

Project:

Storbötet

Description:

PROKON Wind Energy Finland oy
Uusikaarleby / Vöyri

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FCG Suunnittelu ja tekniikka Oy

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Paulina Kaivo-oja / paulina.kaivo-oja@fcg.fi

Calculated:

3.9.2014 11:10/2.9.269

SHADOW - Main Result

Calculation: VE1: Nykarleby 25 x N131 rd131 HH145

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) [UMEA]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.02	2.84	3.78	6.14	8.62	9.94	7.42	5.13	4.32	3.43	1.58	0.96

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

MERRA basic E22.668 N63.500

Operational time

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

785 666 475 439 538 757 957 1 239 972 717 525 585 8 654

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker.

calculation so not visible WTG do not contribute to calculated nickel values. A WTG will be visible if it is visible from any part of the receiver

The ZVI calculation is based on the following assumptions:

Height contours used: Height Contours: CONTOURSLINE Vöyri 1.wpo (3)

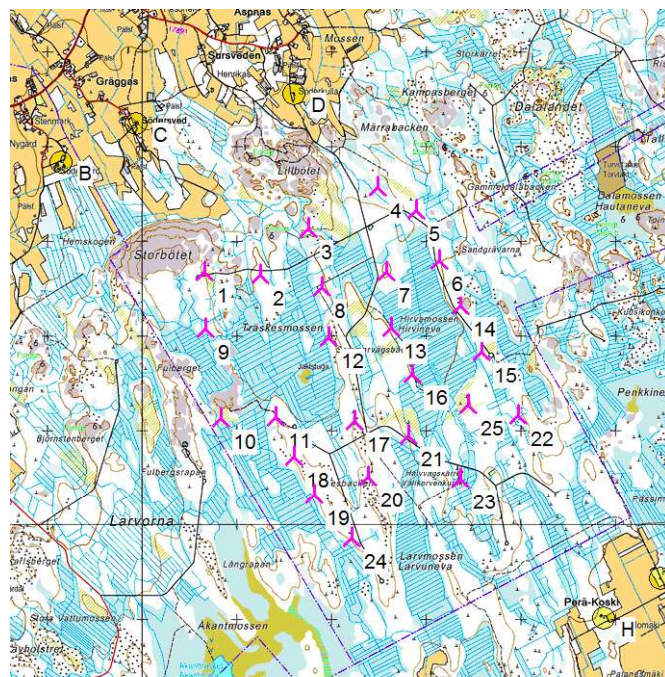
Obstacles not used in calculation

Eye height: 1.5 m

Grid resolution: 25.0 m

WTGs

	Finish TM ETRS-TM35FIN-ETRS89							WTG type				Shadow data		
	East	North	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Calculation distance	RPM		
			[m]					[kW]	[m]	[m]	[m]	[RPM]		
1	278 654	7 028 670	44,7	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
2	279 246	7 028 640	42,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
3	279 753	7 029 129	40,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
4	280 491	7 029 568	33,6	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
5	280 897	7 029 323	37,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
6	281 134	7 028 801	39,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
7	280 577	7 028 680	40,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
8	279 897	7 028 516	41,1	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
9	278 671	7 028 075	45,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
10	278 834	7 027 133	47,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
11	279 410	7 027 143	48,9	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
12	279 972	7 027 985	44,4	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
13	280 633	7 028 083	39,7	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
14	281 366	7 028 324	44,9	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
15	281 588	7 027 831	42,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
16	280 853	7 027 601	40,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
17	280 241	7 027 097	50,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
18	279 605	7 026 721	50,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
19	279 814	7 026 321	49,8	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
20	280 389	7 026 505	50,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
21	280 809	7 026 950	44,8	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
22	281 974	7 027 156	44,8	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
23	281 361	7 026 486	45,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
24	280 212	7 025 857	51,1	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
25	281 444	7 027 269	42,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		



Scale 1:80 000

 New WTG

Shadow receptor

Project:

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Description:

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Uusikaarleby / Vöyri

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Paulina Kaivo-oja / paulina.kaivo-oja@fcg.fi

Calculated:

3.9.2014 11:10/2.9.269

SHADOW - Main Result**Calculation:** VE1: Nykarleby 25 x N131 rd131 HH145**Shadow receptor-Input****Finish TM ETRS-TM35FIN-ETRS89**

No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Asuinrakennus Österby	276 064	7 029 689	22,1	5,0	5,0	1,0	0,0	90,0	"Green house mode"
B	Asuinrakennus Södergård	277 148	7 029 839	22,6	5,0	5,0	1,0	0,0	90,0	"Green house mode"
C	Asuinrakennus Södersved	277 936	7 030 242	25,0	5,0	5,0	1,0	0,0	90,0	"Green house mode"
D	Asuinrakennus Söderkulla	279 601	7 030 557	27,9	5,0	5,0	1,0	0,0	90,0	"Green house mode"
E	Asuinrakennus Björkholma	285 116	7 029 347	35,0	5,0	5,0	1,0	0,0	90,0	"Green house mode"
F	Lomarakennus Katiska	284 929	7 027 331	46,0	5,0	5,0	1,0	0,0	90,0	"Green house mode"
G	Asuinrakennus Koivuranta	283 472	7 025 429	38,1	5,0	5,0	1,0	0,0	90,0	"Green house mode"
H	Asuinrakennus Perä-Koski	282 881	7 025 017	38,6	5,0	5,0	1,0	0,0	90,0	"Green house mode"

Calculation Results

Shadow receptor

Shadow, expected values

No.	Name	Shadow hours per year [h/year]
A	Asuinrakennus Österby	0:00
B	Asuinrakennus Södergård	0:00
C	Asuinrakennus Södersved	0:00
D	Asuinrakennus Söderkulla	4:27
E	Asuinrakennus Björkholma	0:00
F	Lomarakennus Katiska	0:00
G	Asuinrakennus Koivuranta	0:00
H	Asuinrakennus Perä-Koski	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (279)	0:00	0:00
2	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (280)	0:00	0:00
3	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (281)	16:42	2:15
4	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (282)	10:41	2:08
5	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (283)	0:00	0:00
6	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (284)	0:00	0:00
7	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (285)	0:00	0:00
8	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (286)	0:00	0:00
9	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (287)	0:00	0:00
10	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (288)	0:00	0:00
11	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (289)	0:00	0:00
12	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (290)	0:00	0:00
13	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (291)	0:00	0:00
14	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (292)	0:00	0:00
15	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (293)	0:00	0:00
16	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (294)	0:00	0:00
17	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (295)	0:00	0:00
18	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (296)	0:00	0:00
19	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (297)	0:00	0:00
20	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (298)	0:00	0:00
21	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (299)	0:00	0:00
22	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (300)	0:00	0:00
23	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (301)	0:00	0:00
24	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (302)	0:00	0:00
25	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (372)	0:00	0:00

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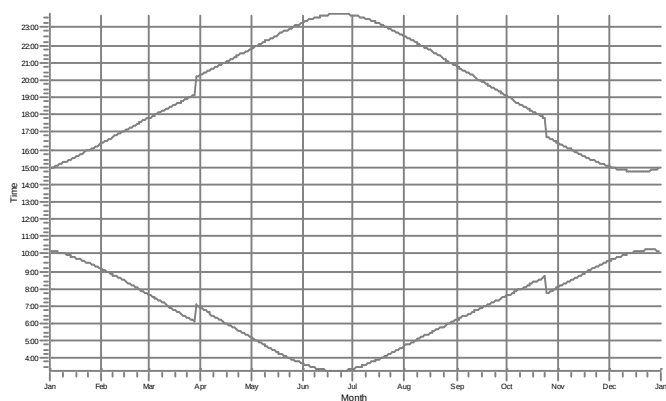
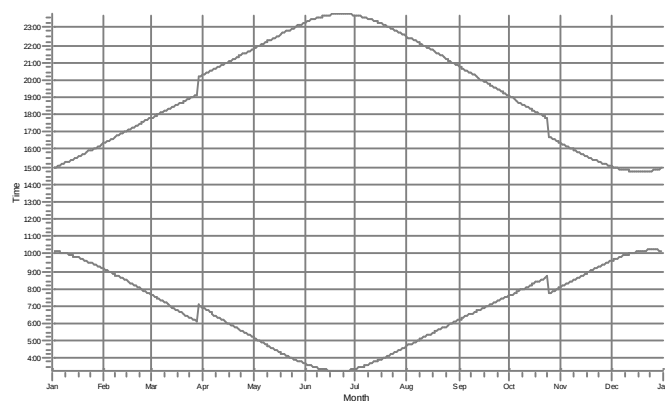
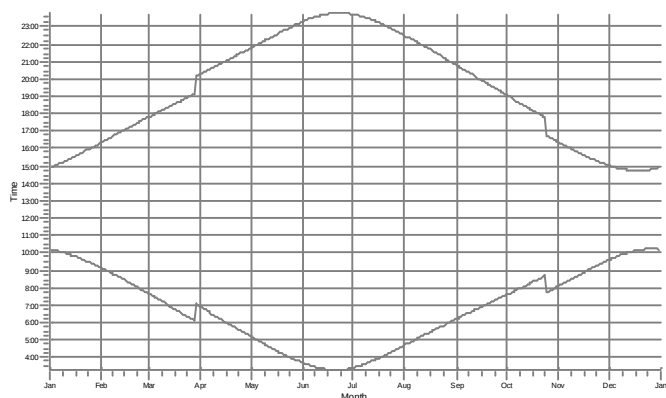
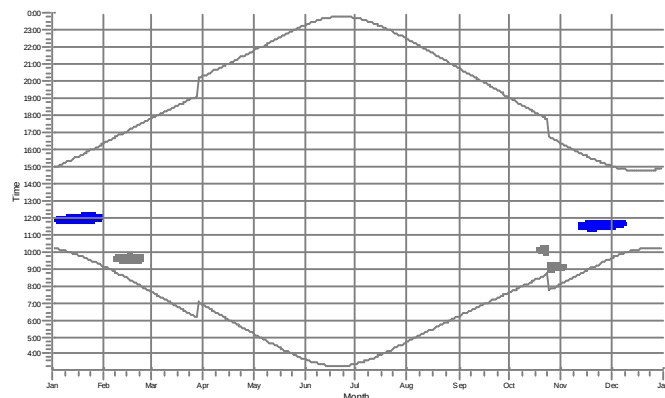
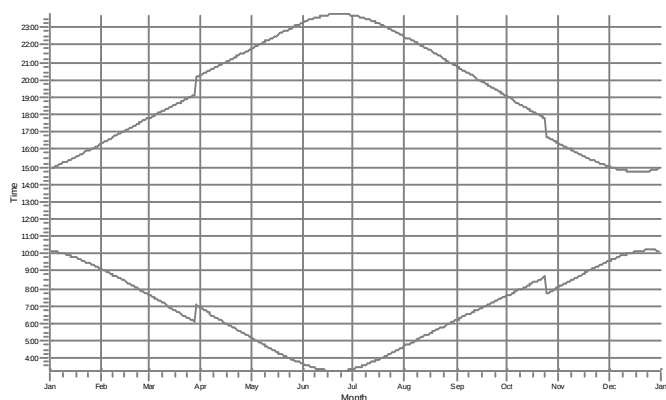
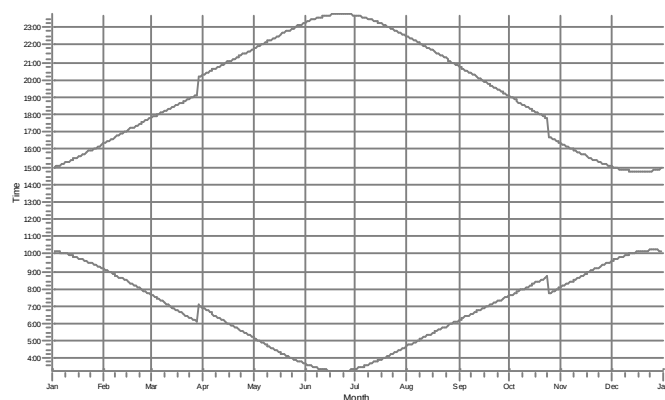
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Calculated:

3.9.2014 11:10/2.9.269

SHADOW - Calendar, graphical**Calculation: VE1: Nykarleby 25 x N131 rd131 HH145****A: Asuinrakennus Österby****B: Asuinrakennus Södergård****C: Asuinrakennus Södersved****D: Asuinrakennus Söderkulla****E: Asuinrakennus Björkholma****F: Lomarakennus Katiska**

WTGs

3: NORDEX N131/3000 3000 131.0 /OI hub: 145,0 m (TOT: 210,5 m) (281)

4: NORDEX N131/3000 3000 131.0 /OI hub: 145,0 m (TOT: 210,5 m) (282)

Project:

Storbötet

Description:

PROKON Wind Energy Finland oy
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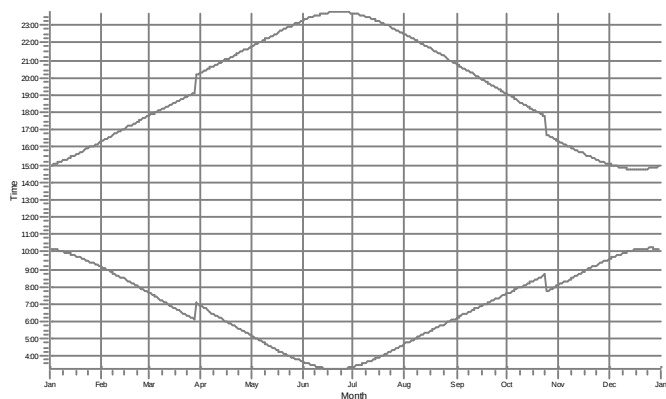
Paulina Kaivo-oja / paulina.kaivo-oja@fcg.fi

Calculated:

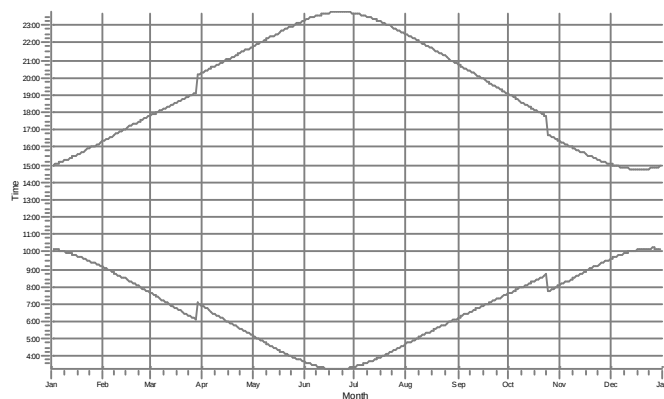
3.9.2014 11:10/2.9.269

SHADOW - Calendar, graphical**Calculation:** VE1: Nykarleby 25 x N131 rd131 HH145

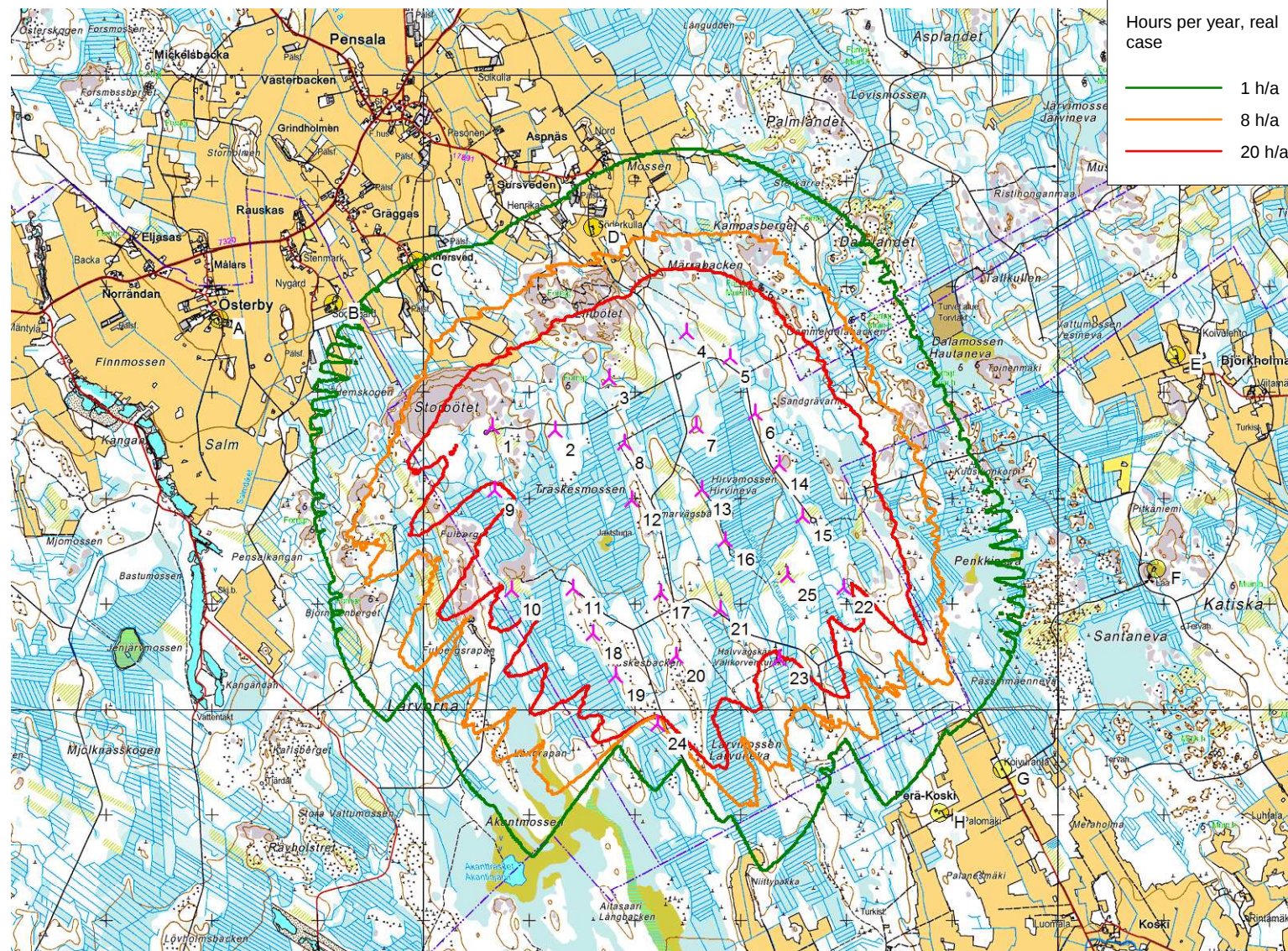
G: Asuinrakennus Koivuranta



H: Asuinrakennus Perä-Koski



WTGs



Hours per year, real case

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

Project:

Storbödet

Description:

PROKON Wind Energy Finland oy
Uusikaarleby / Vöyri

SHADOW - Map

Calculation:

VE1: Nykarleby 25 x N131 rd131 HH145

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Calculated:

3.9.2014 11:10/2.9.269

New WTG

Shadow receptor

Map: Peruskartat, Print scale 1:60 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 279 760 North: 7 027 600

Flicker map level: Height Contours: CONTOURSLINE_Vöyri_1.wpo (3)

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Calculated:

3.9.2014 11:00/2.9.269

SHADOW - Main Result**Calculation:** VE2: Vörrä 7 x N131 rd131 HH145**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) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1,02	2,84	3,78	6,14	8,62	9,94	7,42	5,13	4,32	3,43	1,58	0,96

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

MERRA_basic_E22.668_N63.500

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
785	666	475	439	538	757	957	1239	972	717	525	585	8654

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

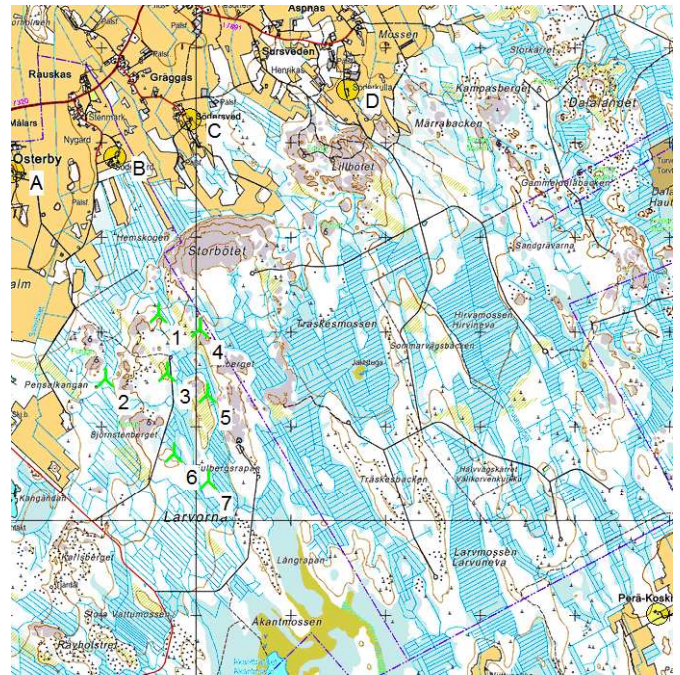
A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

Height contours used: Height Contours: CONTOURSLINE_Vöyri_1.wpo (3)

Obstacles not used in calculation

Eye height: 1,5 m

Grid resolution: 25,0 m



Scale 1:80 000

New WTG

Shadow receptor

WTGs

Finish TM ETRS-TM35FIN-ETRS89				WTG type				Shadow data			
East	North	Z	Row data/Description	Valid	Manuf.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM
[m]											
1	277 601	7 028 185	38,1 NORDEX N131/3000 3000 131.0...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3
2	277 042	7 027 506	35,0 NORDEX N131/3000 3000 131.0...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3
3	277 688	7 027 568	45,0 NORDEX N131/3000 3000 131.0...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3
4	278 035	7 028 034	43,5 NORDEX N131/3000 3000 131.0...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3
5	278 122	7 027 348	45,0 NORDEX N131/3000 3000 131.0...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3
6	277 768	7 026 715	45,0 NORDEX N131/3000 3000 131.0...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3
7	278 133	7 026 428	44,2 NORDEX N131/3000 3000 131.0...	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3

Shadow receptor-Input

Finish TM ETRS-TM35FIN-ETRS89										
No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Asuinrakennus Österby	276 064	7 029 689	22,1	5,0	5,0	1,0	0,0	90,0	"Green house mode"
B	Asuinrakennus Södergård	277 148	7 029 839	22,6	5,0	5,0	1,0	0,0	90,0	"Green house mode"
C	Asuinrakennus Södergsvädd	277 936	7 030 242	25,0	5,0	5,0	1,0	0,0	90,0	"Green house mode"
D	Asuinrakennus Södrekulla	279 601	7 030 557	27,9	5,0	5,0	1,0	0,0	90,0	"Green house mode"
E	Asuinrakennus Björkholma	285 116	7 029 347	35,0	5,0	5,0	1,0	0,0	90,0	"Green house mode"
F	Lomarakennus Katiska	284 929	7 027 331	46,0	5,0	5,0	1,0	0,0	90,0	"Green house mode"
G	Asuinrakennus Koivuranta	283 472	7 025 429	38,1	5,0	5,0	1,0	0,0	90,0	"Green house mode"
H	Asuinrakennus Perä-Koski	282 881	7 025 017	38,6	5,0	5,0	1,0	0,0	90,0	"Green house mode"

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Calculated:

3.9.2014 11:00/2.9.269

SHADOW - Main Result**Calculation:** VE2: Vörå 7 x N131 rd131 HH145**Calculation Results**

Shadow receptor

No.	Name	Shadow, expected values	
		Shadow hours	per year
			[h/year]
A	Asuinrakennus Österby	0:00	
B	Asuinrakennus Södergård	1:28	
C	Asuinrakennus Södersved	0:00	
D	Asuinrakennus Söderkulla	0:00	
E	Asuinrakennus Björkholma	0:00	
F	Lomarakennus Katiska	0:00	
G	Asuinrakennus Koivuranta	0:00	
H	Asuinrakennus Perä-Koski	0:00	

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (272)	10:53	1:28
2	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (273)	0:00	0:00
3	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (274)	0:00	0:00
4	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (275)	0:00	0:00
5	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (276)	0:00	0:00
6	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (277)	0:00	0:00
7	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (278)	0:00	0:00

Project:

Storbötet

Description:

PROKON Wind Energy Finland oy
Uusikaarleby / Vöyri

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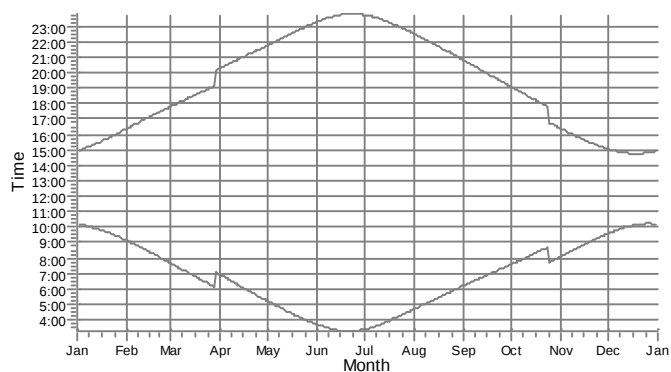
Calculated:

3.9.2014 11:00/2.9.269

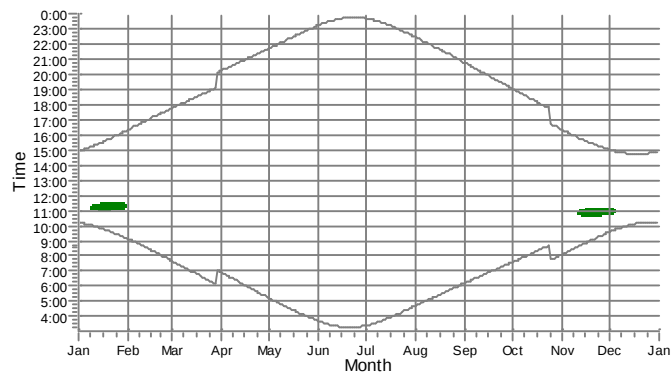
SHADOW - Calendar, graphical

Calculation: VE2: Vörrå 7 x N131 rd131 HH145

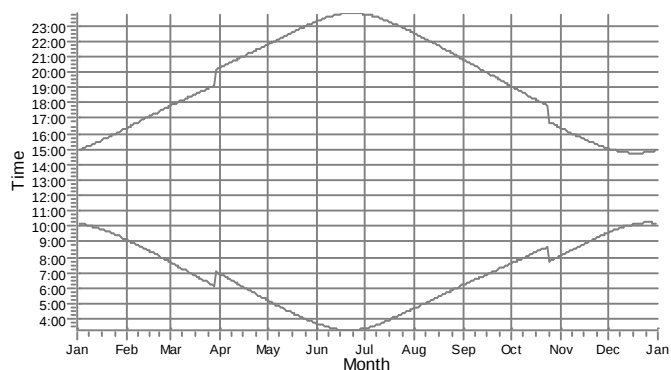
A: Asuinrakennus Österby



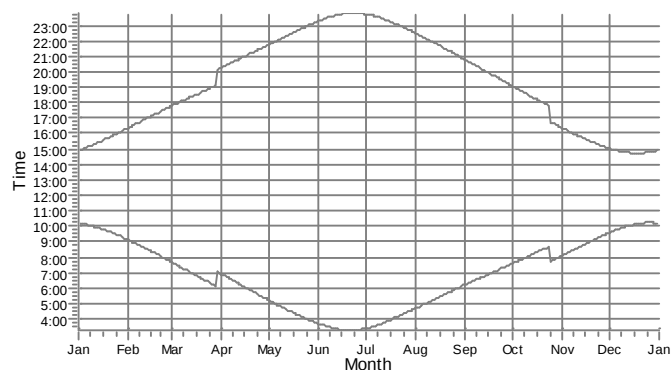
B: Asuinrakennus Södergård



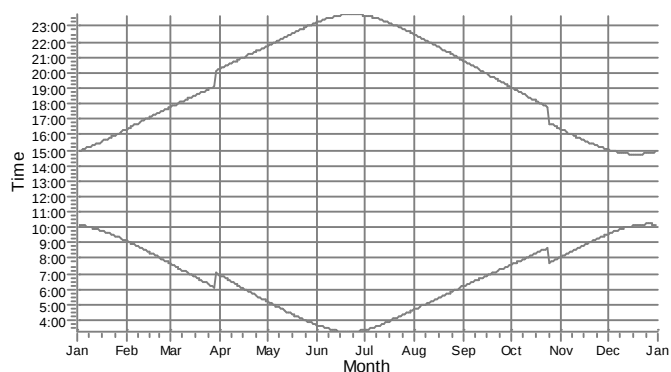
C: Asuinrakennus Södersved



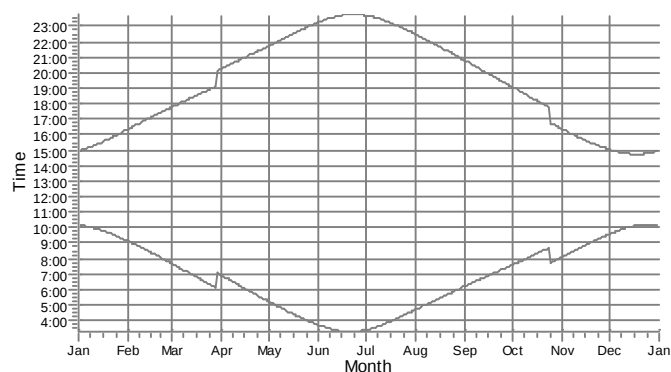
D: Asuinrakennus Söderkulla



E: Asuinrakennus Björkholma



F: Lomarakennus Katiska



WTGs

1: NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (272)

Project:

Storbötet

Description:

PROKON Wind Energy Finland oy
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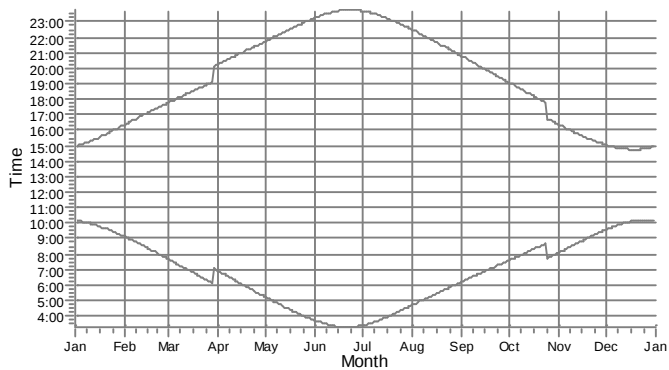
Paulina Kaivo-oja / paulina.kaivo-oja@fcg.fi

Calculated:

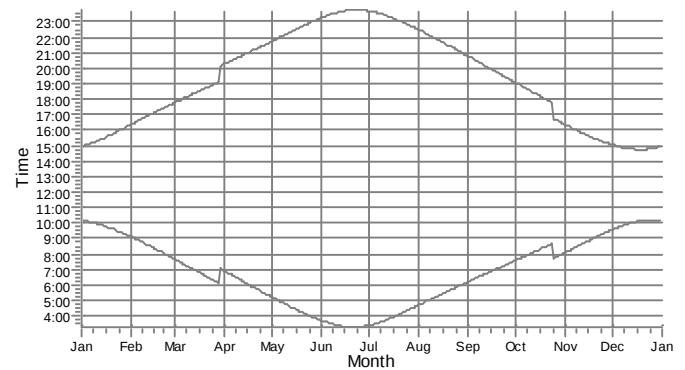
3.9.2014 11:00/2.9.269

SHADOW - Calendar, graphical**Calculation: VE2: Vörå 7 x N131 rd131 HH145**

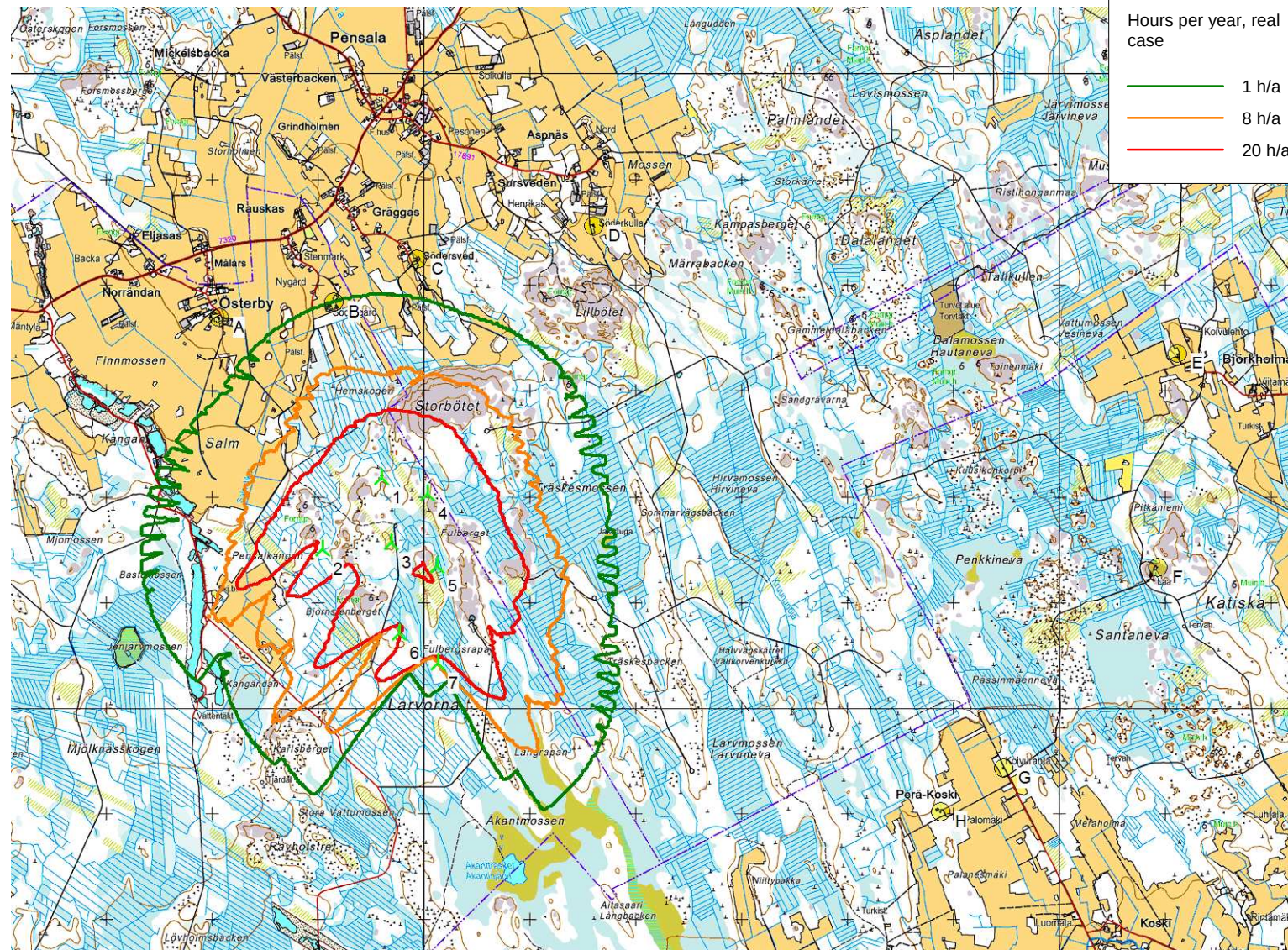
G: Asuinrakennus Koivuranta



H: Asuinrakennus Perä-Koski



WTGs



Hours per year, real case

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

Project:

Storbödet

Description:

PROKON Wind Energy Finland oy
Uusikaarleby / Vöyri

SHADOW - Map

Calculation:

VE2: Vörrä 7 x N131 rd131 HH145

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Calculated:

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New WTG

Shadow receptor

Map: Peruskartat, Print scale 1:60 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 279 760 North: 7 027 600

Flicker map level: Height Contours: CONTOURSLINE_Vöyri_1.wpo (3)

Project:

Storbötet

Description:

PROKON Wind Energy Finland oy
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SHADOW - Main Result

Calculation: VE3: Vörå + Nykarleby 32 x N131 rd131 HH145

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) [UMEA]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.02	2.84	3.78	6.14	8.62	9.94	7.42	5.13	4.32	3.43	1.58	0.96

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

MERRA basic E22.668 N63.500

Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
785	666	475	439	538	757	957	1 239	972	717	525	585	8 654

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: CONTOURSLINE Vöyri 1.wpo (3)

Obstacles not used in calculation

Eye height: 1.5 m

Grid resolution: 25.0 m

WTGs

	Finish TM ETRS-TM35FIN-ETRS89							WTG type				Shadow data		
	East	North	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Calculation distance	RPM		
			[m]					[kW]	[m]		[m]	[RPM]		
1	277 601	7 028 185	38,1	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
2	277 042	7 027 506	35,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
3	277 688	7 027 568	45,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
4	278 035	7 028 034	43,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
5	278 122	7 027 348	45,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
6	277 768	7 026 715	45,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
7	278 133	7 026 428	44,2	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
8	278 654	7 028 670	44,7	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
9	279 246	7 028 640	42,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
10	279 753	7 029 129	40,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
11	280 491	7 029 568	33,6	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
12	280 897	7 029 323	37,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
13	281 134	7 028 801	39,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
14	280 577	7 028 680	40,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
15	279 897	7 028 516	41,1	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
16	278 671	7 028 075	45,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
17	278 834	7 027 133	47,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
18	279 410	7 027 143	48,9	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
19	279 972	7 027 985	44,4	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
20	280 633	7 028 083	39,7	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
21	281 366	7 028 324	44,9	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
22	281 588	7 027 831	42,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
23	280 853	7 027 601	40,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
24	280 241	7 027 097	50,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
25	279 605	7 026 721	50,0	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
26	279 814	7 026 321	49,8	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
27	280 389	7 026 505	50,5	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
28	280 809	7 026 950	44,8	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
29	281 974	7 027 156	44,8	NORDEX N131/3000 3000 131....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		

To be continued on next page...

Project:

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Description:

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Calculated:

3.9.2014 11:23/2.9.269

SHADOW - Main Result**Calculation:** VE3: Vörå + Nykarleby 32 x N131 rd131 HH145

...continued from previous page

Finish TM ETRS-TM35FIN-ETRS89										WTG type			Shadow data				
East		North		Z	Row data/Description					Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Calculation distance	RPM
				[m]									[kW]	[m]	[m]	[m]	[RPM]
30	281 361	7 026 486	45,0	NORDEX	N131/3000	3000	131.....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
31	280 212	7 025 857	51,1	NORDEX	N131/3000	3000	131.....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		
32	281 444	7 027 269	42,5	NORDEX	N131/3000	3000	131.....	Yes	NORDEX	N131/3000-3 000	3 000	131,0	145,0	1 721	10,3		

Shadow receptor-Input

Finish TM ETRS-TM35FIN-ETRS89										
No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Asuinrakennus Österby	276 064	7 029 689	22,1	5,0	5,0	1,0	0,0	90,0	"Green house mode"
B	Asuinrakennus Södergård	277 148	7 029 839	22,6	5,0	5,0	1,0	0,0	90,0	"Green house mode"
C	Asuinrakennus Södergsved	277 936	7 030 242	25,0	5,0	5,0	1,0	0,0	90,0	"Green house mode"
D	Asuinrakennus Söderkulla	279 601	7 030 557	27,9	5,0	5,0	1,0	0,0	90,0	"Green house mode"
E	Asuinrakennus Björkholma	285 116	7 029 347	35,0	5,0	5,0	1,0	0,0	90,0	"Green house mode"
F	Lomarakennus Katiska	284 929	7 027 331	46,0	5,0	5,0	1,0	0,0	90,0	"Green house mode"
G	Asuinrakennus Koivuranta	283 472	7 025 429	38,1	5,0	5,0	1,0	0,0	90,0	"Green house mode"
H	Asuinrakennus Perä-Koski	282 881	7 025 017	38,6	5,0	5,0	1,0	0,0	90,0	"Green house mode"

Calculation Results

Shadow receptor

		Shadow, expected values
No.	Name	Shadow hours per year [h/year]
A	Asuinrakennus Österby	0:00
B	Asuinrakennus Södergård	1:28
C	Asuinrakennus Södergsved	0:00
D	Asuinrakennus Söderkulla	4:27
E	Asuinrakennus Björkholma	0:00
F	Lomarakennus Katiska	0:00
G	Asuinrakennus Koivuranta	0:00
H	Asuinrakennus Perä-Koski	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (272)	10:53	1:28
2	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (273)	0:00	0:00
3	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (274)	0:00	0:00
4	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (275)	0:00	0:00
5	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (276)	0:00	0:00
6	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (277)	0:00	0:00
7	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (278)	0:00	0:00
8	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (279)	0:00	0:00
9	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (280)	0:00	0:00
10	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (281)	16:42	2:15
11	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (282)	10:41	2:08
12	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (283)	0:00	0:00
13	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (284)	0:00	0:00
14	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (285)	0:00	0:00
15	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (286)	0:00	0:00
16	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (287)	0:00	0:00
17	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (288)	0:00	0:00
18	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (289)	0:00	0:00
19	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (290)	0:00	0:00
20	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (291)	0:00	0:00

To be continued on next page...

Project:

Storbötet

Description:

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Calculated:

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SHADOW - Main Result**Calculation:** VE3: Vörå + Nykarleby 32 x N131 rd131 HH145

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
21	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (292)	0:00	0:00
22	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (293)	0:00	0:00
23	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (294)	0:00	0:00
24	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (295)	0:00	0:00
25	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (296)	0:00	0:00
26	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (297)	0:00	0:00
27	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (298)	0:00	0:00
28	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (299)	0:00	0:00
29	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (300)	0:00	0:00
30	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (301)	0:00	0:00
31	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (302)	0:00	0:00
32	NORDEX N131/3000 3000 131.0 !O! hub: 145,0 m (TOT: 210,5 m) (372)	0:00	0:00

Project:

Storbötet

Description:

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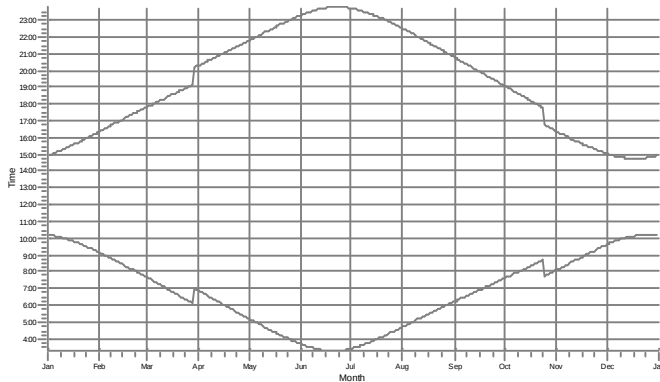
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Calculated:

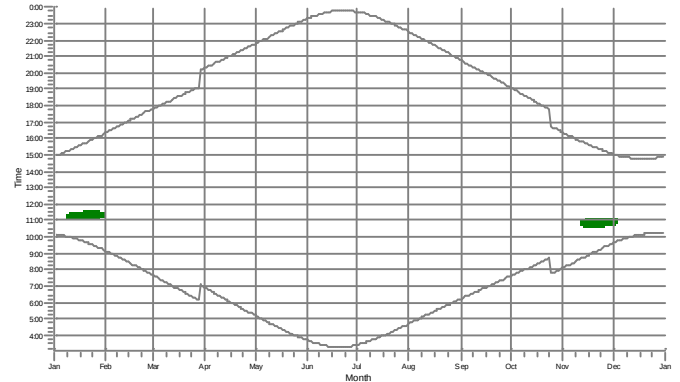
3.9.2014 11:23/2.9.269

SHADOW - Calendar, graphical**Calculation: VE3: Vörrä + Nykarleby 32 x N131 rd131 HH145**

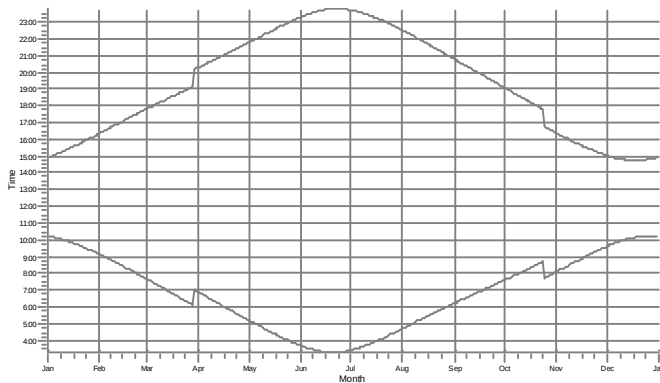
A: Asuinrakennus Österby



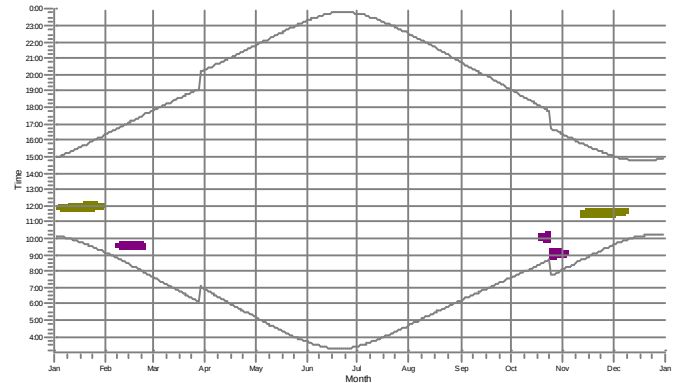
B: Asuinrakennus Södergård



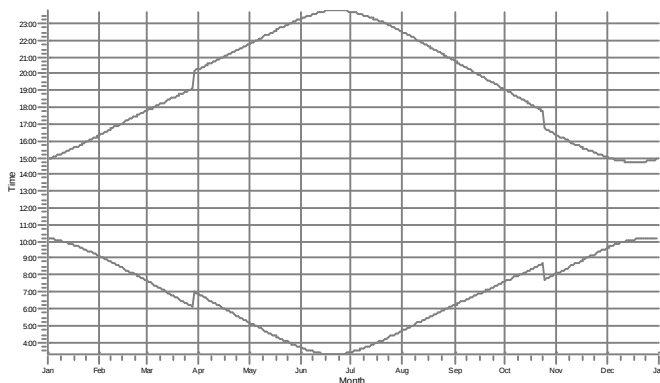
C: Asuinrakennus Södersved



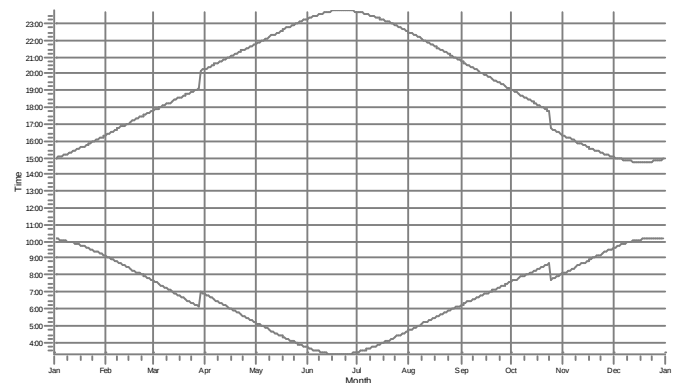
D: Asuinrakennus Söderkulla



E: Asuinrakennus Björkholma



F: Lomarakennus Katiska



WTGs

1: NORDEX N131/3000 3000 131.0 I! hub: 145,0 m (TOT: 210,5 m) (272)

10: NORDEX N131/3000 3000 131.0 I! hub: 145,0 m (TOT: 210,5 m) (281)

11: NORDEX N131/3000 3000 131.0 I! hub: 145,0 m (TOT: 210,5 m) (282)

Project:

Storbötet

Description:

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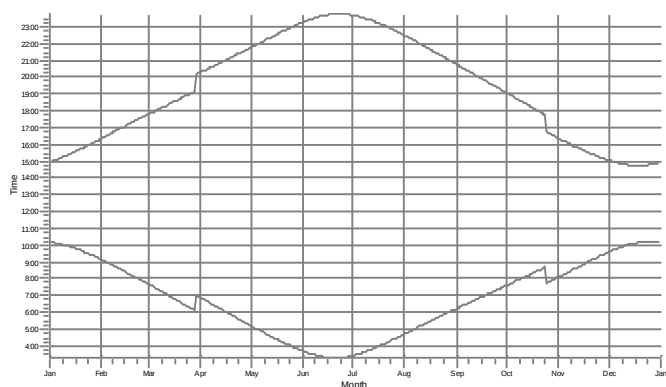
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Calculated:

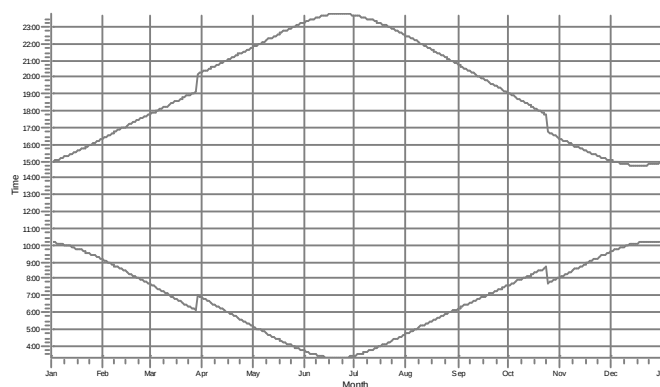
3.9.2014 11:23/2.9.269

SHADOW - Calendar, graphical**Calculation:** VE3: Vörå + Nykarleby 32 x N131 rd131 HH145

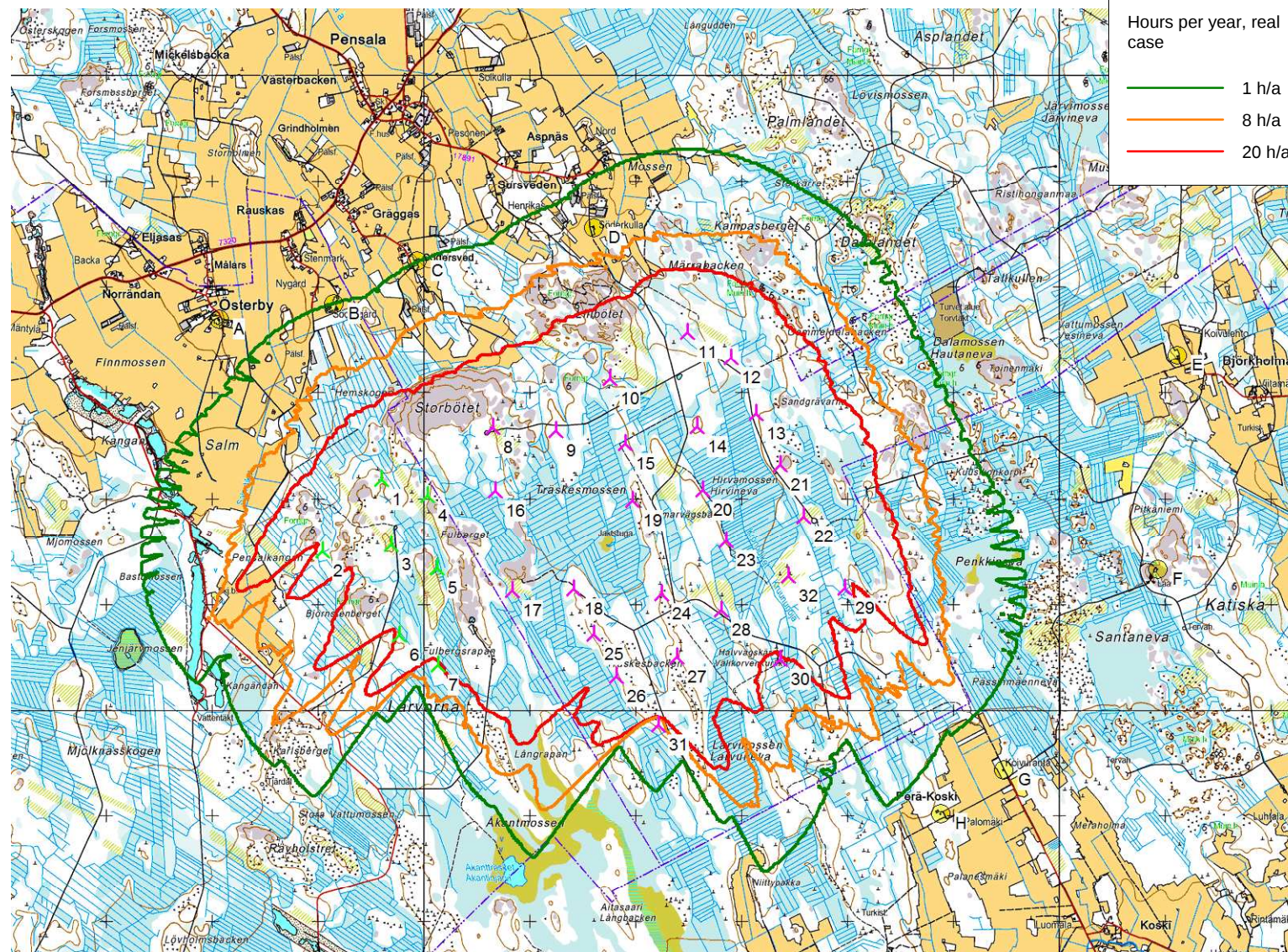
G: Asuinrakennus Koivuranta



H: Asuinrakennus Perä-Koski



WTGs



Hours per year, real case

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

Project:

Storbödet

Description:

PROKON Wind Energy Finland oy
Uusikaarleby / Vöyri

SHADOW - Map

Calculation:

VE3: Vörå + Nykarleby 32 x N131 rd131 HH145

Printed/Page

3.9.2014 16:01 / 6

Licensed user:

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Calculated:

3.9.2014 11:23/2.9.269

New WTG

Shadow receptor

Map: Peruskartat, Print scale 1:60 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 279 760 North: 7 027 600

Flicker map level: Height Contours: CONTOURSLINE_Vöyri_1.wpo (3)