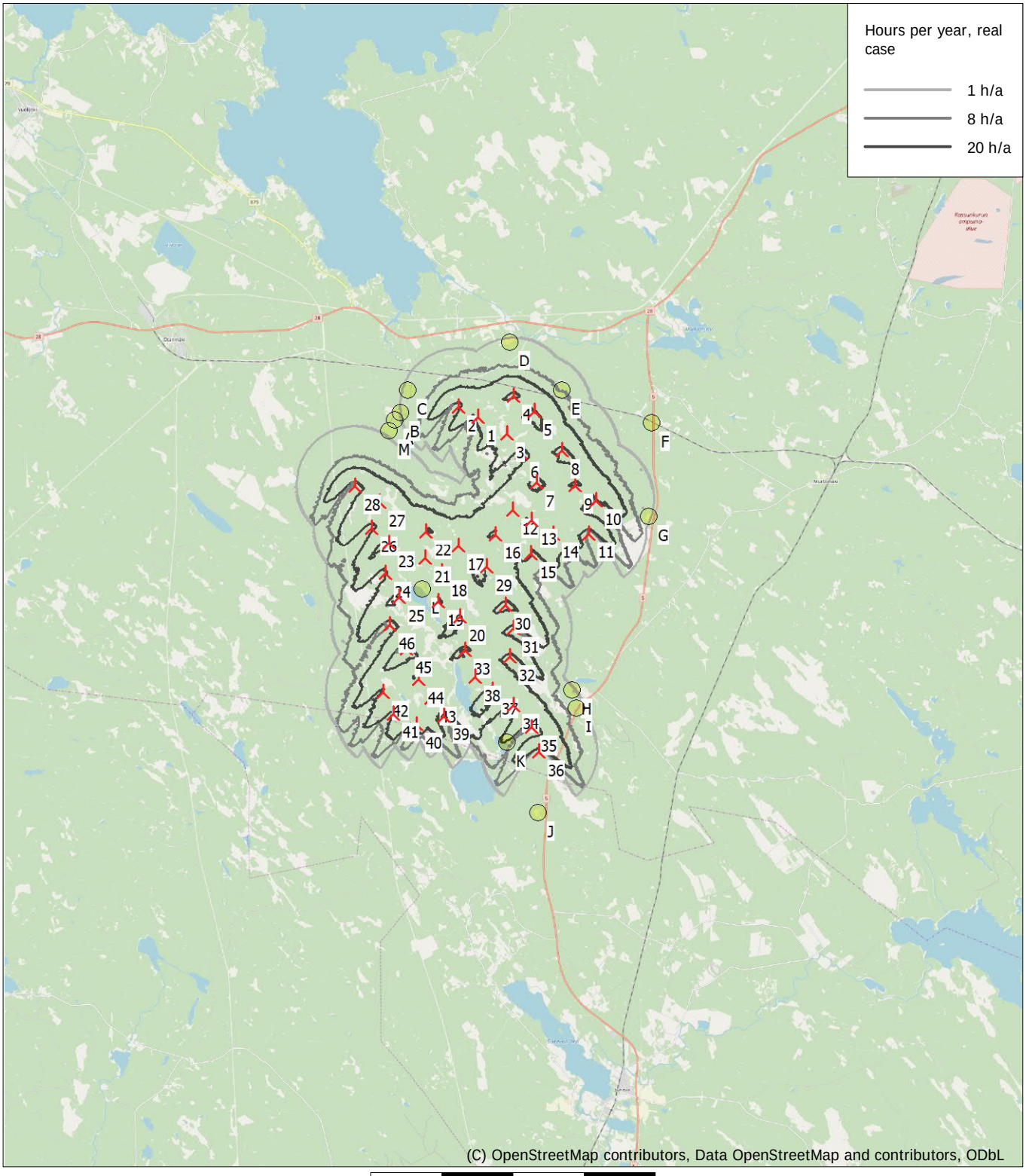
Calculated:
8.3.2022 13.40/3.5.576

SHADOW - Map

Calculation: Katajamäki VE2_RD200x46HH200_real case, no forest_20220131



Map: EMD OpenStreetMap , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 517 100 North: 7 100 540

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Katajamäen tuulivoimahanke_0.wpo (2)

Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 1,5 m

Liite 12. Katajamäen tuulivoimahanke – varjostusmallinnuksen tulokset ”real case, no forest” (VE2). Yhteisvaikutukset Kivikankaan hankkeen kanssa.

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Calculated:
26.8.2022 15.19/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, no forest_20220131+ YV Kivikangas

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
0,77	2,38	4,42	6,93	8,81	9,87	9,13	6,84	4,43	2,23	0,93	0,26

Operational hours are calculated from WTGs in calculation and wind distribution:
MERRA_N64,00_E027,335 (4)

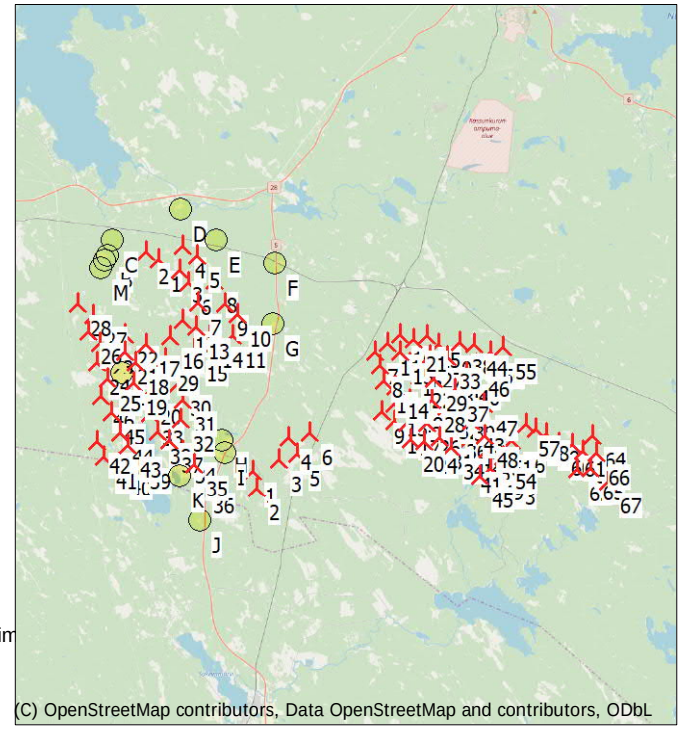
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
519	424	484	521	569	831	1 064	1 068	892	804	724	675	8 574

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Katajamäen tuulivoim
Obstacles used in calculation
Receptor grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:400 000

New WTG Shadow receptor

WTGs

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	520 945	7 095 256	175,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
1	515 909	7 106 459	164,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
2	521 095	7 094 331	164,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
2	515 210	7 106 831	164,9	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
3	522 355	7 095 878	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
3	516 931	7 105 901	145,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
4	522 755	7 097 057	176,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
4	517 160	7 107 206	142,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
5	523 237	7 096 145	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
5	517 906	7 106 667	137,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
6	523 951	7 097 319	165,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
6	517 446	7 105 214	147,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
7	527 400	7 101 633	174,1	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
7	517 980	7 104 206	148,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
8	527 645	7 100 906	176,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
8	518 858	7 105 305	145,9	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
9	527 745	7 098 481	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
9	519 364	7 104 099	155,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
10	527 847	7 100 086	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
10	520 088	7 103 598	172,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
11	528 041	7 102 119	164,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
11	519 817	7 102 420	156,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
12	528 395	7 097 931	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
12	517 144	7 103 226	166,6	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
13	528 420	7 098 881	177,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
13	517 816	7 102 875	160,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
14	528 496	7 099 831	177,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
14	518 583	7 102 417	152,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	528 704	7 101 642	170,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
15	517 771	7 101 673	167,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
16	528 710	7 102 595	162,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4

To be continued on next page...

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SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, no forest_20220131+ YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
16	516 534	7 102 343	177,2	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
17	529 120	7 097 906	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
17	515 249	7 101 935	174,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
18	529 181	7 099 074	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
18	514 670	7 100 997	170,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
19	529 211	7 101 016	183,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
19	514 555	7 099 960	171,1	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
20	529 320	7 097 006	192,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
20	515 309	7 099 437	168,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
21	529 393	7 102 332	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
21	514 070	7 101 510	162,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	514 093	7 102 453	153,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	529 727	7 100 356	205,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
23	529 779	7 098 556	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
23	512 778	7 102 030	157,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
24	530 031	7 096 928	171,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
24	512 646	7 100 974	160,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
25	530 120	7 102 556	174,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
25	513 168	7 100 143	162,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
26	530 192	7 097 881	182,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
26	512 181	7 102 585	153,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
27	530 249	7 101 446	190,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
27	512 447	7 103 491	147,2	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	511 576	7 104 046	147,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	530 402	7 099 101	206,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
29	530 470	7 100 256	185,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
29	516 239	7 101 210	190,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	530 749	7 102 088	177,1	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
30	516 931	7 099 863	197,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
31	530 845	7 097 081	167,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
31	517 213	7 099 034	197,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
32	531 170	7 098 806	195,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
32	517 075	7 098 024	179,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
33	531 199	7 101 417	177,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
33	515 475	7 098 267	165,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	531 442	7 096 615	167,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
34	517 226	7 096 320	171,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
35	531 445	7 100 556	184,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
35	517 845	7 095 564	168,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	518 144	7 094 686	176,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	531 595	7 097 706	177,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
37	531 620	7 099 681	192,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
37	516 462	7 096 860	173,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
38	531 848	7 102 200	181,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
38	515 866	7 097 332	169,4	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
39	531 995	7 098 644	192,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
39	514 763	7 095 958	167,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
40	532 195	7 100 506	177,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
40	513 785	7 095 645	173,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
41	532 370	7 095 881	167,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
41	512 989	7 095 998	185,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
42	532 373	7 097 087	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
42	512 622	7 096 766	187,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
43	532 519	7 098 005	172,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
43	514 288	7 096 590	175,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
44	532 627	7 102 078	185,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
44	513 847	7 097 251	182,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
45	532 995	7 095 106	166,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
45	513 394	7 098 322	187,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
46	532 752	7 101 003	186,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
46	512 819	7 099 163	178,6	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
47	533 198	7 098 953	173,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
48	533 270	7 097 281	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4

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Calculated:
26.8.2022 15.19/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, no forest_20220131+ YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
49	533 563	7 095 498	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
50	533 473	7 101 697	197,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
51	534 002	7 096 854	195,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
52	533 383	7 096 525	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
53	534 153	7 095 289	171,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
54	534 246	7 096 135	174,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
55	534 129	7 101 976	207,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
56	534 691	7 096 987	186,2	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
57	535 406	7 097 920	183,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
58	535 963	7 097 629	190,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
59	536 487	7 097 358	208,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
60	537 145	7 096 906	218,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
61	537 870	7 096 856	208,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
62	538 185	7 095 540	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
63	538 465	7 096 494	193,2	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
64	538 995	7 097 356	197,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
65	538 846	7 095 554	189,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
66	539 204	7 096 413	190,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
67	539 802	7 094 885	187,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Lomarakennus A	512 987	7 106 346	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B	513 159	7 106 642	134,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Lomarakennus C	513 426	7 107 406	131,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D	516 993	7 109 125	130,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E	518 871	7 107 433	147,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Asuinrakennus F	522 013	7 106 307	152,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Asuinrakennus G	521 923	7 103 034	185,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	Asuinrakennus H	519 294	7 096 871	217,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	Asuinrakennus I	519 418	7 096 236	190,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
J	Asuinrakennus J	518 094	7 092 553	194,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
K	Lomarakennus K	516 998	7 095 013	155,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
L	Lomarakennus L	513 968	7 100 391	157,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
M	Lomarakennus M	512 778	7 105 974	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Lomarakennus A	0:00
B	Asuinrakennus B	0:00
C	Lomarakennus C	2:11
D	Asuinrakennus D	1:42
E	Lomarakennus E	7:00
F	Asuinrakennus F	0:00
G	Asuinrakennus G	3:02
H	Asuinrakennus H	2:11
I	Asuinrakennus I	6:33
J	Asuinrakennus J	0:00
K	Lomarakennus K	20:36
L	Lomarakennus L	45:09
M	Lomarakennus M	0:00

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26.8.2022 15.19/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, no forest_20220131+ YV Kivikangas

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

No.	Name	Expected [h/year]
1	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (468)	2:49
1	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (266)	0:00
2	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (469)	0:44
2	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (289)	2:11
3	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (470)	0:00
3	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (267)	0:00
4	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (471)	0:00
4	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)	4:27
5	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (472)	0:00
5	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)	4:15
6	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (473)	0:00
6	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (268)	0:00
7	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (474)	0:00
7	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (269)	0:00
8	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (475)	0:00
8	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (270)	0:00
9	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (476)	0:00
9	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (271)	0:00
10	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (477)	0:00
10	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (272)	3:02
11	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (478)	0:00
11	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (273)	0:00
12	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (479)	0:00
12	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (263)	0:00
13	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (480)	0:00
13	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (264)	0:00
14	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (481)	0:00
14	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (265)	0:00
15	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (482)	0:00
15	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (293)	0:00
16	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (483)	0:00
16	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (276)	0:00
17	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (484)	0:00
17	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (275)	2:28
18	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (485)	0:00
18	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (277)	4:51
19	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (486)	0:00
19	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (278)	13:50
20	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (487)	0:00
20	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (279)	2:27
21	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (488)	0:00
21	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (280)	0:00
22	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (281)	0:00
22	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (489)	0:00
23	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (490)	0:00
23	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (285)	0:06
24	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (491)	0:00
24	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (284)	8:03
25	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (492)	0:00
25	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (283)	11:43
26	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (493)	0:00
26	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (286)	0:00
27	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (494)	0:00
27	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (290)	0:00
28	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (291)	0:00
28	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (495)	0:00
29	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (496)	0:00
29	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (274)	0:00
30	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (497)	0:00
30	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)	0:00
31	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (498)	0:00
31	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)	0:00
32	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (499)	0:00
32	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)	0:00
33	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (500)	0:00

To be continued on next page...

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Calculated:
26.8.2022 15.19/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, no forest_20220131+ YV Kivikangas

...continued from previous page

No.	Name	Expected [h/year]
33	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)	0:00
34	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (501)	0:00
34	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)	0:00
35	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (502)	0:00
35	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)	18:41
36	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)	7:05
36	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (503)	0:00
37	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (504)	0:00
37	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)	0:00
38	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (505)	0:00
38	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)	0:00
39	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (506)	0:00
39	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (253)	0:00
40	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (507)	0:00
40	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)	0:00
41	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (508)	0:00
41	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (288)	0:00
42	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (509)	0:00
42	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (287)	0:00
43	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (510)	0:00
43	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (252)	0:00
44	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (511)	0:00
44	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (251)	0:00
45	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (512)	0:00
45	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (250)	0:00
46	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (513)	0:00
46	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (282)	2:13
47	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (514)	0:00
48	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (515)	0:00
49	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (516)	0:00
50	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (517)	0:00
51	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (518)	0:00
52	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (519)	0:00
53	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (520)	0:00
54	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (521)	0:00
55	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (522)	0:00
56	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (523)	0:00
57	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (524)	0:00
58	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (525)	0:00
59	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (526)	0:00
60	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (527)	0:00
61	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (528)	0:00
62	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (529)	0:00
63	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (530)	0:00
64	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (531)	0:00
65	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (532)	0:00
66	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (533)	0:00
67	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (534)	0:00

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

The calculation of the total expected values for a given receptor assumes a weighted average directional reduction for all WTGs contributing to shadow flicker within the same day. In the case where shadow flicker from different WTGs is not concurrent within the day, the total expected time at a given receptor may deviate marginally from the individual flicker time caused by each turbine separately.

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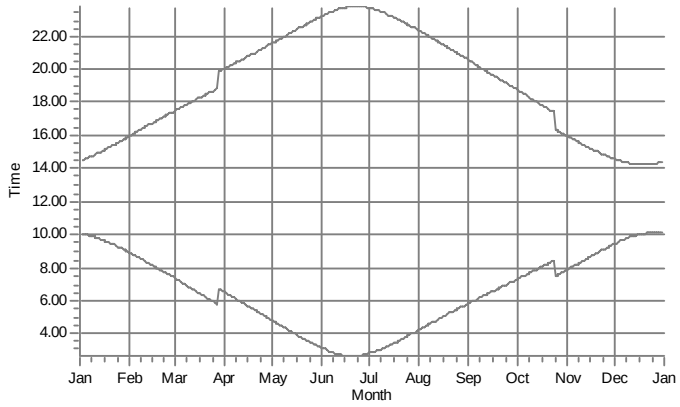
26.8.2022 15.19/3.5.584

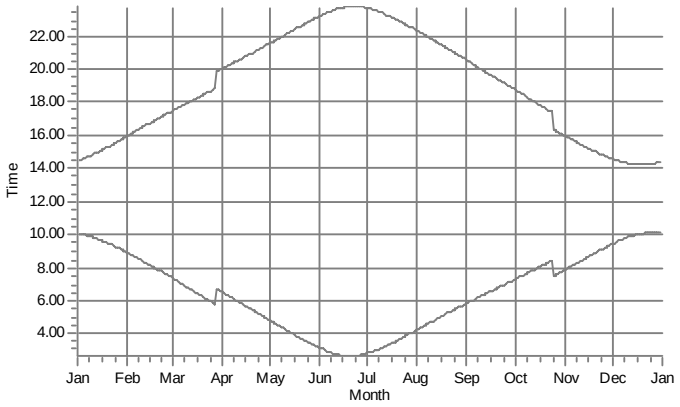
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2 RD200x46HH200_real case, no forest_20220131+ YV Kivikangas

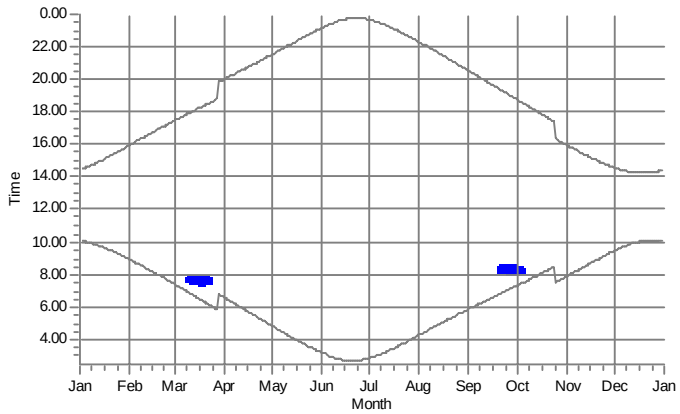
A: Lomarakennus A



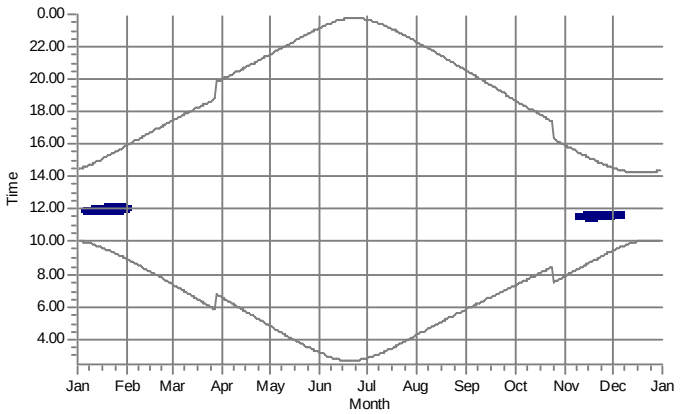
B: Asuinrakennus B



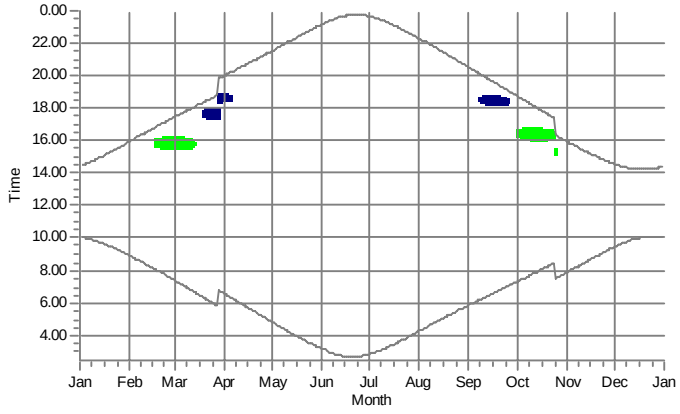
C: Lomarakennus C



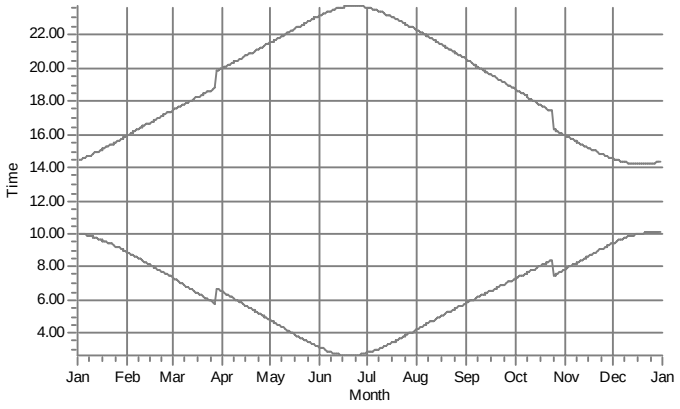
D: Asuinrakennus D



E: Lomarakennus E



F: Asuinrakennus F



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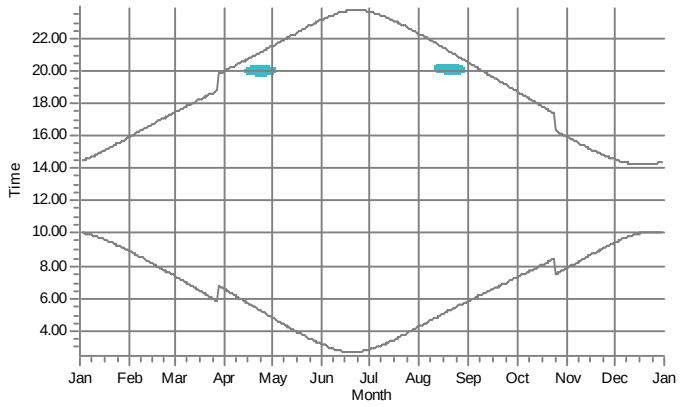
Calculated:
26.8.2022 15.19/3.5.584

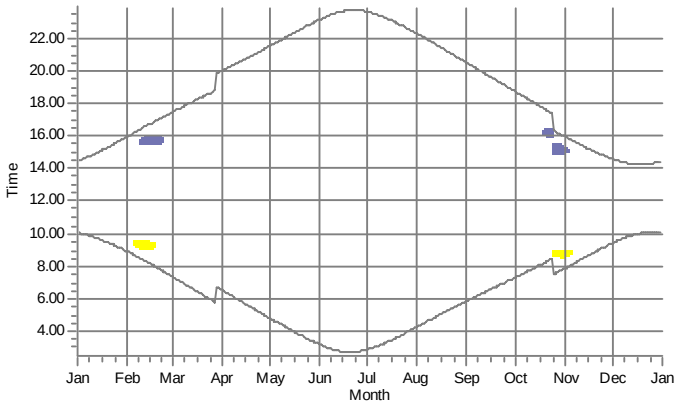
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2 RD200x46HH200_real case, no forest_20220131+ YV Kivikangas

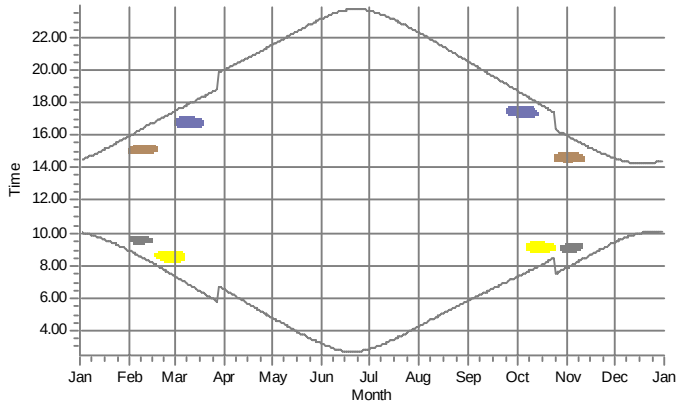
G: Asuinrakennus G



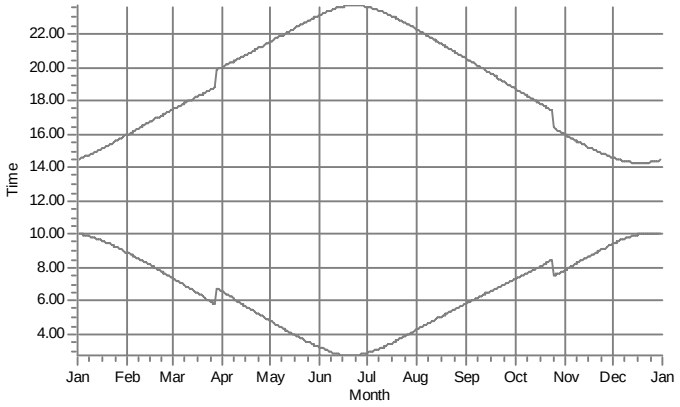
H: Asuinrakennus H



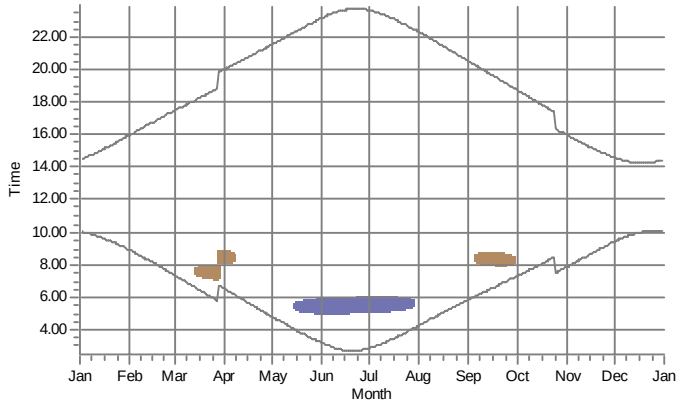
I: Asuinrakennus I



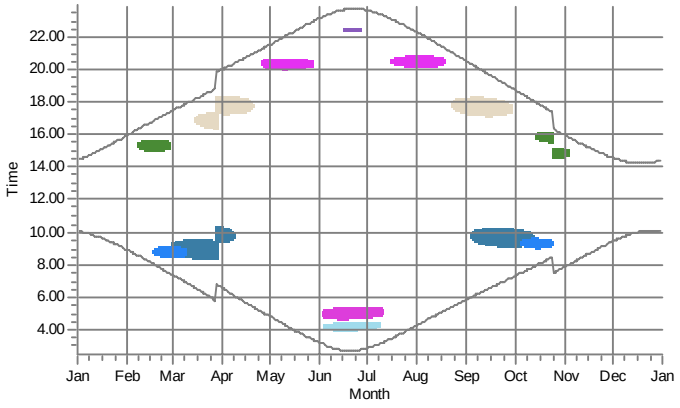
J: Asuinrakennus J



K: Lomarakennus K



L: Lomarakennus L



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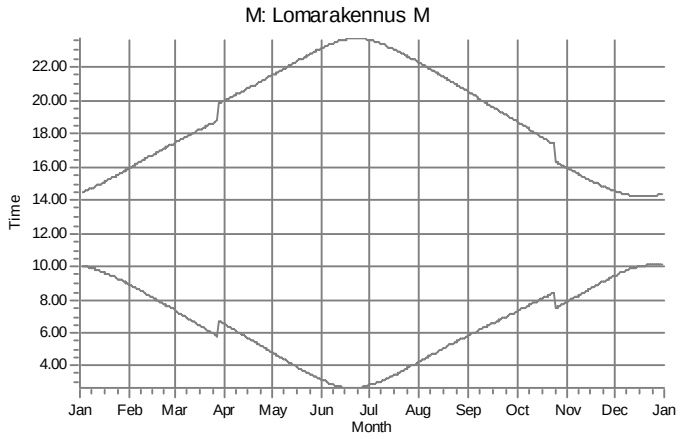
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2 RD200x46HH200_real case, no forest_20220131+ YV Kivikangas



WTGs

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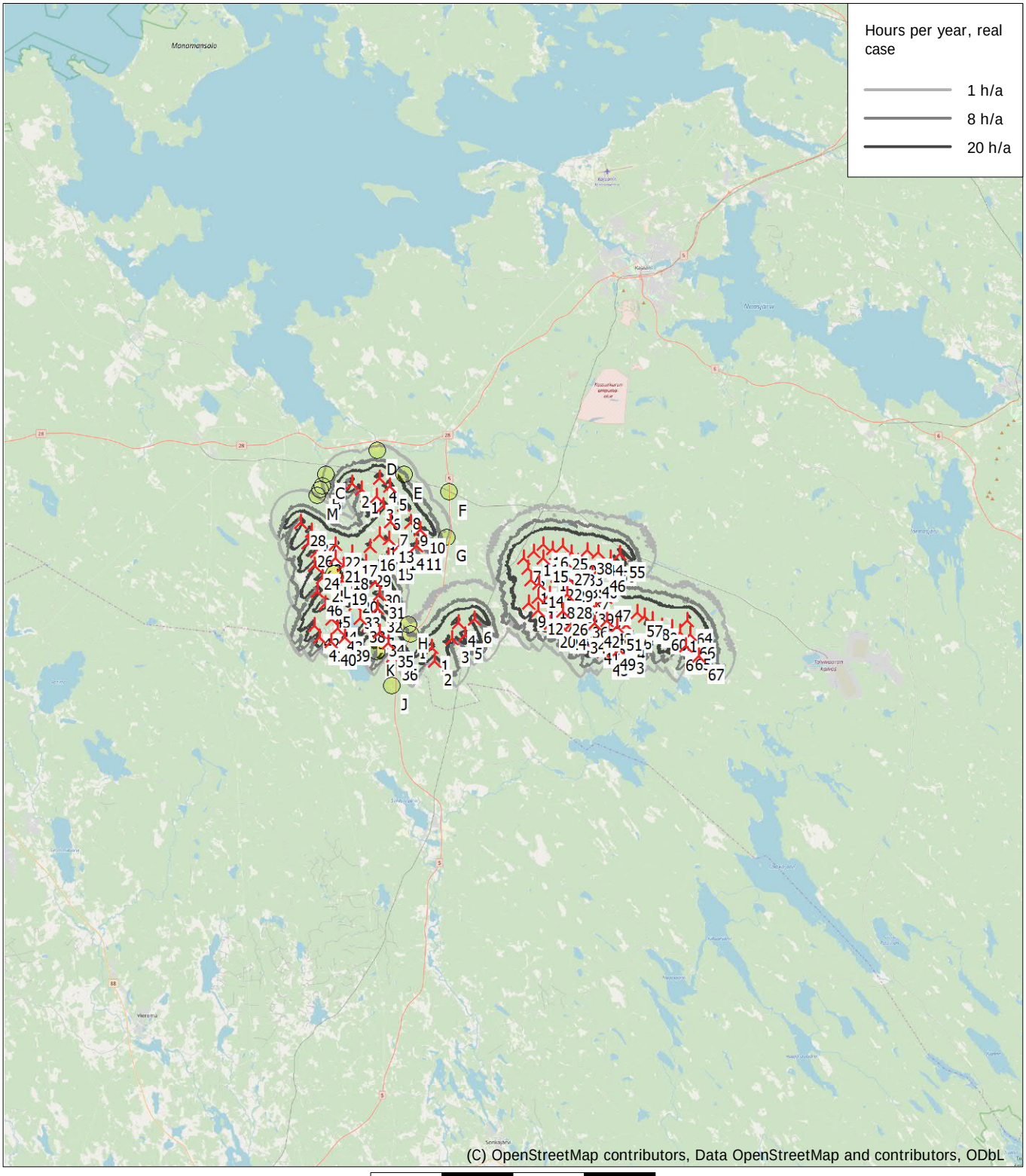
SHADOW - Map

Calculation: Katajamäki VE2 RD200x46HH200_real case, no forest_20220131+ YV Kivikangas



Map: EMD OpenStreetMap , Print scale 1:400 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 526 580 North: 7 099 520

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Katajamäen tuulivoimahanke_0.wpo (2)

Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 1,5 m

Liite 13. Katajamäen tuulivoimahanke – varjostusmallinnuksen tulokset ”real case, Luke forest” (VE1).

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8.3.2022 13.30/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131

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
0,77	2,38	4,42	6,93	8,81	9,87	9,13	6,84	4,43	2,23	0,93	0,26

Operational hours are calculated from WTGs in calculation and wind distribution:
MERRA_N64,00_E027,335 (4)

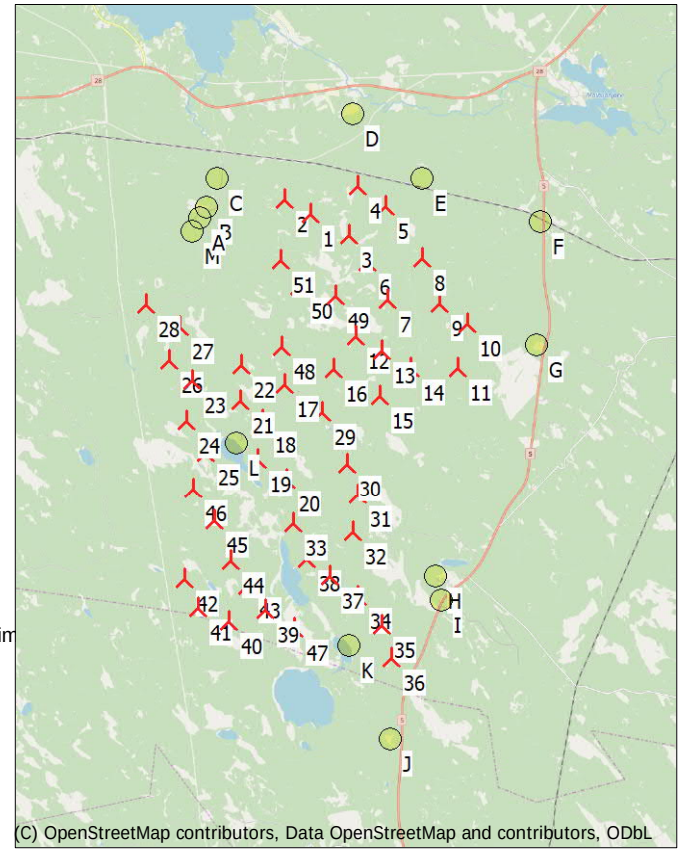
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
519	424	484	521	569	831	1 064	1 068	892	804	724	675	8 574

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Katajamäen tuulivoim
Area object(s) used in calculation:
Area object (NW): (1)
Area object (NE): (2)
Area object (SE): (3)
Area object (SW): (4)
Obstacles used in calculation
Receptor grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:200 000
New WTG Shadow receptor

WTGs

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	515 909	7 106 459	164,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
2	515 210	7 106 831	164,9	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
3	516 931	7 105 901	145,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
4	517 160	7 107 206	142,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
5	517 906	7 106 667	137,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
6	517 446	7 105 214	147,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
7	517 980	7 104 206	148,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
8	518 858	7 105 305	145,9	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
9	519 364	7 104 099	155,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
10	520 088	7 103 598	172,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
11	519 817	7 102 420	156,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
12	517 144	7 103 226	166,6	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
13	517 816	7 102 875	160,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
14	518 583	7 102 417	152,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	517 771	7 101 673	167,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
16	516 534	7 102 343	177,2	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
17	515 249	7 101 935	174,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
18	514 670	7 100 997	170,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
19	514 555	7 099 960	171,1	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
20	515 309	7 099 437	168,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
21	514 070	7 101 510	162,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	514 093	7 102 453	153,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
23	512 778	7 102 030	157,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
24	512 646	7 100 974	160,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
25	513 168	7 100 143	162,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
26	512 181	7 102 585	153,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

To be continued on next page...

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Calculated:
8.3.2022 13.30/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
27	512 447	7 103 491	147,2	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	511 576	7 104 046	147,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
29	516 239	7 101 210	190,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	516 931	7 099 863	197,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
31	517 213	7 099 034	197,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
32	517 075	7 098 024	179,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
33	515 475	7 098 267	165,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	517 226	7 096 320	171,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
35	517 845	7 095 564	168,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	518 144	7 094 686	176,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
37	516 462	7 096 860	173,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
38	515 866	7 097 332	169,4	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
39	514 763	7 095 958	167,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
40	513 785	7 095 645	173,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
41	512 989	7 095 998	185,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
42	512 622	7 096 766	187,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
43	514 288	7 096 590	175,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
44	513 847	7 097 251	182,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
45	513 394	7 098 322	187,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
46	512 819	7 099 163	178,6	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
47	515 539	7 095 480	162,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
48	515 171	7 102 940	162,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
49	516 610	7 104 302	158,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
50	515 639	7 104 571	165,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
51	515 136	7 105 219	160,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Lomarakennus A	512 987	7 106 346	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B	513 159	7 106 642	134,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Lomarakennus C	513 426	7 107 406	131,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D	516 993	7 109 125	130,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E	518 871	7 107 433	147,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Asuinrakennus F	522 013	7 106 307	152,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Asuinrakennus G	521 923	7 103 034	185,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	Asuinrakennus H	519 294	7 096 871	217,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	Asuinrakennus I	519 418	7 096 236	190,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
J	Asuinrakennus J	518 094	7 092 553	194,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
K	Lomarakennus K	516 998	7 095 013	155,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
L	Lomarakennus L	513 968	7 100 391	157,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
M	Lomarakennus M	512 778	7 105 974	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Lomarakennus A	0:00
B	Asuinrakennus B	0:00
C	Lomarakennus C	2:11
D	Asuinrakennus D	1:42
E	Lomarakennus E	7:00
F	Asuinrakennus F	0:00
G	Asuinrakennus G	3:02
H	Asuinrakennus H	1:18
I	Asuinrakennus I	0:00
J	Asuinrakennus J	0:00

To be continued on next page...

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Calculated:
8.3.2022 13.30/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131

...continued from previous page

Shadow, expected values

No.	Name	Shadow hours per year [h/year]
K	Lomarakennus K	5:34
L	Lomarakennus L	11:43
M	Lomarakennus M	0:00

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

No.	Name	Expected [h/year]
1	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (215)	0:00
2	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (238)	2:11
3	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (216)	0:00
4	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (244)	4:27
5	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (243)	4:15
6	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (217)	0:00
7	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (218)	0:00
8	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (219)	0:00
9	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (220)	0:00
10	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (221)	3:02
11	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (222)	0:00
12	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (212)	0:00
13	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (213)	0:00
14	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (214)	0:00
15	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (242)	0:00
16	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (225)	0:00
17	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (224)	0:00
18	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (226)	0:00
19	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (227)	0:00
20	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (228)	0:00
21	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (229)	0:00
22	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (230)	0:00
23	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (234)	0:00
24	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (233)	0:00
25	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (232)	11:43
26	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (235)	0:00
27	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (239)	0:00
28	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (240)	0:00
29	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (223)	0:00
30	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (211)	0:00
31	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (210)	0:00
32	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (209)	0:00
33	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (208)	0:00
34	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (205)	0:00
35	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (204)	1:18
36	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (241)	5:34
37	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (206)	0:00
38	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (207)	0:00
39	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (202)	0:00
40	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (203)	0:00
41	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (237)	0:00
42	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (236)	0:00
43	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (201)	0:00
44	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (200)	0:00
45	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (199)	0:00
46	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (231)	0:00
47	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (245)	0:00
48	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)	0:00
49	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (246)	0:00
50	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)	0:00
51	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)	0:00

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

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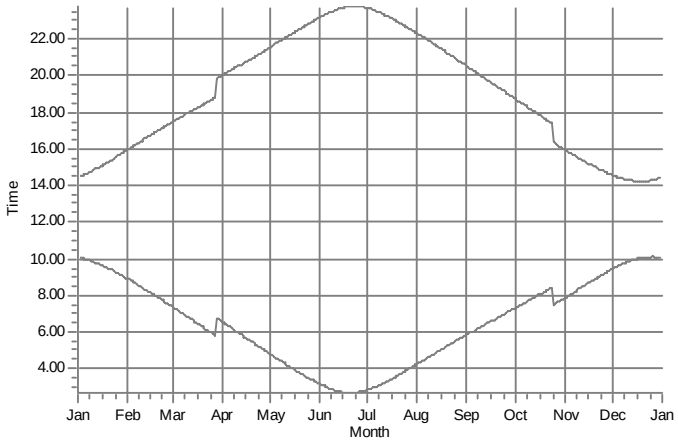
Calculated:
8.3.2022 13.30/3.5.576

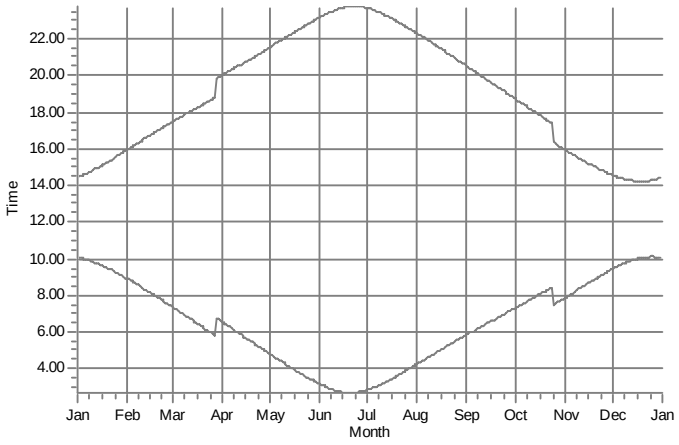
SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131

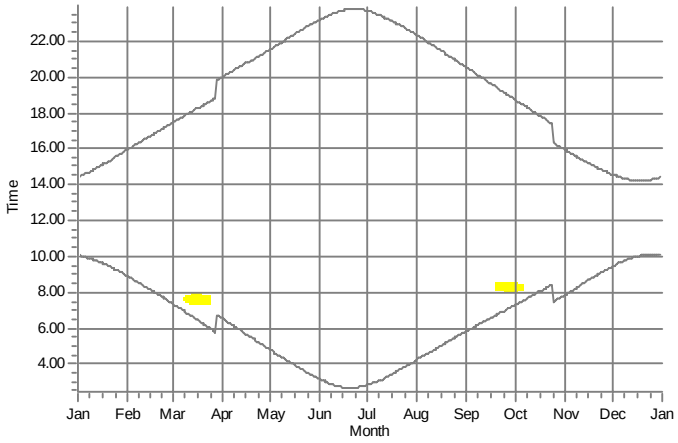
A: Lomarakennus A



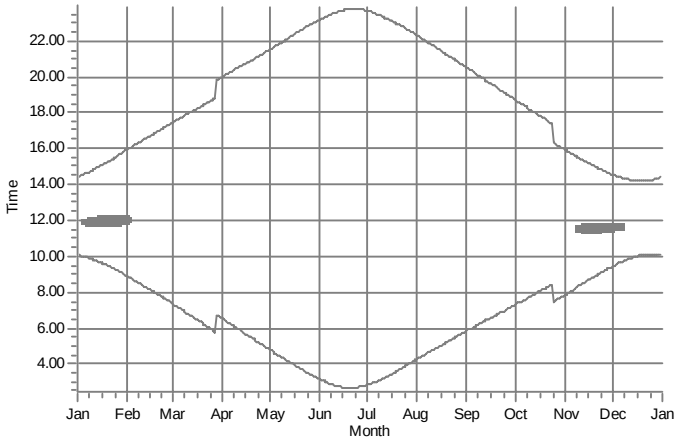
B: Asuinrakennus B



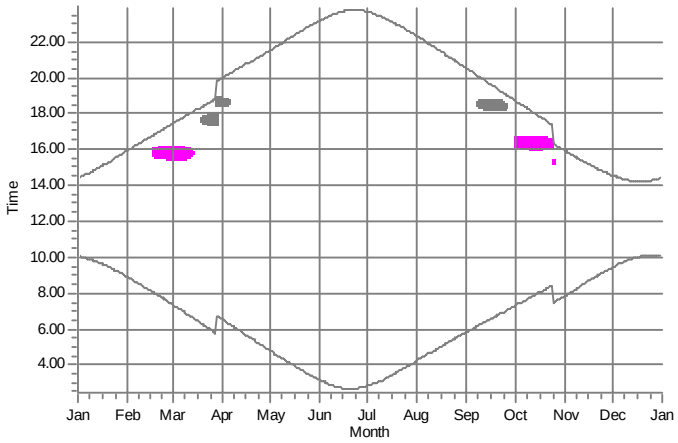
C: Lomarakennus C



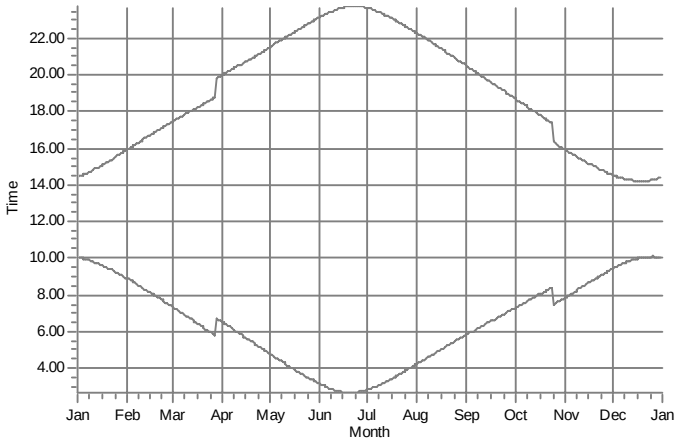
D: Asuinrakennus D



E: Lomarakennus E



F: Asuinrakennus F



WTGs

2: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (238)

4: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (244)

5: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (243)

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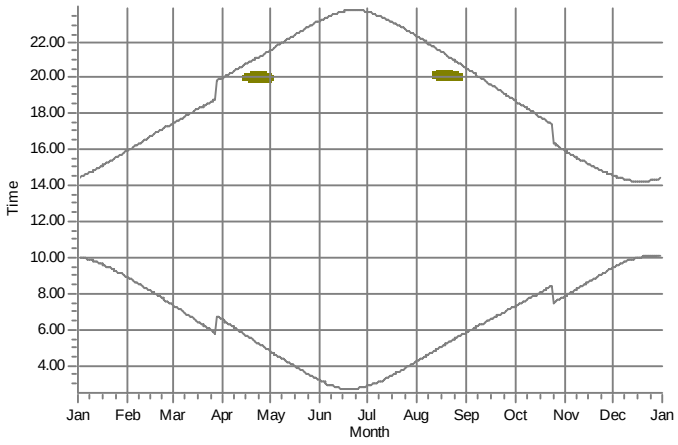
Calculated:
8.3.2022 13.30/3.5.576

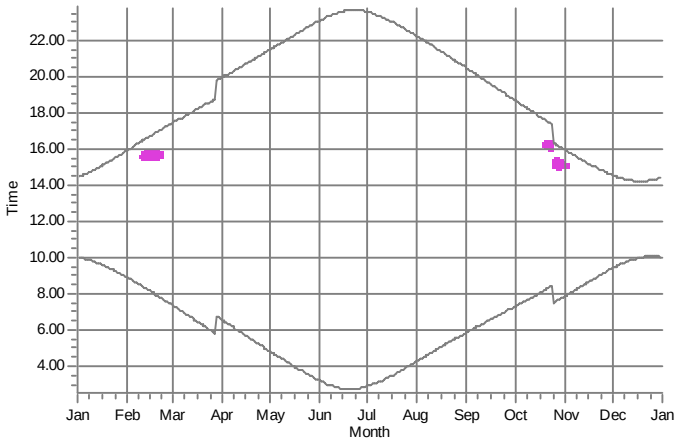
SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131

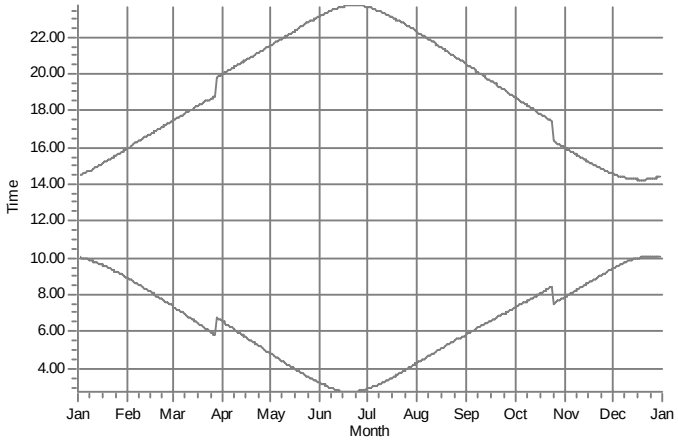
G: Asuinrakennus G



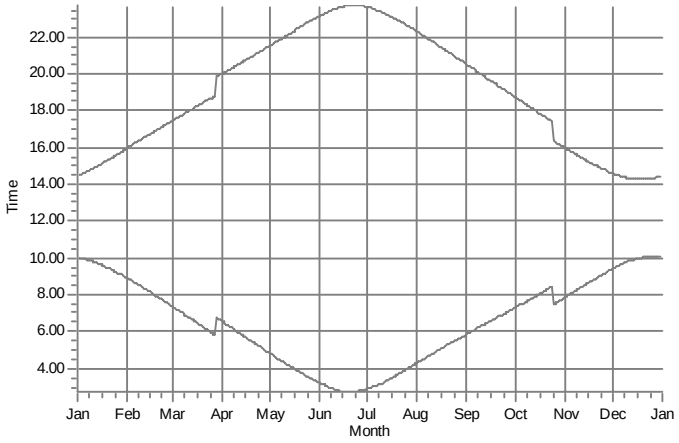
H: Asuinrakennus H



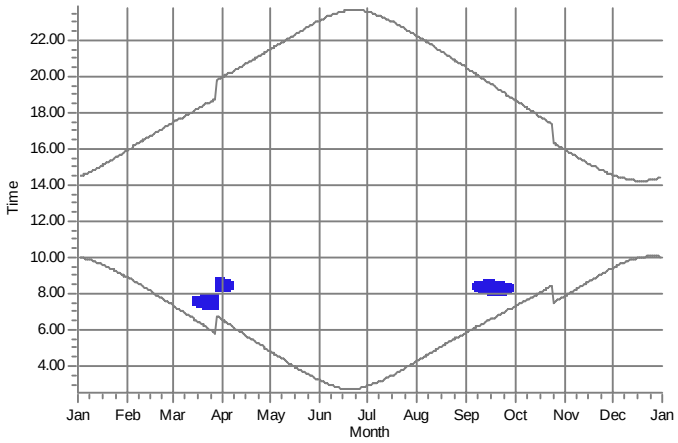
I: Asuinrakennus I



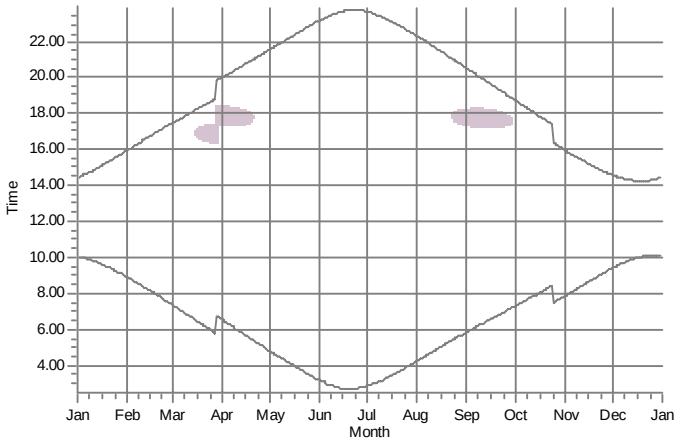
J: Asuinrakennus J



K: Lomarakennus K



L: Lomarakennus L



WTGs

10: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (221)
25: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (232)
35: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (204)
36: Generic RD200 Fortum 5600 200.0 IO! hub: 200,0 m (TOT: 300,0 m) (241)

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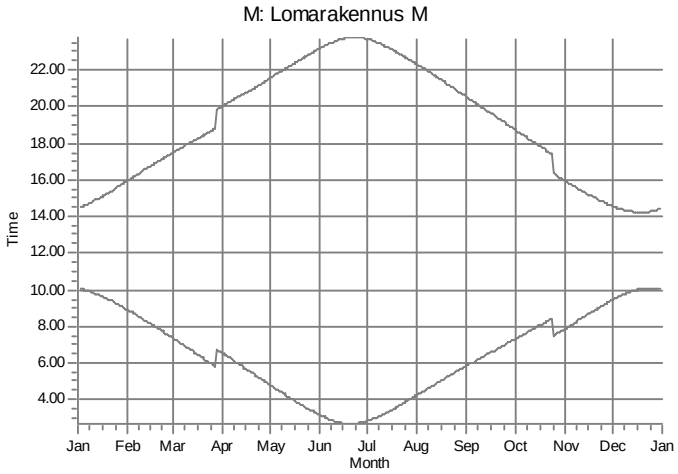
Calculated:
8.3.2022 13.30/3.5.576

SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131



WTGs

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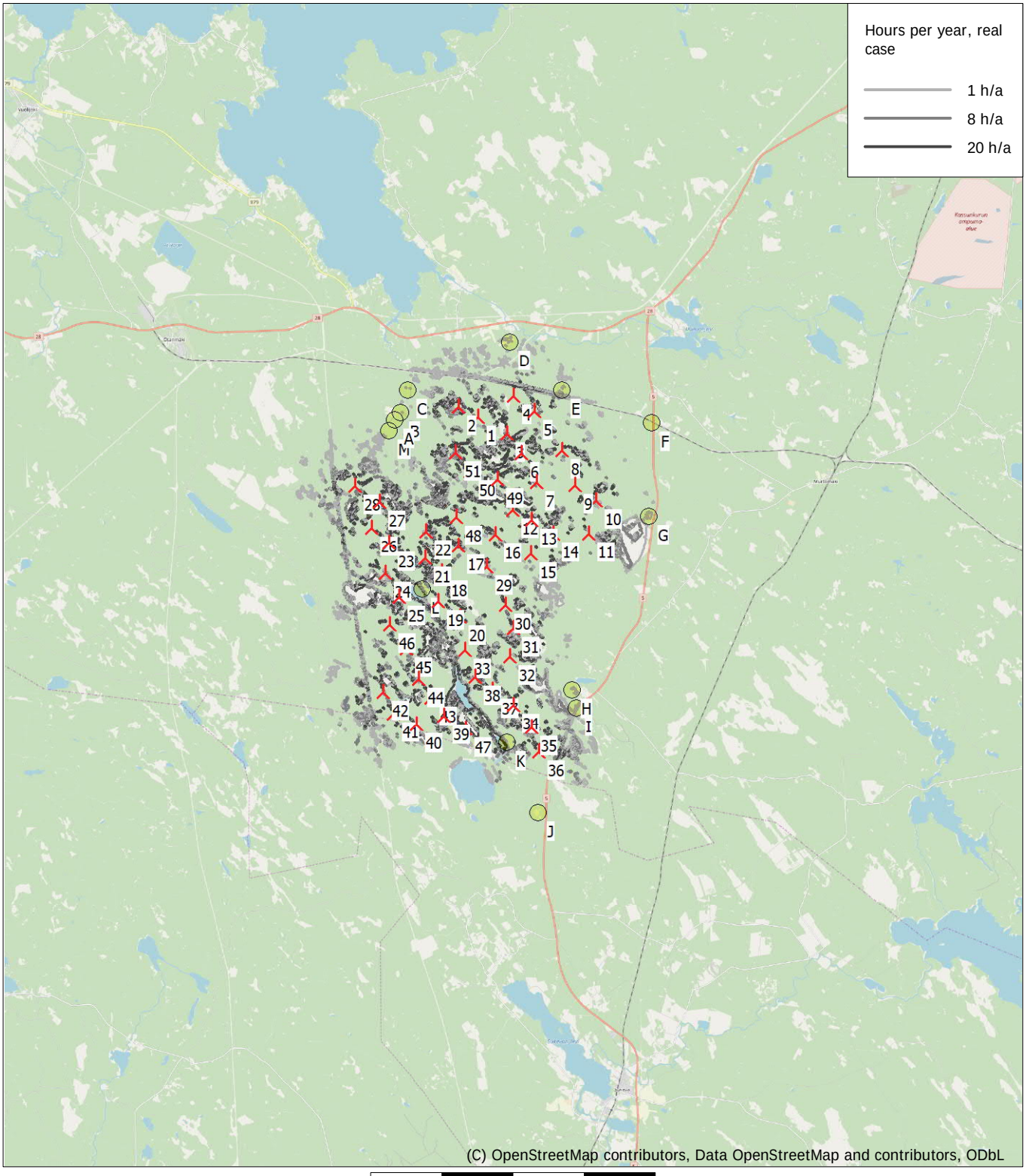
Calculated:
8.3.2022 13.30/3.5.576

SHADOW - Map

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131



0 2,5 5 7,5 10km

Map: EMD OpenStreetMap , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 517 100 North: 7 100 540

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Katajamäen tuulivoimahanke_0.wpo (2)

Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 1,5 m

Liite 14. Katajamäen tuulivoimahanke – varjostusmallinnuksen tulokset ”real case, Luke forest” (VE1). Yhteisvaikutukset Kivikankaan hankkeen kanssa.

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Calculated:
26.8.2022 14.02/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas

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
0,77	2,38	4,42	6,93	8,81	9,87	9,13	6,84	4,43	2,23	0,93	0,26

Operational hours are calculated from WTGs in calculation and wind distribution:
MERRA_N64,00_E027,335 (4)

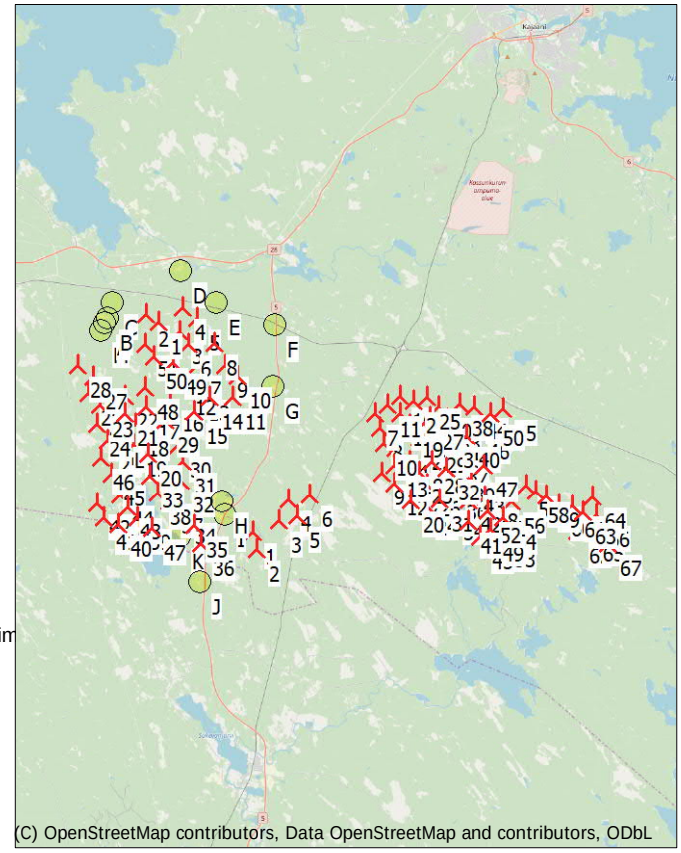
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
519	424	484	521	569	831	1 064	1 068	892	804	724	675	8 574

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Katajamäen tuulivoim
Area object(s) used in calculation:
Area object (NW): (1)
Area object (NE): (2)
Area object (SE): (3)
Area object (SW): (4)
Obstacles used in calculation
Receptor grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:400 000
New WTG
Shadow receptor

WTGs

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	520 945	7 095 256	175,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
1	515 909	7 106 459	164,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
2	521 095	7 094 331	164,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
2	515 210	7 106 831	164,9	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
3	522 355	7 095 878	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
3	516 931	7 105 901	145,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
4	522 755	7 097 057	176,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
4	517 160	7 107 206	142,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
5	523 237	7 096 145	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
5	517 906	7 106 667	137,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
6	523 951	7 097 319	165,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
6	517 446	7 105 214	147,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
7	527 400	7 101 633	174,1	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
7	517 980	7 104 206	148,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
8	527 645	7 100 906	176,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
8	518 858	7 105 305	145,9	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
9	527 745	7 098 481	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
9	519 364	7 104 099	155,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
10	527 847	7 100 086	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
10	520 088	7 103 598	172,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
11	528 041	7 102 119	164,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
11	519 817	7 102 420	156,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
12	528 395	7 097 931	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
12	517 144	7 103 226	166,6	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
13	528 420	7 098 881	177,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
13	517 816	7 102 875	160,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

To be continued on next page...

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Calculated:
26.8.2022 14.02/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
14	528 496	7 099 831	177,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
14	518 583	7 102 417	152,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	517 771	7 101 673	167,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	528 704	7 101 642	170,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
16	528 710	7 102 595	162,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
16	516 534	7 102 343	177,2	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
17	529 120	7 097 906	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
17	515 249	7 101 935	174,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
18	529 181	7 099 074	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
18	514 670	7 100 997	170,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
19	529 211	7 101 016	183,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
19	514 555	7 099 960	171,1	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
20	529 320	7 097 006	192,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
20	515 309	7 099 437	168,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
21	529 393	7 102 332	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
21	514 070	7 101 510	162,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	529 727	7 100 356	205,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
22	514 093	7 102 453	153,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
23	529 779	7 098 556	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
23	512 778	7 102 030	157,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
24	530 031	7 096 928	171,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
24	512 646	7 100 974	160,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
25	530 120	7 102 556	174,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
25	513 168	7 100 143	162,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
26	530 192	7 097 881	182,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
26	512 181	7 102 585	153,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
27	530 249	7 101 446	190,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
27	512 447	7 103 491	147,2	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	530 402	7 099 101	206,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
28	511 576	7 104 046	147,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
29	530 470	7 100 256	185,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
29	516 239	7 101 210	190,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	516 931	7 099 863	197,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	530 749	7 102 088	177,1	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
31	530 845	7 097 081	167,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
31	517 213	7 099 034	197,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
32	531 170	7 098 806	195,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
32	517 075	7 098 024	179,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
33	531 199	7 101 417	177,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
33	515 475	7 098 267	165,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	517 226	7 096 320	171,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	531 442	7 096 615	167,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
35	531 445	7 100 556	184,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
35	517 845	7 095 564	168,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	531 595	7 097 706	177,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
36	518 144	7 094 686	176,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
37	531 620	7 099 681	192,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
37	516 462	7 096 860	173,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
38	531 848	7 102 200	181,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
38	515 866	7 097 332	169,4	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
39	531 995	7 098 644	192,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
39	514 763	7 095 958	167,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
40	532 195	7 100 506	177,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
40	513 785	7 095 645	173,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
41	532 370	7 095 881	167,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
41	512 989	7 095 998	185,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
42	532 373	7 097 087	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
42	512 622	7 096 766	187,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
43	532 519	7 098 005	172,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
43	514 288	7 096 590	175,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
44	532 627	7 102 078	185,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
44	513 847	7 097 251	182,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
45	532 995	7 095 106	166,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4

To be continued on next page...

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SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
45	513 394	7 098 322	187,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
46	532 752	7 101 003	186,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
46	512 819	7 099 163	178,6	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
47	533 198	7 098 953	173,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
47	515 539	7 095 480	162,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
48	533 270	7 097 281	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
48	515 171	7 102 940	162,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
49	533 563	7 095 498	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
49	516 610	7 104 302	158,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
50	533 473	7 101 697	197,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
50	515 639	7 104 571	165,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
51	534 002	7 096 854	195,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
51	515 136	7 105 219	160,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
52	533 383	7 096 525	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
53	534 153	7 095 289	171,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
54	534 246	7 096 135	174,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
55	534 129	7 101 976	207,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
56	534 691	7 096 987	186,2	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
57	535 406	7 097 920	183,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
58	535 963	7 097 629	190,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
59	536 487	7 097 358	208,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
60	537 145	7 096 906	218,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
61	537 870	7 096 856	208,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
62	538 185	7 095 540	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
63	538 465	7 096 494	193,2	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
64	538 995	7 097 356	197,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
65	538 846	7 095 554	189,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
66	539 204	7 096 413	190,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
67	539 802	7 094 885	187,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Lomarakennus A	512 987	7 106 346	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B	513 159	7 106 642	134,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Lomarakennus C	513 426	7 107 406	131,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D	516 993	7 109 125	130,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E	518 871	7 107 433	147,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Asuinrakennus F	522 013	7 106 307	152,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Asuinrakennus G	521 923	7 103 034	185,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	Asuinrakennus H	519 294	7 096 871	217,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	Asuinrakennus I	519 418	7 096 236	190,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
J	Asuinrakennus J	518 094	7 092 553	194,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
K	Lomarakennus K	516 998	7 095 013	155,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
L	Lomarakennus L	513 968	7 100 391	157,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
M	Lomarakennus M	512 778	7 105 974	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Lomarakennus A	0:00
B	Asuinrakennus B	0:00
C	Lomarakennus C	2:11
D	Asuinrakennus D	1:42
E	Lomarakennus E	7:00
F	Asuinrakennus F	0:00

To be continued on next page...

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SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas

...continued from previous page

No.	Name	Shadow, expected values Shadow hours per year [h/year]
G	Asuinrakennus G	3:02
H	Asuinrakennus H	1:18
I	Asuinrakennus I	0:00
J	Asuinrakennus J	0:00
K	Lomarakennus K	5:34
L	Lomarakennus L	11:43
M	Lomarakennus M	0:00

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

No.	Name	Expected [h/year]
1	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (468)	0:00
1	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (215)	0:00
2	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (469)	0:00
2	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (238)	2:11
3	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (470)	0:00
3	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (216)	0:00
4	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (471)	0:00
4	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (244)	4:27
5	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (472)	0:00
5	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (243)	4:15
6	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (473)	0:00
6	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (217)	0:00
7	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (474)	0:00
7	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (218)	0:00
8	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (475)	0:00
8	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (219)	0:00
9	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (476)	0:00
9	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (220)	0:00
10	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (477)	0:00
10	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (221)	3:02
11	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (478)	0:00
11	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (222)	0:00
12	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (479)	0:00
12	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (212)	0:00
13	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (480)	0:00
13	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (213)	0:00
14	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (481)	0:00
14	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (214)	0:00
15	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (242)	0:00
15	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (482)	0:00
16	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (483)	0:00
16	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (225)	0:00
17	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (484)	0:00
17	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (224)	0:00
18	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (485)	0:00
18	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (226)	0:00
19	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (486)	0:00
19	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (227)	0:00
20	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (487)	0:00
20	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (228)	0:00
21	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (488)	0:00
21	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (229)	0:00
22	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (489)	0:00
22	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (230)	0:00
23	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (490)	0:00
23	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (234)	0:00
24	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (491)	0:00
24	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (233)	0:00
25	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (492)	0:00
25	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (232)	11:43
26	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (493)	0:00

To be continued on next page...

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26.8.2022 14.02/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas

...continued from previous page

No.	Name	Expected [h/year]
26	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (235)	0:00
27	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (494)	0:00
27	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (239)	0:00
28	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (495)	0:00
28	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (240)	0:00
29	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (496)	0:00
29	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (223)	0:00
30	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (211)	0:00
30	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (497)	0:00
31	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (498)	0:00
31	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (210)	0:00
32	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (499)	0:00
32	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (209)	0:00
33	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (500)	0:00
33	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (208)	0:00
34	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (205)	0:00
34	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (501)	0:00
35	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (502)	0:00
35	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (204)	1:18
36	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (503)	0:00
36	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (241)	5:34
37	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (504)	0:00
37	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (206)	0:00
38	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (505)	0:00
38	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (207)	0:00
39	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (506)	0:00
39	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (202)	0:00
40	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (507)	0:00
40	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (203)	0:00
41	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (508)	0:00
41	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (237)	0:00
42	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (509)	0:00
42	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (236)	0:00
43	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (510)	0:00
43	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (201)	0:00
44	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (511)	0:00
44	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (200)	0:00
45	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (512)	0:00
45	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (199)	0:00
46	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (513)	0:00
46	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (231)	0:00
47	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (514)	0:00
47	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (245)	0:00
48	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (515)	0:00
48	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (249)	0:00
49	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (516)	0:00
49	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (246)	0:00
50	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (517)	0:00
50	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (247)	0:00
51	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (518)	0:00
51	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (248)	0:00
52	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (519)	0:00
53	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (520)	0:00
54	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (521)	0:00
55	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (522)	0:00
56	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (523)	0:00
57	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (524)	0:00
58	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (525)	0:00
59	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (526)	0:00
60	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (527)	0:00
61	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (528)	0:00
62	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (529)	0:00
63	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (530)	0:00
64	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (531)	0:00
65	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (532)	0:00

To be continued on next page...

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SHADOW - Main Result

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas

...continued from previous page

No.	Name	Expected [h/year]
66	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (533)	0:00
67	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (534)	0:00

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

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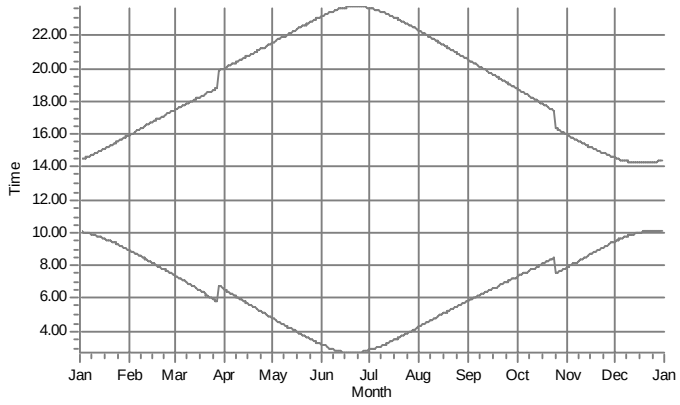
Calculated:
26.8.2022 14.02/3.5.584

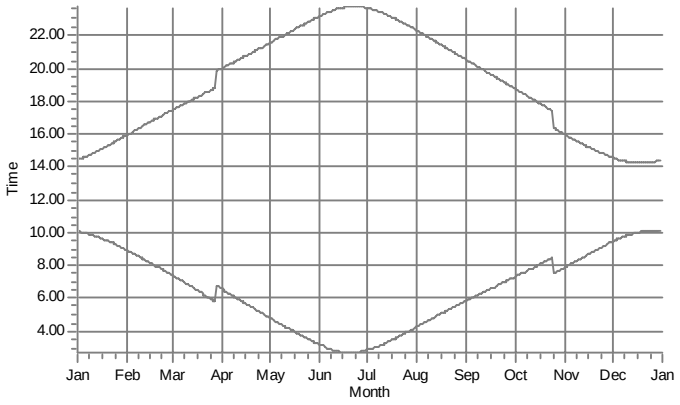
SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas

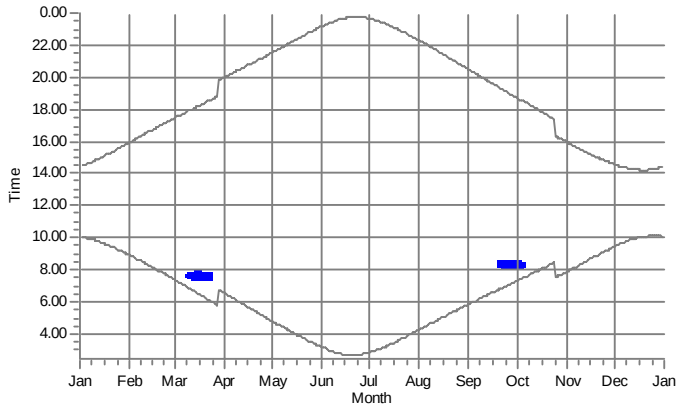
A: Lomarakennus A



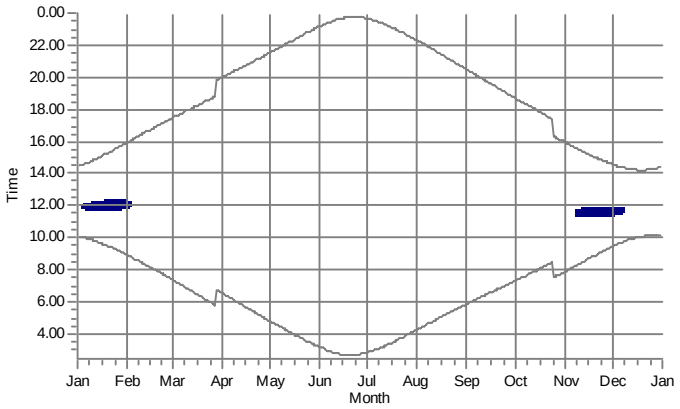
B: Asuinrakennus B



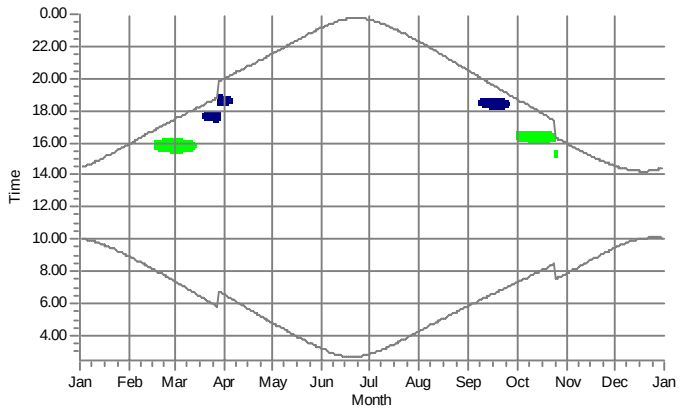
C: Lomarakennus C



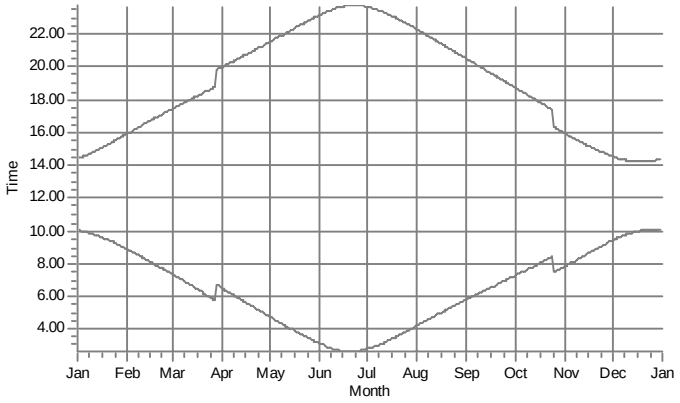
D: Asuinrakennus D



E: Lomarakennus E



F: Asuinrakennus F



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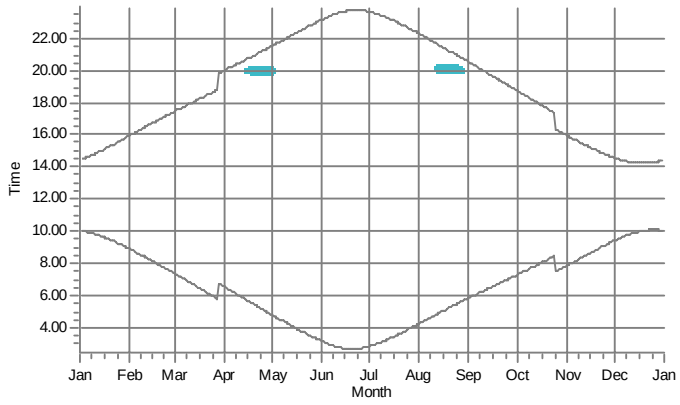
26.8.2022 14.02/3.5.584

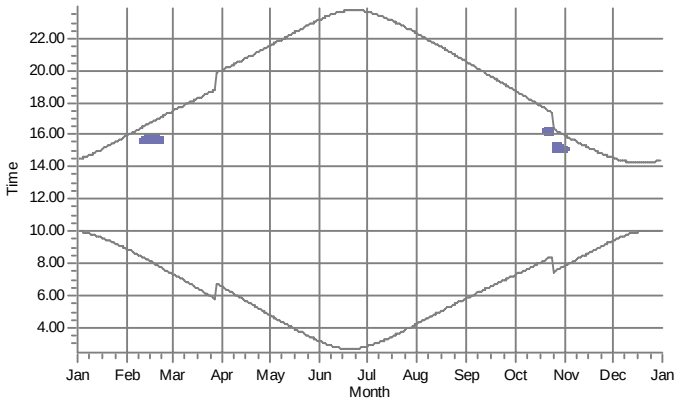
SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas

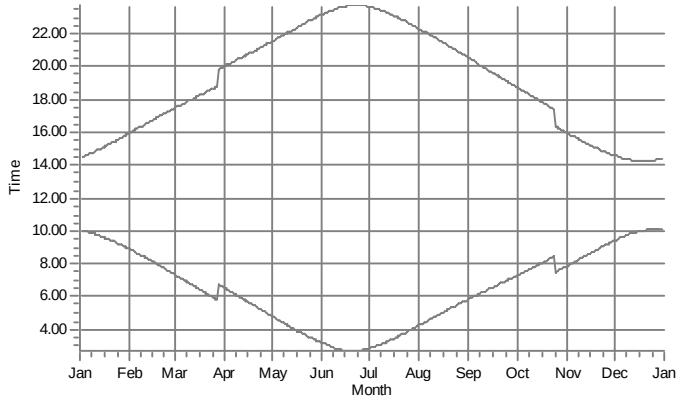
G: Asuinrakennus G



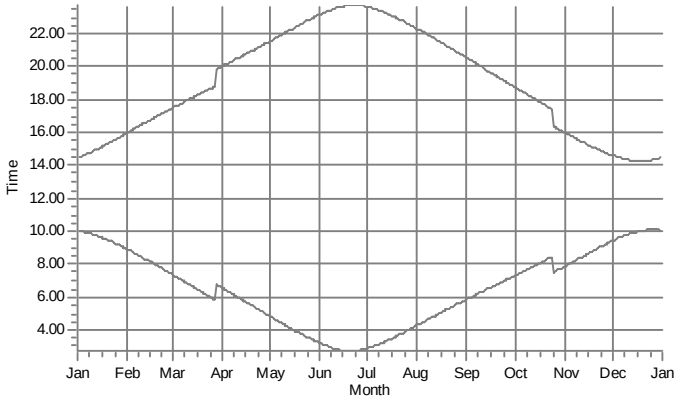
H: Asuinrakennus H



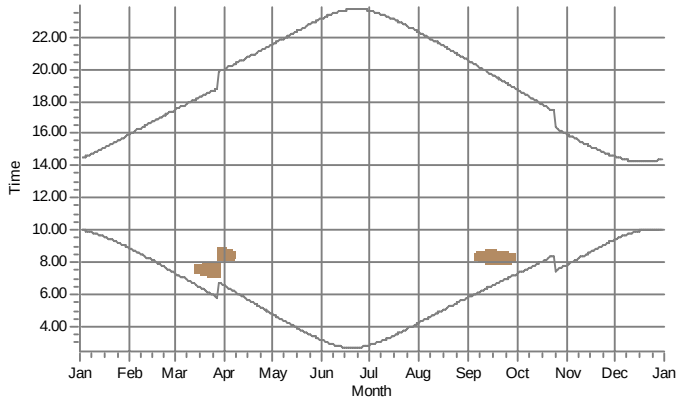
I: Asuinrakennus I



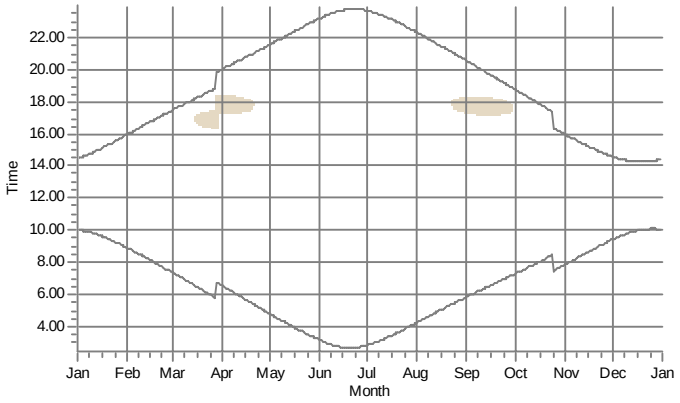
J: Asuinrakennus J



K: Lomarakennus K



L: Lomarakennus L



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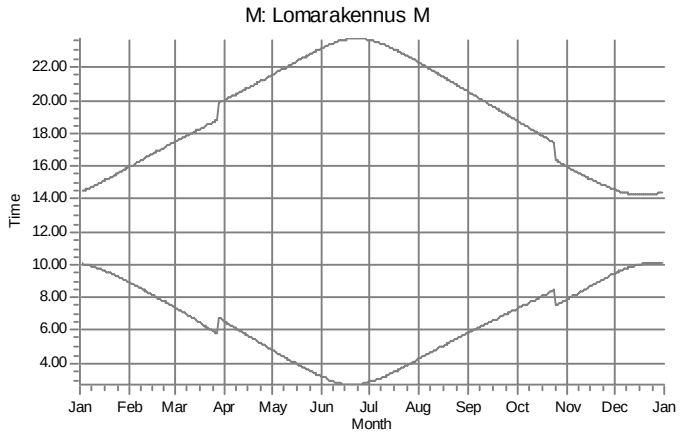
Calculated:
26.8.2022 14.02/3.5.584

SHADOW - Calendar, graphical

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas



WTGs

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Calculated:
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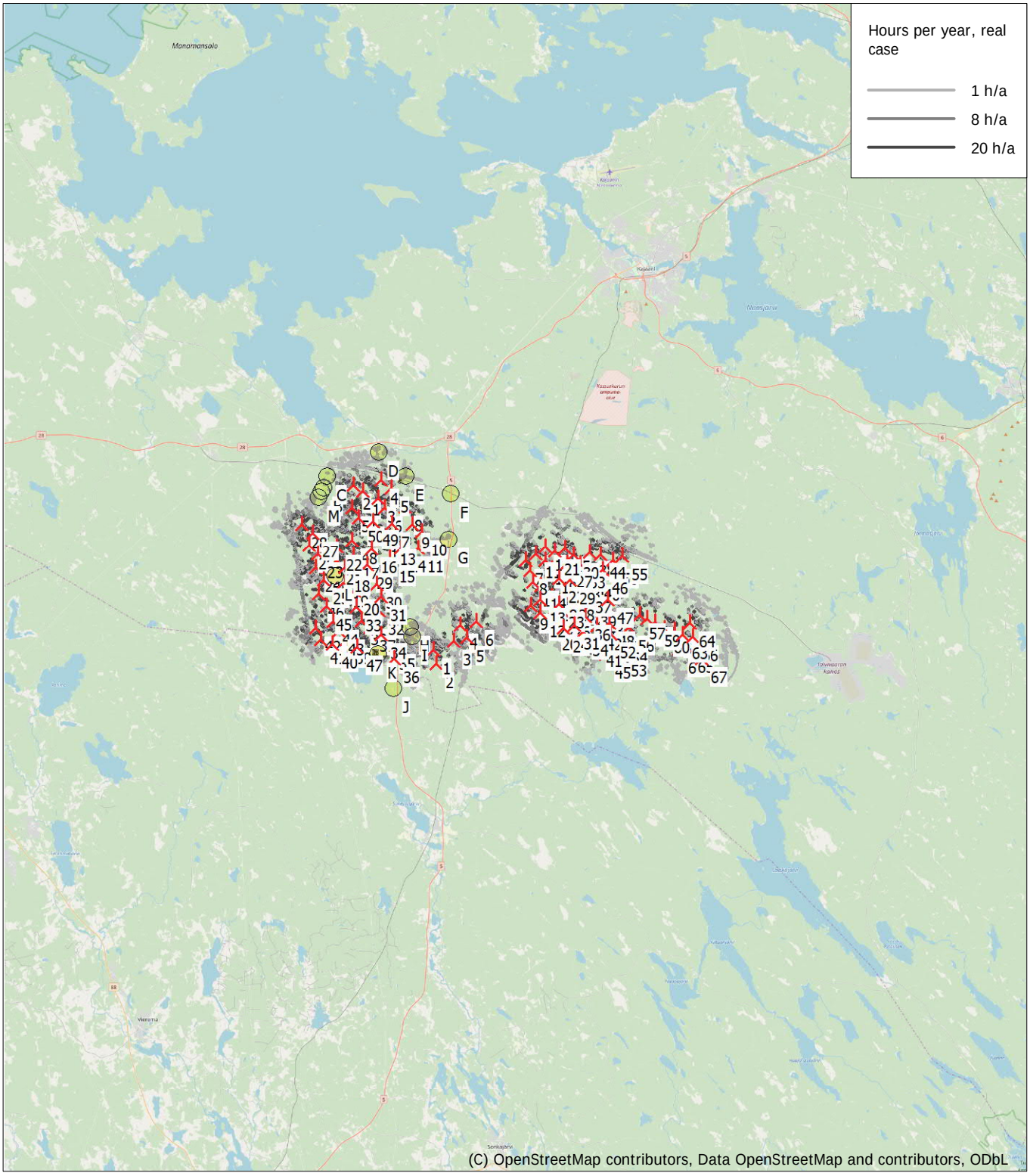
SHADOW - Map

Calculation: Katajamäki VE1 RD200x51HH200_real case, Luke forest_20220131+ YV Kivikangas



0 5 10 15 20 km

Map: EMD OpenStreetMap , Print scale 1:400 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 526 580 North: 7 099 520

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Katajamäen tuulivoimahanke_0.wpo (2)

Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 1,5 m

Liite 15. Katajamäen tuulivoimahanke – varjostusmallinnuksen tulokset ”real case, Luke forest” (VE2).

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9.3.2022 14.54/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE2_RD200x46HH200_real case, Luke forest_20220131

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
0,77	2,38	4,42	6,93	8,81	9,87	9,13	6,84	4,43	2,23	0,93	0,26

Operational hours are calculated from WTGs in calculation and wind distribution:
MERRA_N64,00_E027,335 (4)

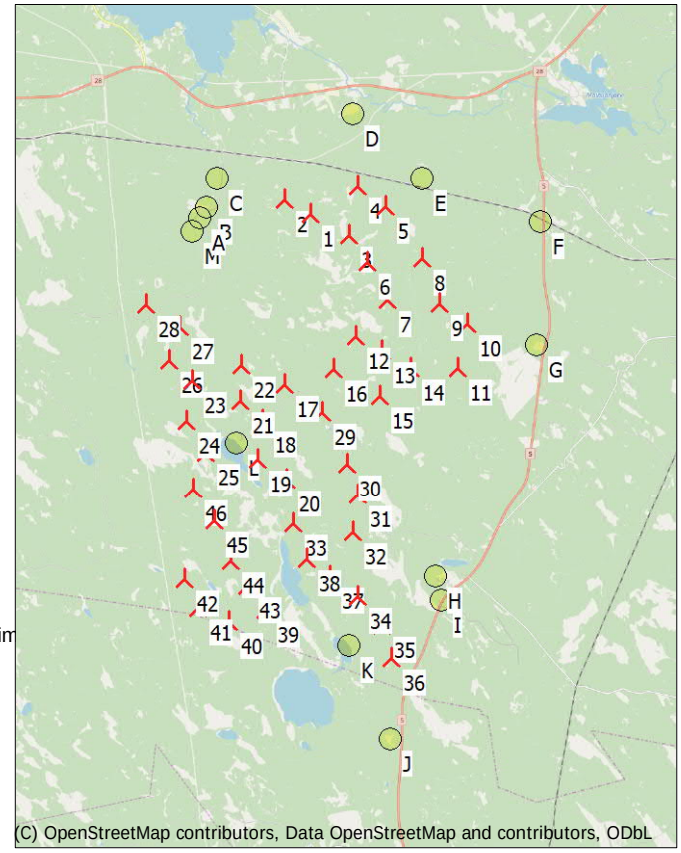
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
519	424	484	521	569	831	1 064	1 068	892	804	724	675	8 574

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Katajamäen tuulivoim
Area object(s) used in calculation:
Area object (NW): (1)
Area object (NE): (2)
Area object (SE): (3)
Area object (SW): (4)
Obstacles used in calculation
Receptor grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:200 000

New WTG Shadow receptor

WTGs

	East	North	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data Calculation distance [m]	RPM [RPM]
1	515 909	7 106 459	164,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
2	515 210	7 106 831	164,9	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
3	516 931	7 105 901	145,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
4	517 160	7 107 206	142,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
5	517 906	7 106 667	137,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
6	517 446	7 105 214	147,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
7	517 980	7 104 206	148,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
8	518 858	7 105 305	145,9	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
9	519 364	7 104 099	155,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
10	520 088	7 103 598	172,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
11	519 817	7 102 420	156,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
12	517 144	7 103 226	166,6	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
13	517 816	7 102 875	160,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
14	518 583	7 102 417	152,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	517 771	7 101 673	167,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
16	516 534	7 102 343	177,2	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
17	515 249	7 101 935	174,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
18	514 670	7 100 997	170,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
19	514 555	7 099 960	171,1	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
20	515 309	7 099 437	168,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
21	514 070	7 101 510	162,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	514 093	7 102 453	153,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
23	512 778	7 102 030	157,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
24	512 646	7 100 974	160,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
25	513 168	7 100 143	162,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
26	512 181	7 102 585	153,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

To be continued on next page...

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Calculated:
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SHADOW - Main Result

Calculation: Katajamäki VE2_RD200x46HH200_real case, Luke forest_20220131

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
27	512 447	7 103 491	147,2	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	511 576	7 104 046	147,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
29	516 239	7 101 210	190,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	516 931	7 099 863	197,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
31	517 213	7 099 034	197,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
32	517 075	7 098 024	179,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
33	515 475	7 098 267	165,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	517 226	7 096 320	171,8	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
35	517 845	7 095 564	168,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	518 144	7 094 686	176,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
37	516 462	7 096 860	173,7	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
38	515 866	7 097 332	169,4	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
39	514 763	7 095 958	167,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
40	513 785	7 095 645	173,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
41	512 989	7 095 998	185,0	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
42	512 622	7 096 766	187,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
43	514 288	7 096 590	175,3	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
44	513 847	7 097 251	182,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
45	513 394	7 098 322	187,5	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
46	512 819	7 099 163	178,6	Generic RD200 Fortum 5600 ...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Lomarakennus A	512 987	7 106 346	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B	513 159	7 106 642	134,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Lomarakennus C	513 426	7 107 406	131,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D	516 993	7 109 125	130,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E	518 871	7 107 433	147,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Asuinrakennus F	522 013	7 106 307	152,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Asuinrakennus G	521 923	7 103 034	185,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	Asuinrakennus H	519 294	7 096 871	217,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	Asuinrakennus I	519 418	7 096 236	190,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
J	Asuinrakennus J	518 094	7 092 553	194,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
K	Lomarakennus K	516 998	7 095 013	155,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
L	Lomarakennus L	513 968	7 100 391	157,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
M	Lomarakennus M	512 778	7 105 974	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Lomarakennus A	0:00
B	Asuinrakennus B	0:00
C	Lomarakennus C	2:11
D	Asuinrakennus D	1:42
E	Lomarakennus E	7:00
F	Asuinrakennus F	0:00
G	Asuinrakennus G	3:02
H	Asuinrakennus H	1:18
I	Asuinrakennus I	0:00
J	Asuinrakennus J	0:00
K	Lomarakennus K	5:34
L	Lomarakennus L	11:43
M	Lomarakennus M	0:00

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Calculated:
9.3.2022 14.54/3.5.576

SHADOW - Main Result

Calculation: Katajamäki VE2_RD200x46HH200_real case, Luke forest_20220131

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

No.	Name	Expected [h/year]
1	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (266)	0:00
2	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (289)	2:11
3	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (267)	0:00
4	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)	4:27
5	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)	4:15
6	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (268)	0:00
7	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (269)	0:00
8	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (270)	0:00
9	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (271)	0:00
10	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (272)	3:02
11	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (273)	0:00
12	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (263)	0:00
13	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (264)	0:00
14	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (265)	0:00
15	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (293)	0:00
16	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (276)	0:00
17	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (275)	0:00
18	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (277)	0:00
19	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (278)	0:00
20	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (279)	0:00
21	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (280)	0:00
22	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (281)	0:00
23	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (285)	0:00
24	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (284)	0:00
25	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (283)	11:43
26	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (286)	0:00
27	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (290)	0:00
28	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (291)	0:00
29	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (274)	0:00
30	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)	0:00
31	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)	0:00
32	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)	0:00
33	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)	0:00
34	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)	0:00
35	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)	1:18
36	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)	5:34
37	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)	0:00
38	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)	0:00
39	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (253)	0:00
40	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)	0:00
41	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (288)	0:00
42	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (287)	0:00
43	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (252)	0:00
44	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (251)	0:00
45	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (250)	0:00
46	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (282)	0:00

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

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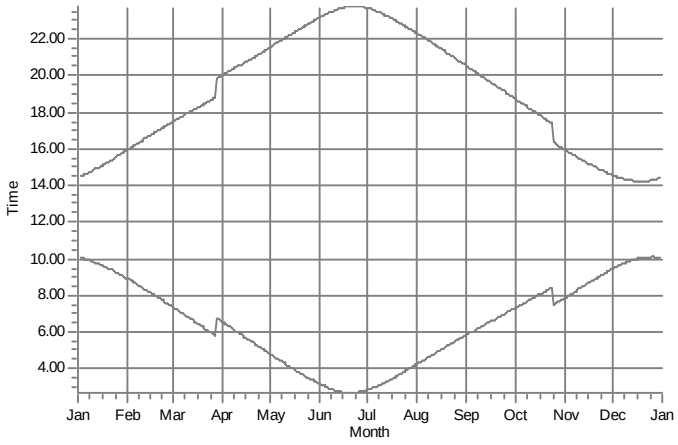
Calculated:
9.3.2022 14.54/3.5.576

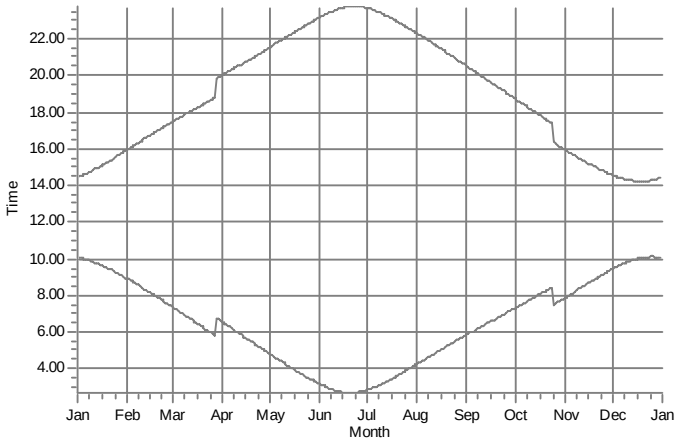
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2_RD200x46HH200_real case, Luke forest_20220131

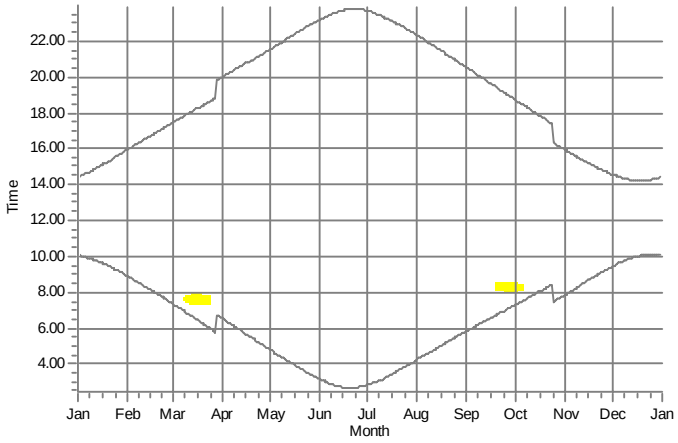
A: Lomarakennus A



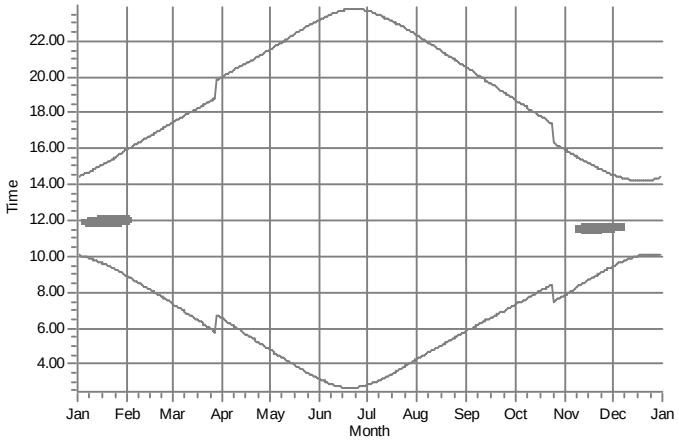
B: Asuinrakennus B



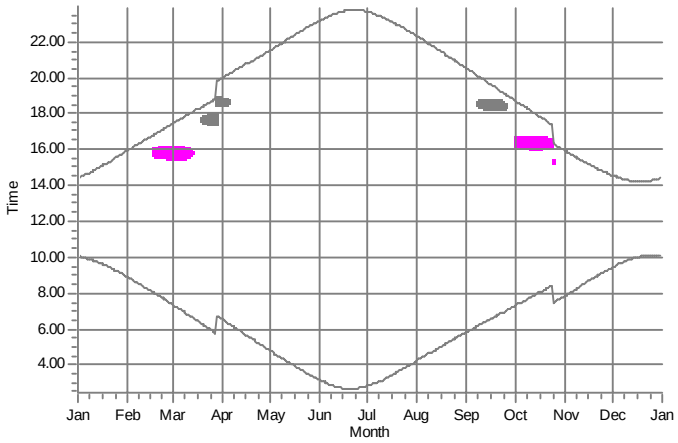
C: Lomarakennus C



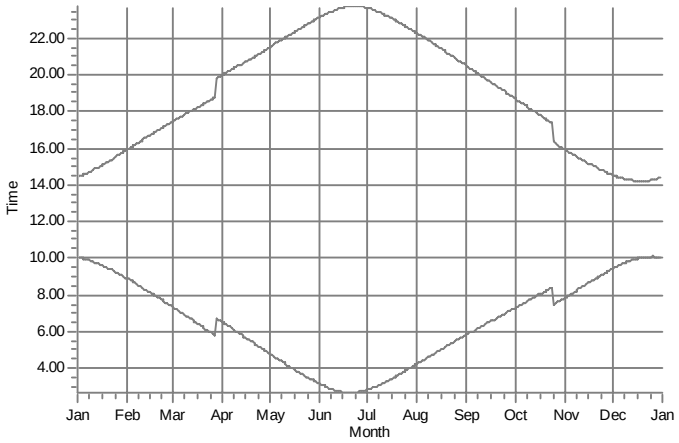
D: Asuinrakennus D



E: Lomarakennus E



F: Asuinrakennus F



WTGs

2: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (289)

4: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)

5: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)

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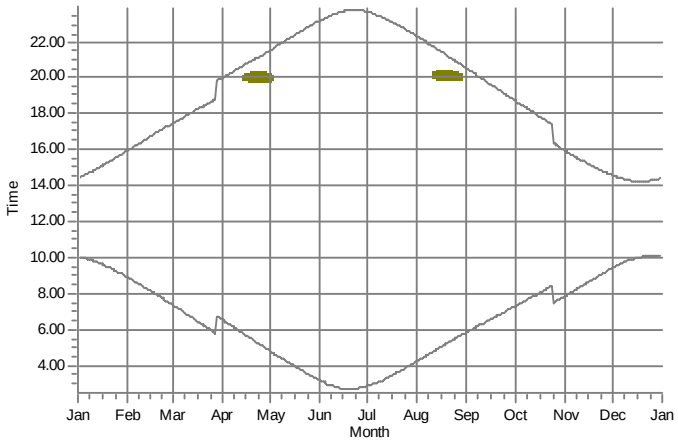
9.3.2022 14.54/3.5.576

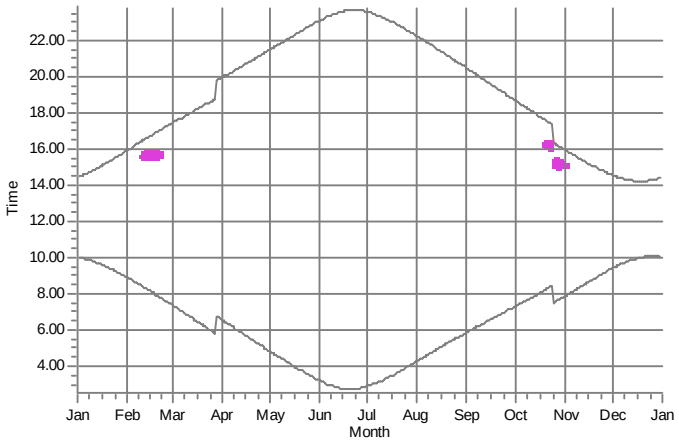
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2_RD200x46HH200_real case, Luke forest_20220131

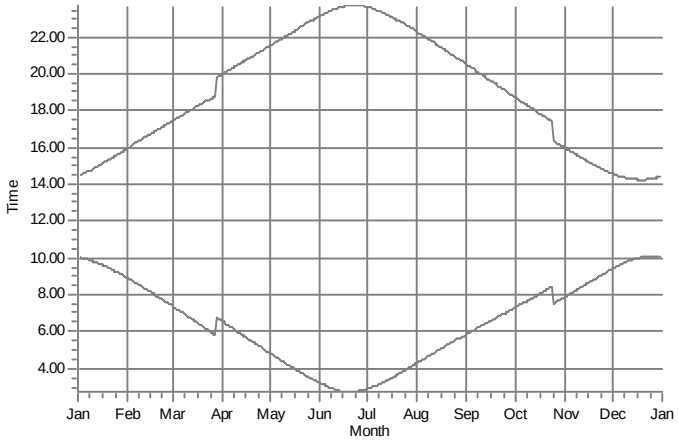
G: Asuinrakennus G



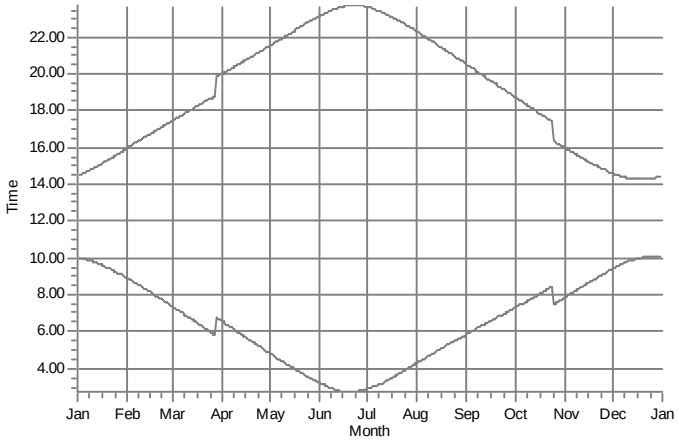
H: Asuinrakennus H



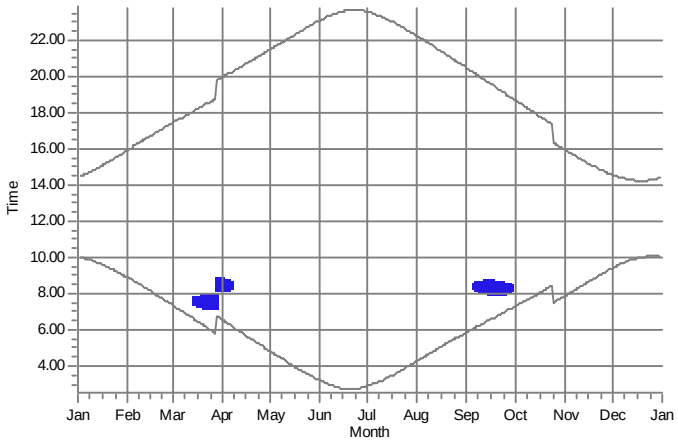
I: Asuinrakennus I



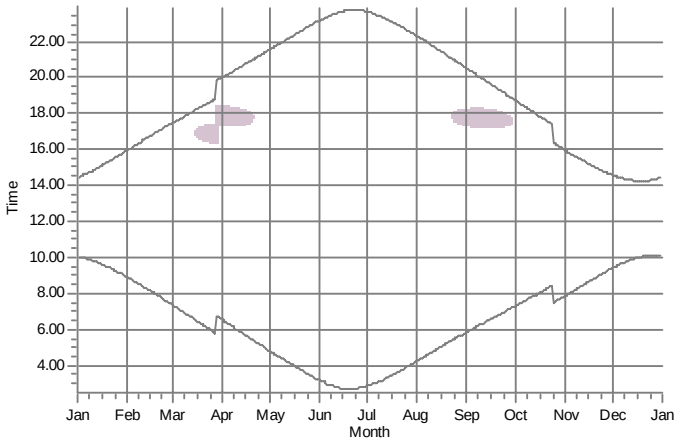
J: Asuinrakennus J



K: Lomarakennus K



L: Lomarakennus L



WTGs

10: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (272)
25: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (283)
35: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)
36: Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)

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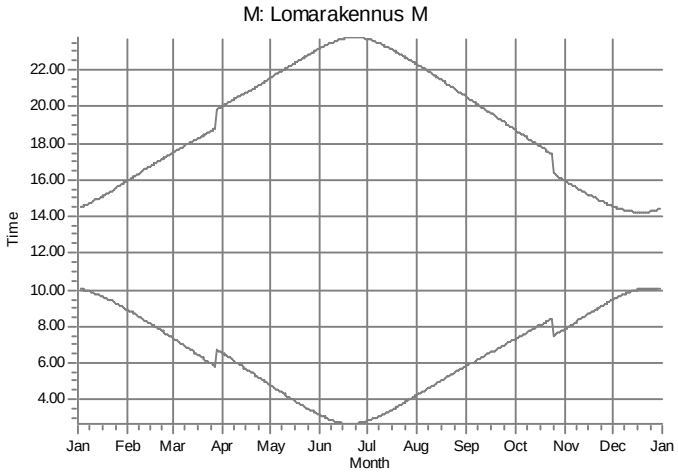
9.3.2022 14.54/3.5.576

SHADOW - Calendar, graphical

Calculation: Katajamäki VE2_RD200x46HH200_real case, Luke forest_20220131



WTGs

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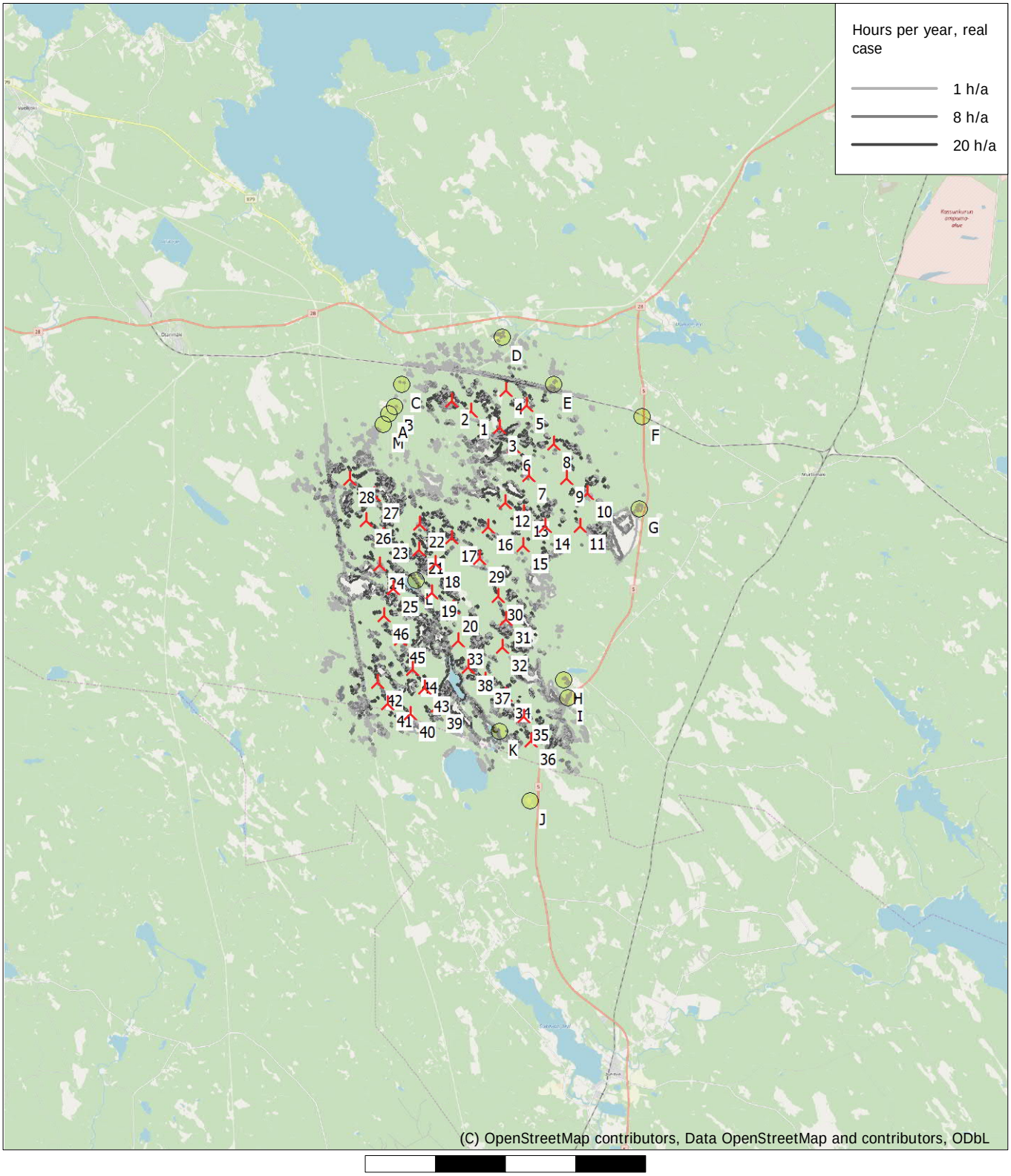
Calculated:
9.3.2022 14.54/3.5.576

SHADOW - Map

Calculation: Katajamäki VE2_RD200x46HH200_real case, Luke forest_20220131



Map: EMD OpenStreetMap , Print scale 1:200 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 517 100 North: 7 100 540

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Katajamäen tuulivoimahanke_0.wpo (2)

Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 1,5 m

Liite 16. Katajamäen tuulivoimahanke – varjostusmallinnuksen tulokset ”real case, Luke forest” (VE2). Yhteisvaikutukset Kivikankaan hankkeen kanssa.

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Calculated:
26.8.2022 15.48/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, Luke forest_20220131+ YV Kivikangas

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
0,77	2,38	4,42	6,93	8,81	9,87	9,13	6,84	4,43	2,23	0,93	0,26

Operational hours are calculated from WTGs in calculation and wind distribution:
MERRA_N64,00_E027,335 (4)

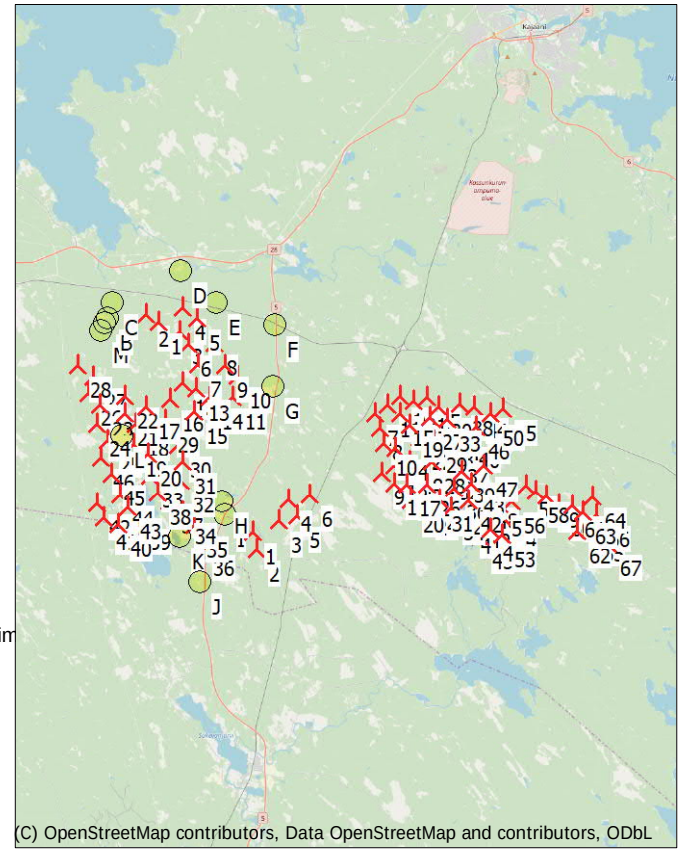
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
519	424	484	521	569	831	1 064	1 068	892	804	724	675	8 574

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

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_Katajamäen tuulivoim
Area object(s) used in calculation:
Area object (NW): (1)
Area object (NE): (2)
Area object (SE): (3)
Area object (SW): (4)
Obstacles used in calculation
Receptor grid resolution: 1,0 m

All coordinates are in
Finish TM ETRS-TM35FIN-ETRS89



Scale 1:400 000
New WTG
Shadow receptor

WTGs

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	520 945	7 095 256	175,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
1	515 909	7 106 459	164,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
2	521 095	7 094 331	164,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
2	515 210	7 106 831	164,9	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
3	522 355	7 095 878	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
3	516 931	7 105 901	145,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
4	522 755	7 097 057	176,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
4	517 160	7 107 206	142,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
5	523 237	7 096 145	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
5	517 906	7 106 667	137,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
6	523 951	7 097 319	165,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
6	517 446	7 105 214	147,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
7	527 400	7 101 633	174,1	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
7	517 980	7 104 206	148,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
8	527 645	7 100 906	176,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
8	518 858	7 105 305	145,9	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
9	527 745	7 098 481	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
9	519 364	7 104 099	155,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
10	527 847	7 100 086	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
10	520 088	7 103 598	172,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
11	528 041	7 102 119	164,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
11	519 817	7 102 420	156,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
12	528 395	7 097 931	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
12	517 144	7 103 226	166,6	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
13	528 420	7 098 881	177,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
13	517 816	7 102 875	160,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0

To be continued on next page...

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Calculated:
26.8.2022 15.48/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, Luke forest_20220131+ YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
14	528 496	7 099 831	177,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
14	518 583	7 102 417	152,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
15	528 704	7 101 642	170,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
15	517 771	7 101 673	167,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
16	528 710	7 102 595	162,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
16	516 534	7 102 343	177,2	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
17	529 120	7 097 906	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
17	515 249	7 101 935	174,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
18	529 181	7 099 074	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
18	514 670	7 100 997	170,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
19	529 211	7 101 016	183,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
19	514 555	7 099 960	171,1	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
20	529 320	7 097 006	192,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
20	515 309	7 099 437	168,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
21	529 393	7 102 332	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
21	514 070	7 101 510	162,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	514 093	7 102 453	153,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
22	529 727	7 100 356	205,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
23	529 779	7 098 556	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
23	512 778	7 102 030	157,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
24	530 031	7 096 928	171,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
24	512 646	7 100 974	160,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
25	530 120	7 102 556	174,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
25	513 168	7 100 143	162,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
26	530 192	7 097 881	182,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
26	512 181	7 102 585	153,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
27	530 249	7 101 446	190,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
27	512 447	7 103 491	147,2	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	511 576	7 104 046	147,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
28	530 402	7 099 101	206,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
29	530 470	7 100 256	185,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
29	516 239	7 101 210	190,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
30	530 749	7 102 088	177,1	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
30	516 931	7 099 863	197,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
31	530 845	7 097 081	167,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
31	517 213	7 099 034	197,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
32	531 170	7 098 806	195,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
32	517 075	7 098 024	179,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
33	531 199	7 101 417	177,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
33	515 475	7 098 267	165,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
34	531 442	7 096 615	167,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
34	517 226	7 096 320	171,8	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
35	531 445	7 100 556	184,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
35	517 845	7 095 564	168,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	518 144	7 094 686	176,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
36	531 595	7 097 706	177,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
37	531 620	7 099 681	192,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
37	516 462	7 096 860	173,7	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
38	531 848	7 102 200	181,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
38	515 866	7 097 332	169,4	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
39	531 995	7 098 644	192,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
39	514 763	7 095 958	167,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
40	532 195	7 100 506	177,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
40	513 785	7 095 645	173,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
41	532 370	7 095 881	167,3	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
41	512 989	7 095 998	185,0	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
42	532 373	7 097 087	172,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
42	512 622	7 096 766	187,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
43	532 519	7 098 005	172,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
43	514 288	7 096 590	175,3	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
44	532 627	7 102 078	185,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
44	513 847	7 097 251	182,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
45	532 995	7 095 106	166,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4

To be continued on next page...

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Calculated:
26.8.2022 15.48/3.5.584

SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, Luke forest_20220131+ YV Kivikangas

...continued from previous page

	East	North	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
45	513 394	7 098 322	187,5	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
46	532 752	7 101 003	186,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
46	512 819	7 099 163	178,6	Generic RD200 Fortu...	Yes	Generic	RD200 Fortum-5 600	5 600	200,0	200,0	2 038	0,0
47	533 198	7 098 953	173,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
48	533 270	7 097 281	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
49	533 563	7 095 498	170,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
50	533 473	7 101 697	197,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
51	534 002	7 096 854	195,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
52	533 383	7 096 525	175,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
53	534 153	7 095 289	171,6	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
54	534 246	7 096 135	174,8	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
55	534 129	7 101 976	207,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
56	534 691	7 096 987	186,2	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
57	535 406	7 097 920	183,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
58	535 963	7 097 629	190,0	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
59	536 487	7 097 358	208,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
60	537 145	7 096 906	218,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
61	537 870	7 096 856	208,4	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
62	538 185	7 095 540	187,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
63	538 465	7 096 494	193,2	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
64	538 995	7 097 356	197,5	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
65	538 846	7 095 554	189,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
66	539 204	7 096 413	190,7	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4
67	539 802	7 094 885	187,9	Generic RD200 HH200...	Yes	Generic	RD200 HH200 b.V162-5 600	5 600	200,0	200,0	2 547	10,4

Shadow receptor-Input

No.	Name	East	North	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
				[m]	[m]	[m]	[m]	[°]		[m]
A	Lomarakennus A	512 987	7 106 346	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
B	Asuinrakennus B	513 159	7 106 642	134,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
C	Lomarakennus C	513 426	7 107 406	131,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
D	Asuinrakennus D	516 993	7 109 125	130,2	5,0	5,0	1,0	90,0	"Green house mode"	6,0
E	Lomarakennus E	518 871	7 107 433	147,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
F	Asuinrakennus F	522 013	7 106 307	152,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
G	Asuinrakennus G	521 923	7 103 034	185,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
H	Asuinrakennus H	519 294	7 096 871	217,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
I	Asuinrakennus I	519 418	7 096 236	190,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0
J	Asuinrakennus J	518 094	7 092 553	194,7	5,0	5,0	1,0	90,0	"Green house mode"	6,0
K	Lomarakennus K	516 998	7 095 013	155,3	5,0	5,0	1,0	90,0	"Green house mode"	6,0
L	Lomarakennus L	513 968	7 100 391	157,5	5,0	5,0	1,0	90,0	"Green house mode"	6,0
M	Lomarakennus M	512 778	7 105 974	135,0	5,0	5,0	1,0	90,0	"Green house mode"	6,0

Calculation Results

Shadow receptor

No.	Name	Shadow, expected values Shadow hours per year [h/year]
A	Lomarakennus A	0:00
B	Asuinrakennus B	0:00
C	Lomarakennus C	2:11
D	Asuinrakennus D	1:42
E	Lomarakennus E	7:00
F	Asuinrakennus F	0:00
G	Asuinrakennus G	3:02
H	Asuinrakennus H	1:18
I	Asuinrakennus I	0:00
J	Asuinrakennus J	0:00
K	Lomarakennus K	5:34

To be continued on next page...

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SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, Luke forest_20220131+ YV Kivikangas

...continued from previous page

No.	Name	Shadow, expected values Shadow hours per year [h/year]
L	Lomarakennus L	11:43
M	Lomarakennus M	0:00

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

No.	Name	Expected [h/year]
1	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (468)	0:00
1	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (266)	0:00
2	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (469)	0:00
2	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (289)	2:11
3	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (470)	0:00
3	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (267)	0:00
4	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (471)	0:00
4	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (295)	4:27
5	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (472)	0:00
5	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (294)	4:15
6	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (473)	0:00
6	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (268)	0:00
7	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (474)	0:00
7	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (269)	0:00
8	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (475)	0:00
8	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (270)	0:00
9	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (476)	0:00
9	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (271)	0:00
10	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (477)	0:00
10	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (272)	3:02
11	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (478)	0:00
11	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (273)	0:00
12	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (479)	0:00
12	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (263)	0:00
13	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (480)	0:00
13	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (264)	0:00
14	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (481)	0:00
14	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (265)	0:00
15	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (482)	0:00
15	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (293)	0:00
16	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (483)	0:00
16	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (276)	0:00
17	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (484)	0:00
17	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (275)	0:00
18	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (485)	0:00
18	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (277)	0:00
19	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (486)	0:00
19	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (278)	0:00
20	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (487)	0:00
20	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (279)	0:00
21	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (488)	0:00
21	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (280)	0:00
22	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (281)	0:00
22	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (489)	0:00
23	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (490)	0:00
23	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (285)	0:00
24	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (491)	0:00
24	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (284)	0:00
25	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (492)	0:00
25	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (283)	11:43
26	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (493)	0:00
26	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (286)	0:00
27	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (494)	0:00
27	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (290)	0:00
28	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (291)	0:00
28	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (495)	0:00

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SHADOW - Main Result

Calculation: Katajamäki VE2 RD200x46HH200_real case, Luke forest_20220131+ YV Kivikangas

...continued from previous page

No.	Name	Expected [h/year]
29	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (496)	0:00
29	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (274)	0:00
30	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (497)	0:00
30	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (262)	0:00
31	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (498)	0:00
31	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (261)	0:00
32	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (499)	0:00
32	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (260)	0:00
33	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (500)	0:00
33	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (259)	0:00
34	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (501)	0:00
34	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (256)	0:00
35	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (502)	0:00
35	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (255)	1:18
36	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (292)	5:34
36	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (503)	0:00
37	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (504)	0:00
37	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (257)	0:00
38	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (505)	0:00
38	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (258)	0:00
39	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (506)	0:00
39	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (253)	0:00
40	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (507)	0:00
40	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (254)	0:00
41	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (508)	0:00
41	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (288)	0:00
42	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (509)	0:00
42	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (287)	0:00
43	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (510)	0:00
43	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (252)	0:00
44	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (511)	0:00
44	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (251)	0:00
45	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (512)	0:00
45	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (250)	0:00
46	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (513)	0:00
46	Generic RD200 Fortum 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (282)	0:00
47	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (514)	0:00
48	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (515)	0:00
49	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (516)	0:00
50	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (517)	0:00
51	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (518)	0:00
52	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (519)	0:00
53	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (520)	0:00
54	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (521)	0:00
55	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (522)	0:00
56	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (523)	0:00
57	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (524)	0:00
58	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (525)	0:00
59	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (526)	0:00
60	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (527)	0:00
61	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (528)	0:00
62	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (529)	0:00
63	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (530)	0:00
64	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (531)	0:00
65	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (532)	0:00
66	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (533)	0:00
67	Generic RD200 HH200 b.V162 5600 200.0 !O! hub: 200,0 m (TOT: 300,0 m) (534)	0:00

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

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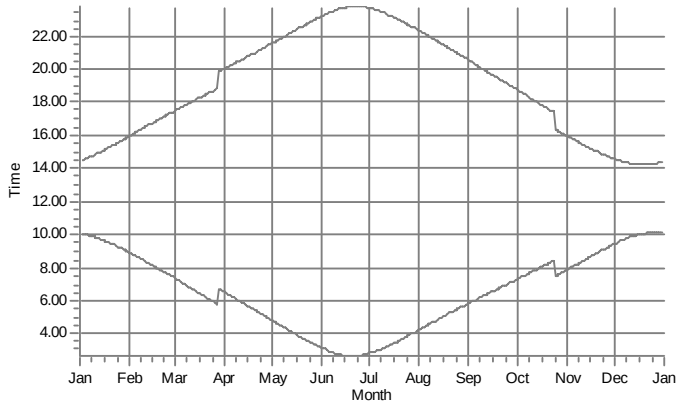
Calculated:
26.8.2022 15.48/3.5.584

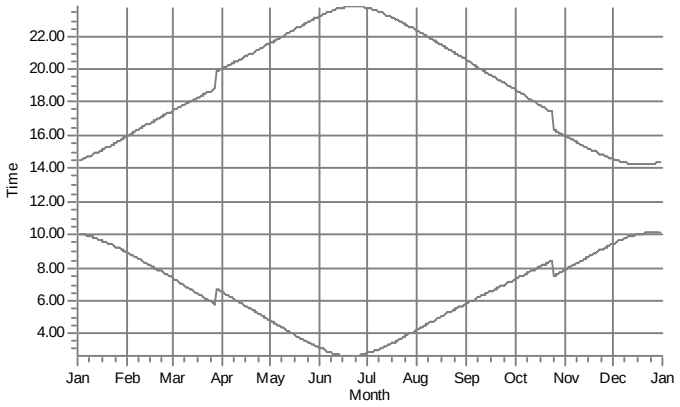
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2 RD200x46HH200_real case, Luke forest_20220131+ YV Kivikangas

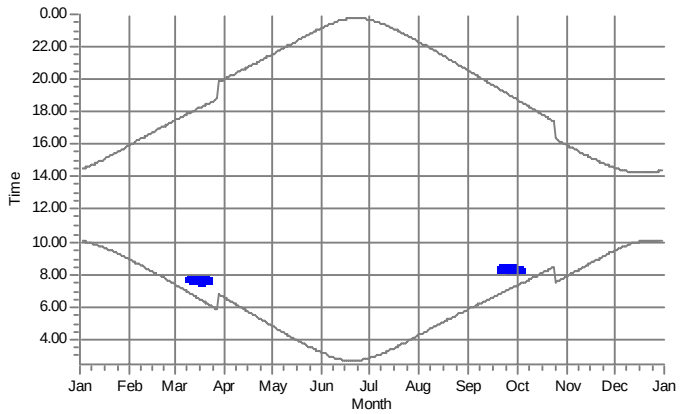
A: Lomarakennus A



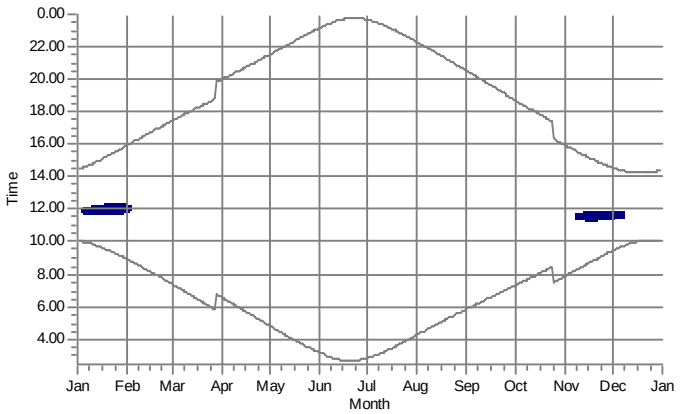
B: Asuinrakennus B



C: Lomarakennus C



D: Asuinrakennus D



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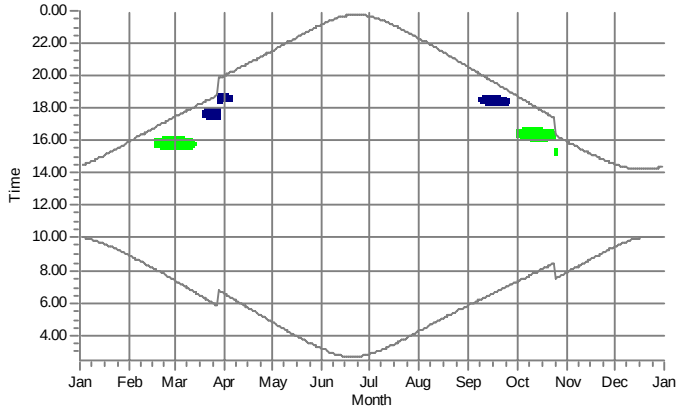
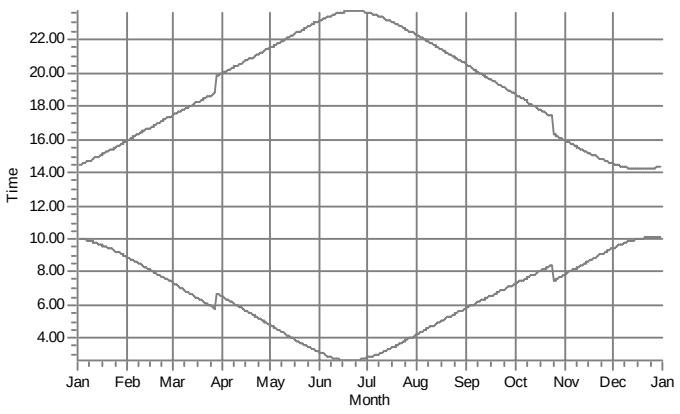


F: Asuinrakennus F



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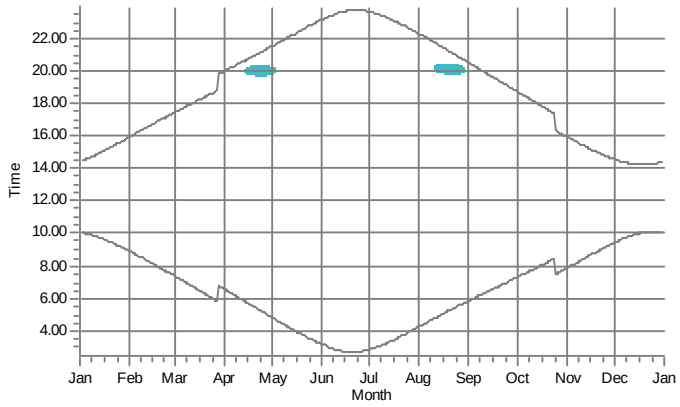
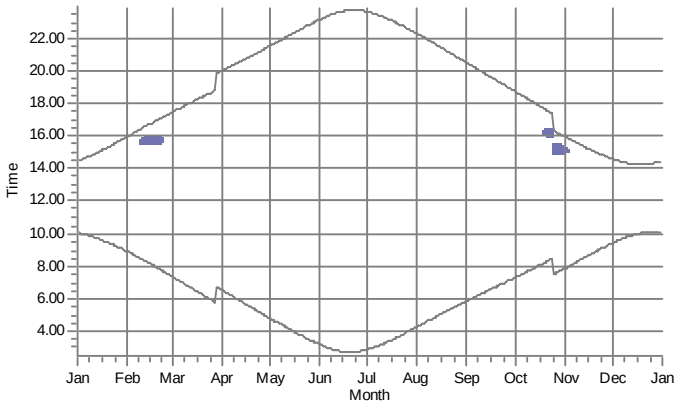
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2 RD200x46HH200_real case, Luke forest_20220131+ YV Kivikangas

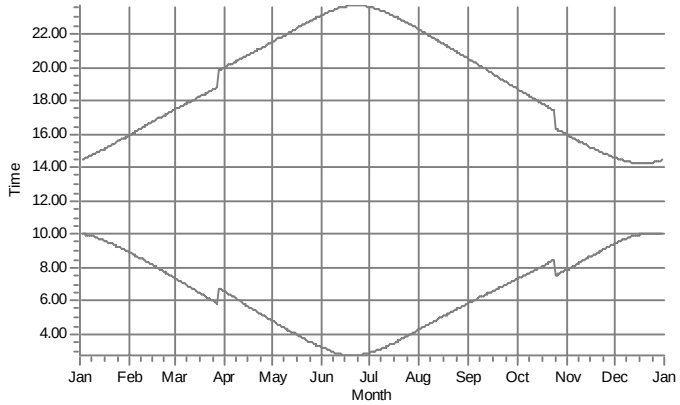
G: Asuinrakennus G



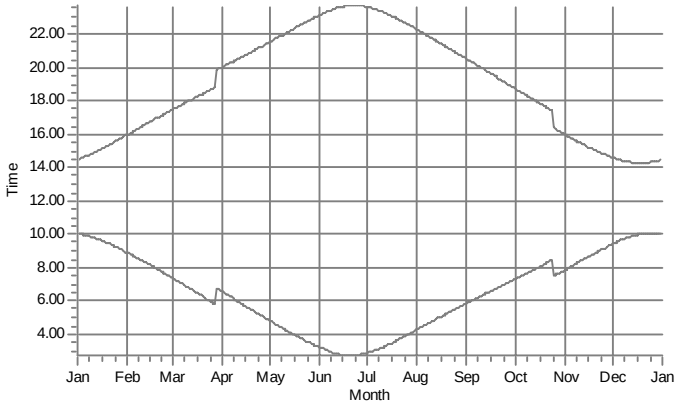
H: Asuinrakennus H



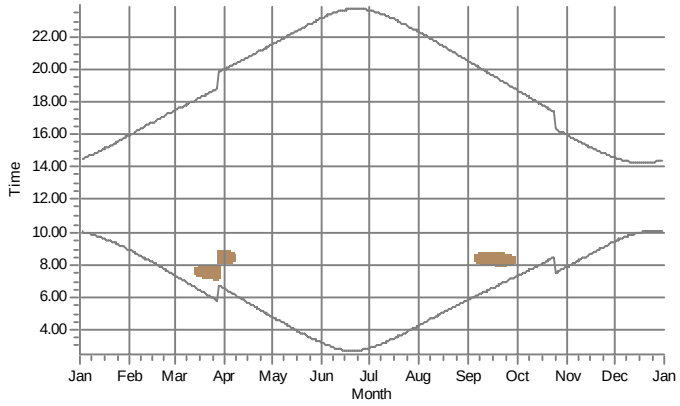
I: Asuinrakennus I



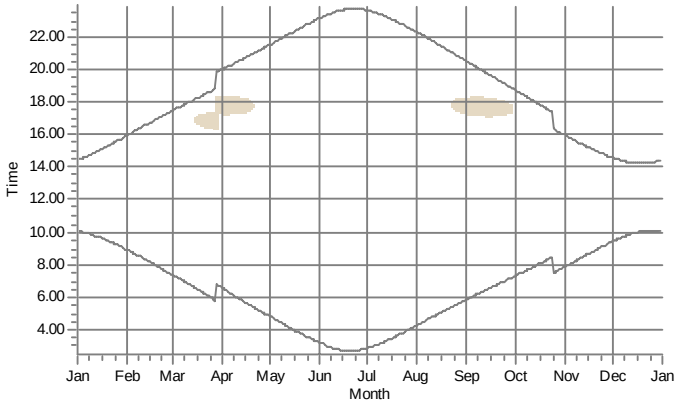
J: Asuinrakennus J



K: Lomarakennus K



L: Lomarakennus L



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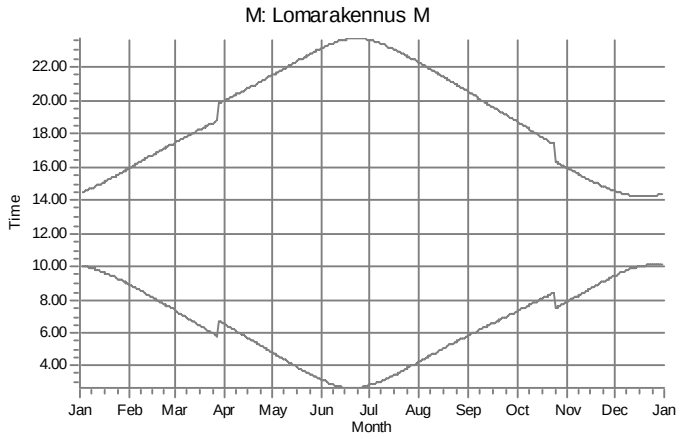
SHADOW - Calendar, graphical

Calculation: Katajamäki VE2 RD200x46HH200_real case, Luke forest_20220131+ YV Kivikangas



WTGs

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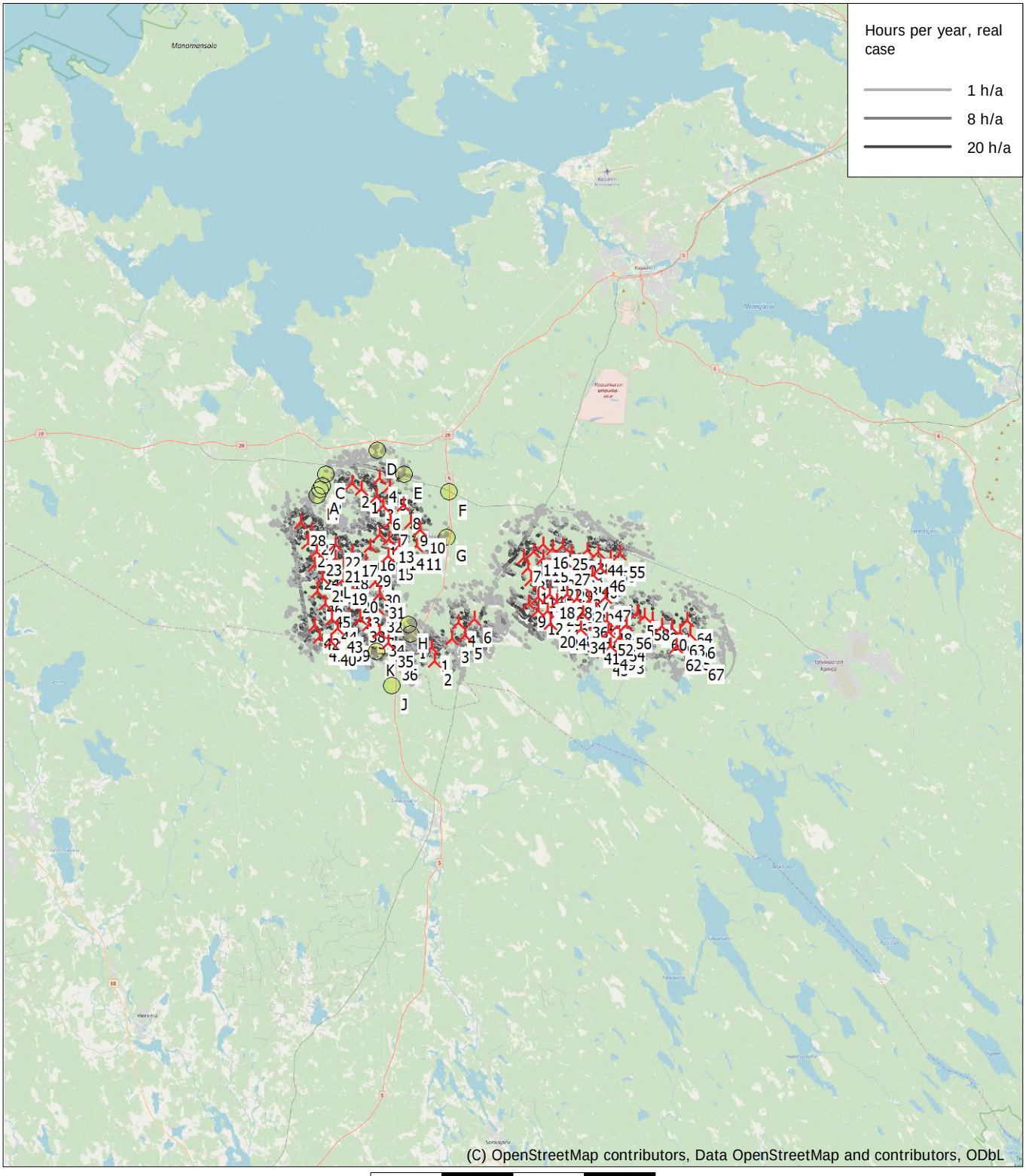
SHADOW - Map

Calculation: Katajamäki VE2 RD200x46HH200_real case, Luke forest_20220131+ YV Kivikangas



Map: EMD OpenStreetMap , Print scale 1:400 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 526 580 North: 7 099 520

New WTG Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_Katajamäen tuulivoimahanke_0.wpo (2)

Time step: 3 minutes, Day step: 7 days, Map resolution: 20 m, Visibility resolution: 10 m, Eye height: 1,5 m