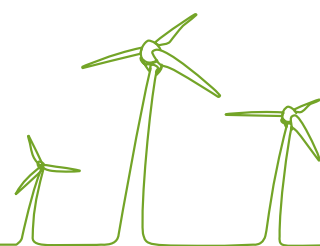
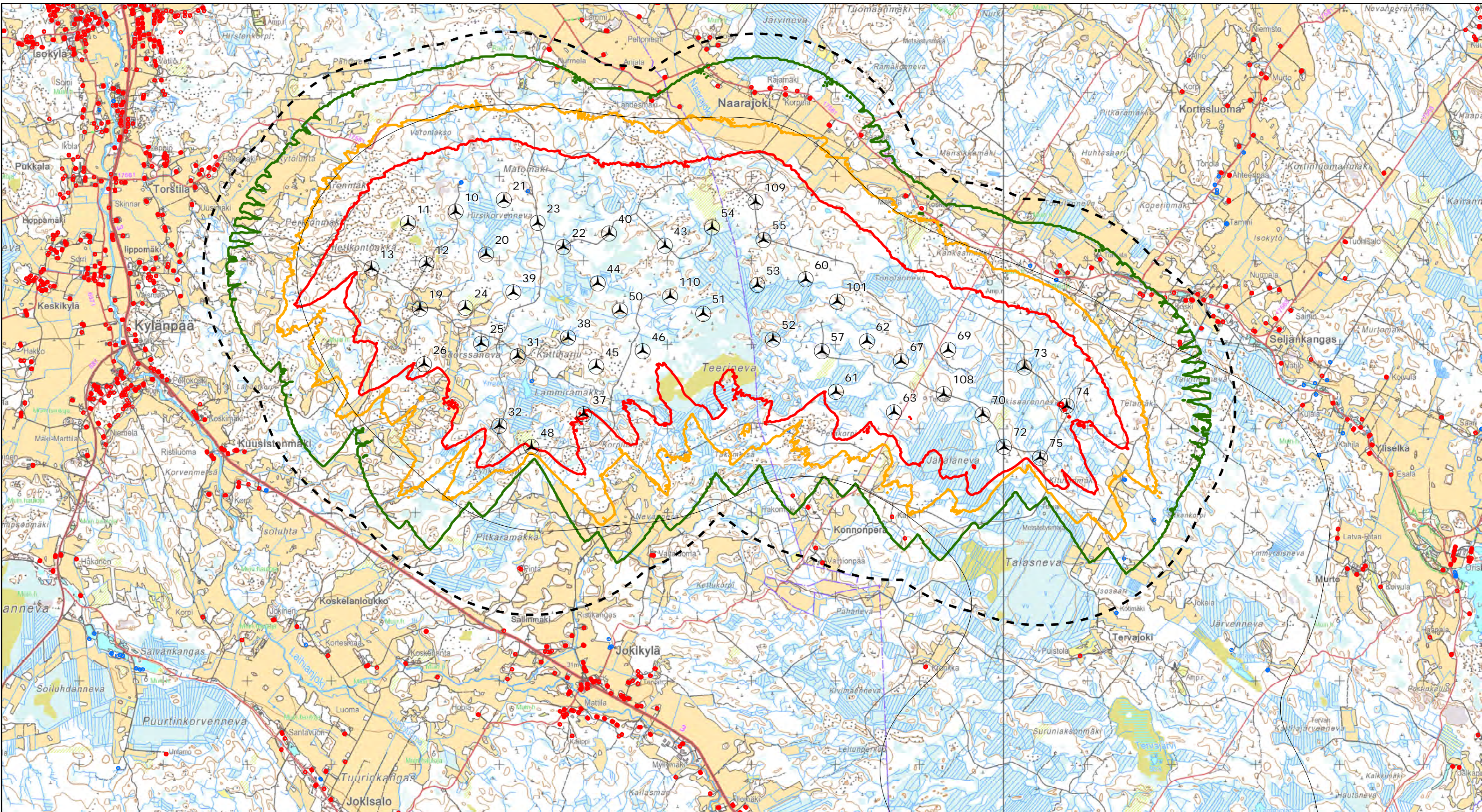


LIITE 5





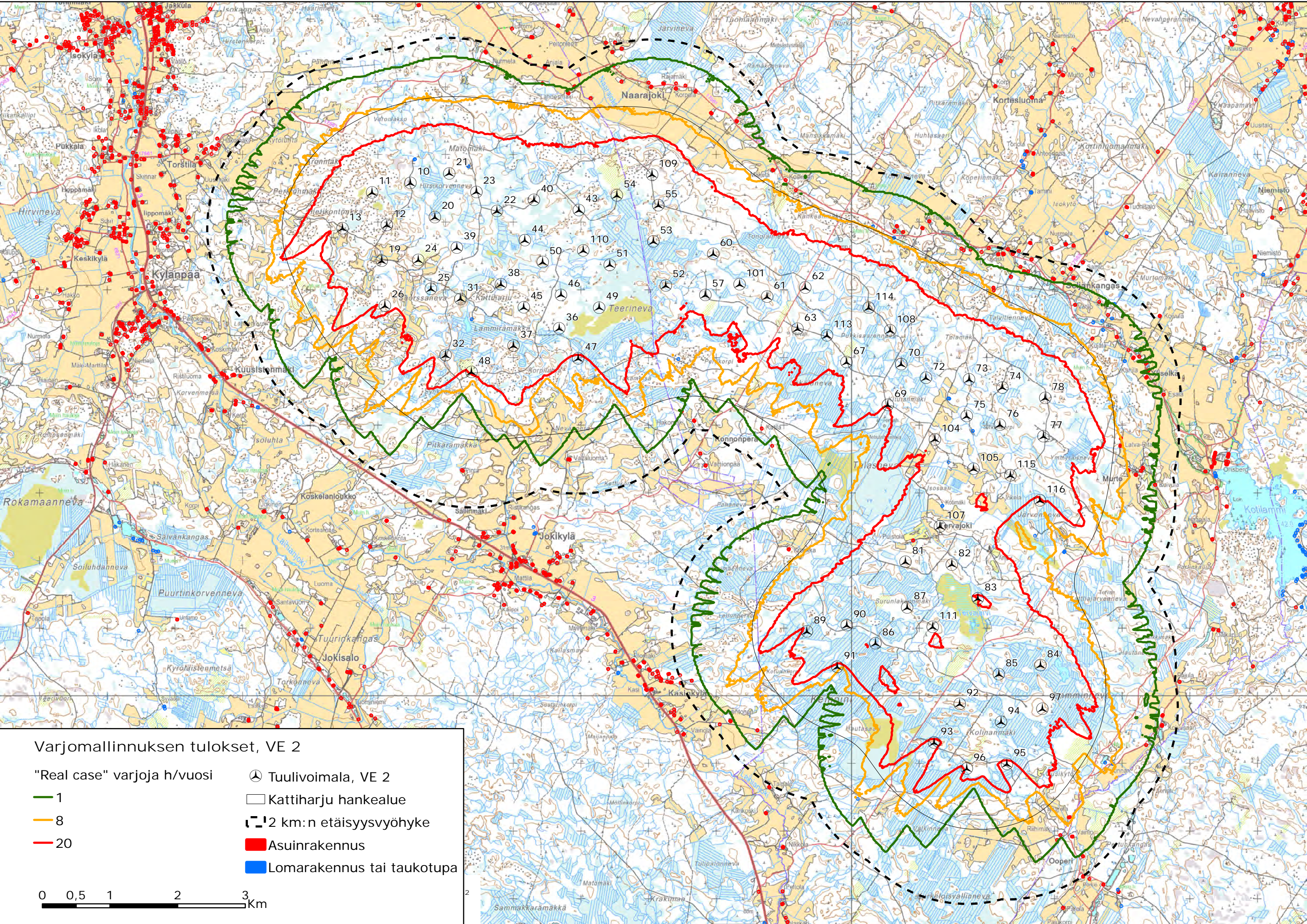
Varjomallinnuksen tulokset, VE 1

"Real Case" varjoja h/vuosi

- 1
- 8
- 20

- Tuulivoimala, VE 1
- Kattiharju hankealue
- 2 km:n etäisyysvyöhyke
- Asuinrakennus
- Lomarakennus tai taukotupa





Varjomallinnuksen tulokset, VE 2

"Real case" varjoja h/vuosi

- 1
- 8
- 20

☼ Tuulivoimala, VE 2

□ Kattiharju hankealue

⋯ 2 km:n etäisyysvyöhyke

■ Asuinrakennus

■ Lomarakennus tai taukotupa



Project:

Kattiharju

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Hans Vadback / hans.vadback@fcg.fi

Calculated:

10.10.2014 9:39/2.8.579

SHADOW - Main Result

Calculation: Kattiharju Nordex N131 x 45 x HH144_VE1 (no forest)

Assumptions for shadow calculations

Maximum distance for influence

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

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

Sunshine probability S (Average daily sunshine hours) [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_N63.000

Operational time

| | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|------|------|-----|-----|-----|-----|------|
| N | NNE | ENE | E | ESE | SSE | S | SSW | WSW | W | WNW | NNW | Sum |
| 734 | 529 | 428 | 418 | 546 | 822 | 1041 | 1206 | 883 | 767 | 618 | 643 | 8635 |

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

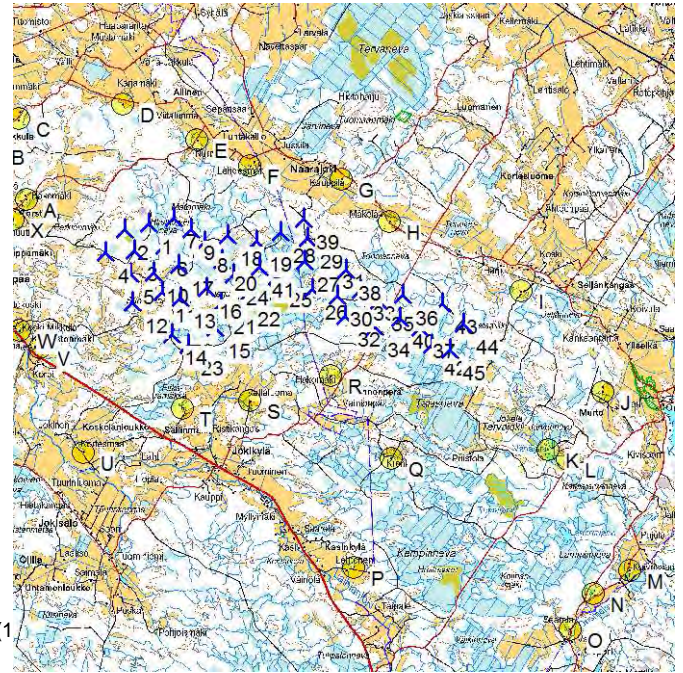
A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

Height contours used: Height Contours: Kattiharju height contour lines.wpo (1

Obstacles not used in calculation

Eye height: 1,5 m

Grid resolution: 10,0 m



New WTG

Scale 1:175 000

Shadow receptor

WTGs

| | Finish TM ETRS-TM35FIN-ETRS89 | | | Row data/Description | Valid | WTG type | | | Shadow data | | | |
|----|-------------------------------|-----------|------|----------------------|-------|-----------|-----------------|-------------------|--------------------|----------------|--------------------------|-----------|
| | East | North | Z | | | Manufact. | Type-generator | Power, rated [kW] | Rotor diameter [m] | Hub height [m] | Calculation distance [m] | RPM [RPM] |
| 1 | 253 483 | 6 985 584 | 45,0 | WEA 10 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 2 | 252 916 | 6 985 443 | 44,3 | WEA 11 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 3 | 253 135 | 6 984 959 | 47,5 | WEA 12 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 4 | 252 479 | 6 984 909 | 42,5 | WEA 13 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 5 | 253 058 | 6 984 432 | 40,0 | WEA 19 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 6 | 253 845 | 6 985 076 | 45,0 | WEA 20 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 7 | 254 057 | 6 985 724 | 48,5 | WEA 21 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 8 | 254 763 | 6 985 166 | 45,1 | WEA 22 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 9 | 254 459 | 6 985 451 | 47,5 | WEA 23 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 10 | 253 599 | 6 984 443 | 42,5 | WEA 24 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 11 | 253 787 | 6 984 016 | 43,3 | WEA 25 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 12 | 253 108 | 6 983 770 | 40,0 | WEA 26 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 13 | 254 222 | 6 983 865 | 42,5 | WEA 31 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 14 | 254 003 | 6 983 038 | 46,1 | WEA 32 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 15 | 255 007 | 6 983 175 | 48,8 | WEA 37 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 16 | 254 821 | 6 984 085 | 42,5 | WEA 38 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 17 | 254 170 | 6 984 626 | 42,5 | WEA 39 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 18 | 255 310 | 6 985 328 | 50,0 | WEA 40 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 19 | 255 973 | 6 985 180 | 51,9 | WEA 43 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 20 | 255 175 | 6 984 732 | 46,2 | WEA 44 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 21 | 255 158 | 6 983 743 | 47,5 | WEA 45 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 22 | 255 710 | 6 983 927 | 47,5 | WEA 46 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 23 | 254 386 | 6 982 785 | 47,5 | WEA 48 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 24 | 255 439 | 6 984 410 | 46,8 | WEA 50 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 25 | 256 430 | 6 984 372 | 50,0 | WEA 51 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 26 | 257 259 | 6 984 067 | 50,0 | WEA 52 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 27 | 257 076 | 6 984 715 | 50,0 | WEA 53 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 28 | 256 536 | 6 985 396 | 49,5 | WEA 54 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 29 | 257 149 | 6 985 250 | 50,0 | WEA 55 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |

To be continued on next page...

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Calculated:

10.10.2014 9:39/2.8.579

SHADOW - Main Result**Calculation:** Kattiharju Nordex N131 x 45 x HH144_VE1 (no forest)

...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 [kW] | Rotor diameter [m] | Hub height [m] | Calculation distance [m] | RPM [RPM] |
| 30 | 257 843 | 6 983 925 | 52,5 | WEA 57 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 31 | 257 651 | 6 984 780 | 48,3 | WEA 60 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 32 | 258 011 | 6 983 441 | 53,9 | WEA 61 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 33 | 258 380 | 6 984 045 | 52,5 | WEA 62 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 34 | 258 701 | 6 983 202 | 52,2 | WEA 63 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 35 | 258 786 | 6 983 809 | 50,0 | WEA 67 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 36 | 259 348 | 6 983 942 | 47,5 | WEA 69 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 37 | 259 757 | 6 983 173 | 50,0 | WEA 70 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 38 | 258 028 | 6 984 519 | 50,0 | WEA 101 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 39 | 257 055 | 6 985 701 | 47,8 | WEA 109 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 40 | 259 295 | 6 983 417 | 52,4 | WEA 108 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 41 | 256 038 | 6 984 579 | 50,0 | WEA 110 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 42 | 260 013 | 6 982 788 | 52,3 | WEA 72 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 43 | 260 255 | 6 983 735 | 45,0 | WEA 73 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 44 | 260 759 | 6 983 276 | 45,0 | WEA 74 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 45 | 260 443 | 6 982 663 | 47,5 | WEA 75 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |

Shadow receptor-Input

| No. | Name | Finish TM ETRS-TM35FIN-ETRS89 | | | | Height a.g.l. [m] | Degrees from south cw [°] | Slope of window [°] | Direction mode |
|-----|--|-------------------------------|-----------|------|-----------|-------------------|---------------------------|---------------------|--------------------|
| | | East | North | Z | Width [m] | | | | |
| A | Asuinrakennus (Torstilantie 141) | 250 645 | 6 986 140 | 27,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| B | Asuinrakennus (Vatilo) | 249 902 | 6 987 373 | 23,7 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| C | Asuinrakennus (Allisentie 95) | 250 470 | 6 988 007 | 22,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| D | Asuinrakennus (Allisentie 393) | 252 879 | 6 988 341 | 22,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| E | Asuinrakennus (Torstilantie 627) | 254 594 | 6 987 512 | 27,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| F | Asuinrakennus (Naarajoentie 135) | 255 815 | 6 986 912 | 27,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| G | Asuinrakennus (Naarajoentie 385) | 257 928 | 6 986 614 | 27,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| H | Asuinrakennus (Naarajoentie 534) | 259 029 | 6 985 627 | 32,1 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| I | Asuinrakennus (Perätie 63) | 262 098 | 6 984 027 | 40,0 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| J | Asuinrakennus (Murrantie 99) | 263 976 | 6 981 696 | 39,8 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| K | Lomarakennus (Vähäjärvi) | 262 717 | 6 980 366 | 47,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| L | Lomarakennus (Poutunmäki) | 263 150 | 6 980 129 | 50,1 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| M | Asuinrakennus (Kinnartammentie 110) | 264 590 | 6 977 562 | 47,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| N | Lomarakennus (Kinnartammentie 215) | 263 750 | 6 977 014 | 55,0 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| O | Asuinrakennus (Åbergintie 665) | 263 219 | 6 976 206 | 55,0 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| P | Asuinrakennus (Karjanmaantie 88) | 258 214 | 6 977 627 | 47,4 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| Q | Asuinrakennus (Fronkantie 224) | 259 077 | 6 980 164 | 52,8 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| R | Asuinrakennus (Konnonperäntie, Hakomäki) | 257 676 | 6 982 064 | 50,0 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| S | Asuinrakennus (Konnonperäntie 106) | 255 820 | 6 981 491 | 41,9 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| T | Asuinrakennus (Tampereentie 1584) | 254 255 | 6 981 325 | 42,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| U | Asuinrakennus (Malkamäentie 178) | 251 960 | 6 980 298 | 35,0 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| V | Asuinrakennus (Sahakuja 25) | 250 968 | 6 982 726 | 35,0 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| W | Asuinrakennus (Tampereentie 1160) | 250 495 | 6 983 107 | 30,2 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| X | Asuinrakennus (Torstilantie 99) | 250 345 | 6 985 669 | 26,8 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |

Calculation Results

Shadow receptor

| No. | Name | Shadow, expected values | |
|-----|----------------------------------|--------------------------------|--|
| | | Shadow hours per year [h/year] | |
| A | Asuinrakennus (Torstilantie 141) | 0:00 | |
| B | Asuinrakennus (Vatilo) | 0:00 | |
| C | Asuinrakennus (Allisentie 95) | 0:00 | |
| D | Asuinrakennus (Allisentie 393) | 0:00 | |

To be continued on next page...

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Calculated:

10.10.2014 9:39/2.8.579

SHADOW - Main Result

Calculation: Kattiharju Nordex N131 x 45 x HH144_VE1 (no forest)

...continued from previous page

| No. | Name | Shadow, expected values | |
|-----|--|-------------------------|--|
| | | Shadow hours | |
| | | per year | |
| | | [h/year] | |
| E | Asuinrakennus (Torstilantie 627) | 0:00 | |
| F | Asuinrakennus (Naarajoentie 135) | 2:54 | |
| G | Asuinrakennus (Naarajoentie 385) | 3:49 | |
| H | Asuinrakennus (Naarajoentie 534) | 6:07 | |
| I | Asuinrakennus (Perätie 63) | 1:28 | |
| J | Asuinrakennus (Murrantie 99) | 0:00 | |
| K | Lomarakennus (Vähäjärvi) | 0:00 | |
| L | Lomarakennus (Poutunmäki) | 0:00 | |
| M | Asuinrakennus (Kinnartammentie 110) | 0:00 | |
| N | Lomarakennus (Kinnartammentie 215) | 0:00 | |
| O | Asuinrakennus (Åbergintie 665) | 0:00 | |
| P | Asuinrakennus (Karjanmaantie 88) | 0:00 | |
| Q | Asuinrakennus (Fronkantie 224) | 0:00 | |
| R | Asuinrakennus (Konnonperäntie, Hakomäki) | 0:00 | |
| S | Asuinrakennus (Konnonperäntie 106) | 0:00 | |
| T | Asuinrakennus (Tampereentie 1584) | 0:00 | |
| U | Asuinrakennus (Malkamäentie 178) | 0:00 | |
| V | Asuinrakennus (Sahakuja 25) | 0:00 | |
| W | Asuinrakennus (Tampereentie 1160) | 0:00 | |
| X | Asuinrakennus (Torstilantie 99) | 0:00 | |

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

| No. | Name | Worst case | Expected |
|-----|--------|------------|----------|
| | | [h/year] | [h/year] |
| 1 | WEA 10 | 0:00 | 0:00 |
| 2 | WEA 11 | 0:00 | 0:00 |
| 3 | WEA 12 | 0:00 | 0:00 |
| 4 | WEA 13 | 0:00 | 0:00 |
| 5 | WEA 19 | 0:00 | 0:00 |
| 6 | WEA 20 | 0:00 | 0:00 |
| 7 | WEA 21 | 0:00 | 0:00 |
| 8 | WEA 22 | 0:00 | 0:00 |
| 9 | WEA 23 | 0:00 | 0:00 |
| 10 | WEA 24 | 0:00 | 0:00 |
| 11 | WEA 25 | 0:00 | 0:00 |
| 12 | WEA 26 | 0:00 | 0:00 |
| 13 | WEA 31 | 0:00 | 0:00 |
| 14 | WEA 32 | 0:00 | 0:00 |
| 15 | WEA 37 | 0:00 | 0:00 |
| 16 | WEA 38 | 0:00 | 0:00 |
| 17 | WEA 39 | 0:00 | 0:00 |
| 18 | WEA 40 | 12:50 | 1:39 |
| 19 | WEA 43 | 0:00 | 0:00 |
| 20 | WEA 44 | 0:00 | 0:00 |
| 21 | WEA 45 | 0:00 | 0:00 |
| 22 | WEA 46 | 0:00 | 0:00 |
| 23 | WEA 48 | 0:00 | 0:00 |
| 24 | WEA 50 | 0:00 | 0:00 |
| 25 | WEA 51 | 0:00 | 0:00 |
| 26 | WEA 52 | 0:00 | 0:00 |
| 27 | WEA 53 | 0:00 | 0:00 |
| 28 | WEA 54 | 8:29 | 1:15 |
| 29 | WEA 55 | 10:21 | 1:27 |
| 30 | WEA 57 | 0:00 | 0:00 |
| 31 | WEA 60 | 6:33 | 1:20 |
| 32 | WEA 61 | 0:00 | 0:00 |
| 33 | WEA 62 | 11:09 | 1:26 |
| 34 | WEA 63 | 0:00 | 0:00 |
| 35 | WEA 67 | 0:00 | 0:00 |

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Calculated:

10.10.2014 9:39/2.8.579



SHADOW - Main Result

Calculation: Kattiharju Nordex N131 x 45 x HH144_VE1 (no forest)

...continued from previous page

| No. | Name | Worst case [h/year] | Expected [h/year] |
|-----|---------|------------------------|----------------------|
| 36 | WEA 69 | 12:42 | 1:37 |
| 37 | WEA 70 | 0:00 | 0:00 |
| 38 | WEA 101 | 9:09 | 1:40 |
| 39 | WEA 109 | 11:50 | 2:20 |
| 40 | WEA 108 | 0:00 | 0:00 |
| 41 | WEA 110 | 0:00 | 0:00 |
| 42 | WEA 72 | 0:00 | 0:00 |
| 43 | WEA 73 | 0:00 | 0:00 |
| 44 | WEA 74 | 7:11 | 1:28 |
| 45 | WEA 75 | 0:00 | 0:00 |

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Kattiharju

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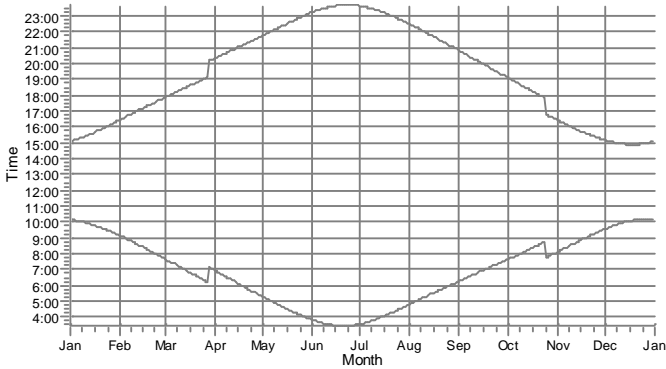


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Calculated:
10.10.2014 9:39/2.8.579

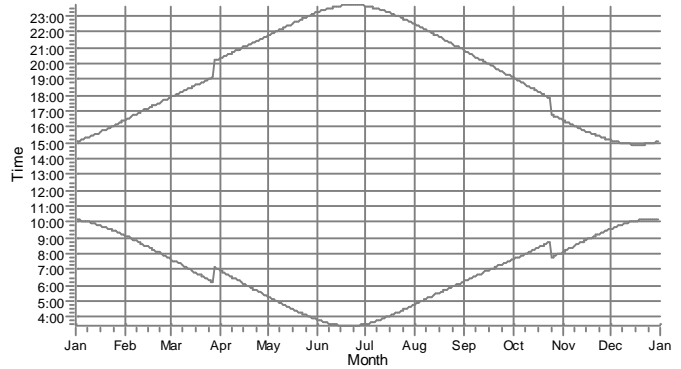
SHADOW - Calendar, graphical

Calculation: Kattiharju Nordex N131 x 45 x HH144_VE1 (no forest)

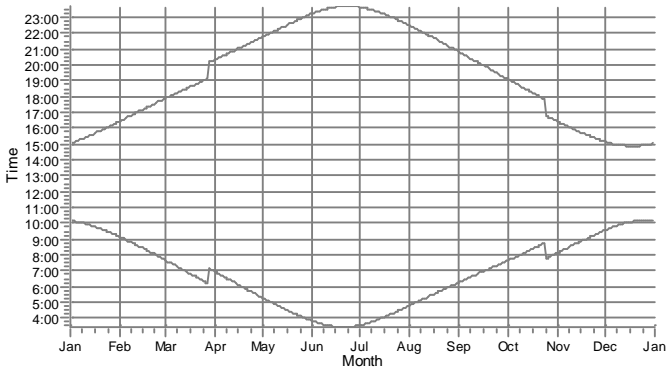
A: Asuinrakennus (Torstilanatie 141)



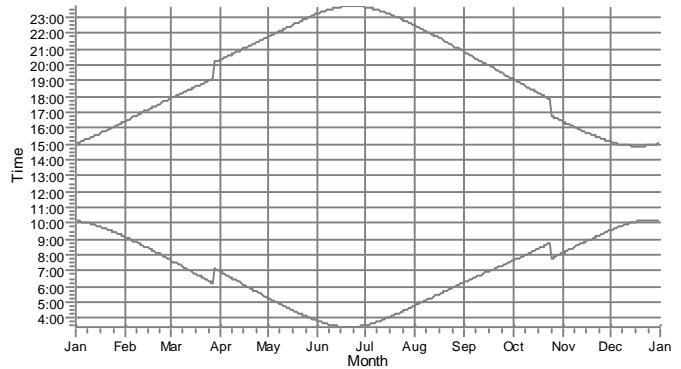
B: Asuinrakennus (Vatilo)



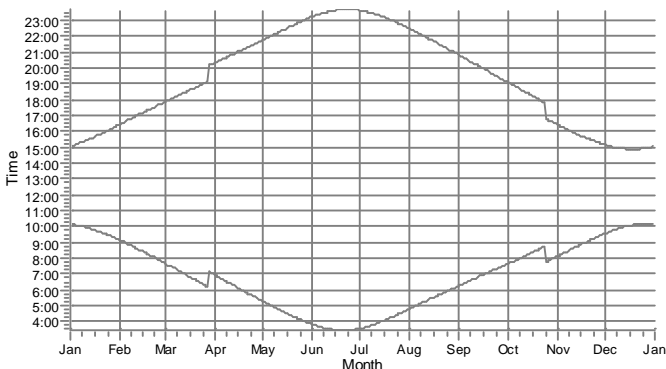
C: Asuinrakennus (Allisentie 95)



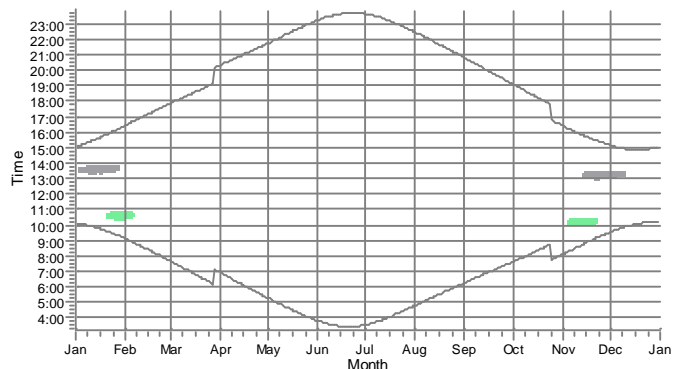
D: Asuinrakennus (Allisentie 393)



E: Asuinrakennus (Torstilanatie 627)



F: Asuinrakennus (Naarajontie 135)



WTGs

18: WEA 40 28: WEA 54

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Calculated:

10.10.2014 9:39/2.8.579

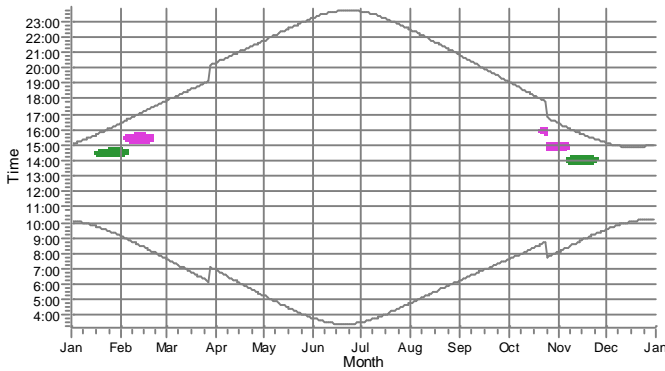


SUUNNITTELU JA TEKNIikka

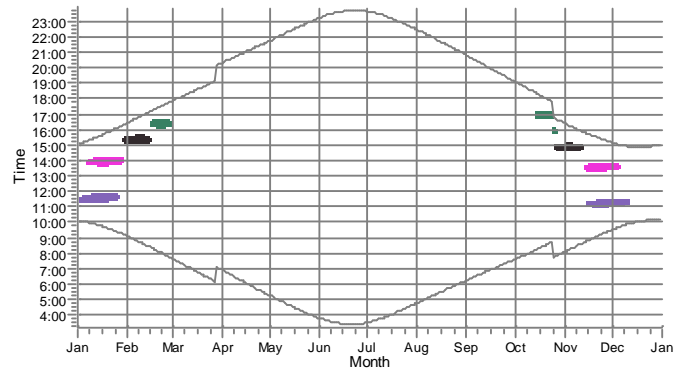
SHADOW - Calendar, graphical

Calculation: Kattiharju Nordex N131 x 45 x HH144_VE1 (no forest)

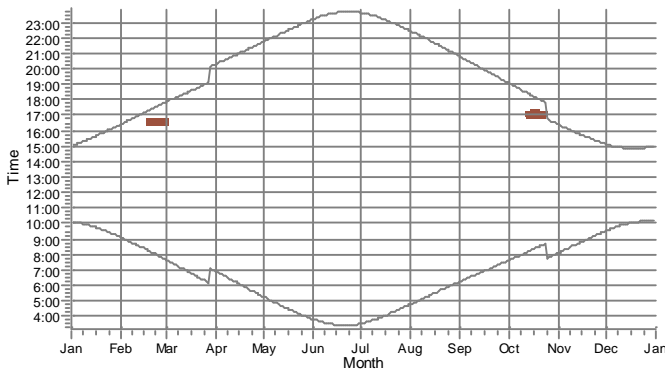
G: Asuinrakennus (Naarajoentie 385)



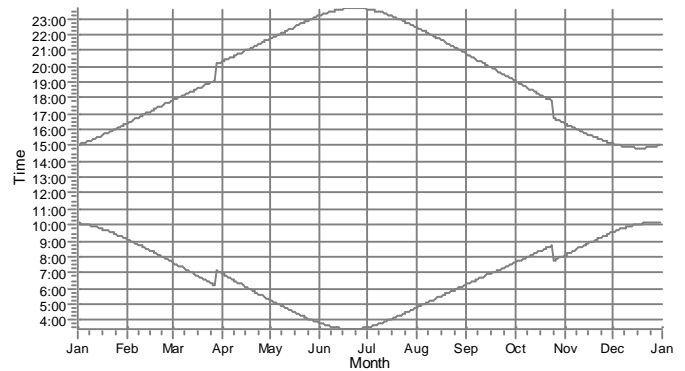
H: Asuinrakennus (Naarajoentie 534)



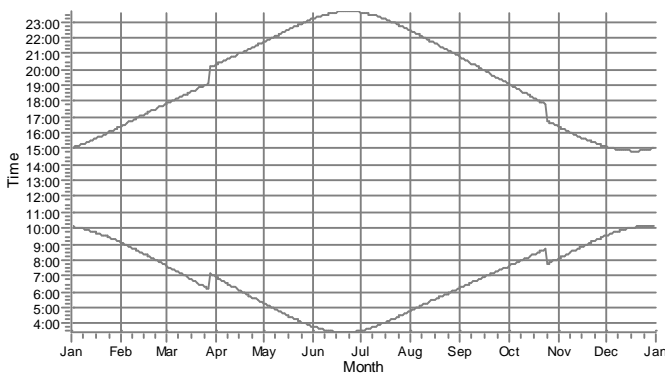
I: Asuinrakennus (Perätie 63)



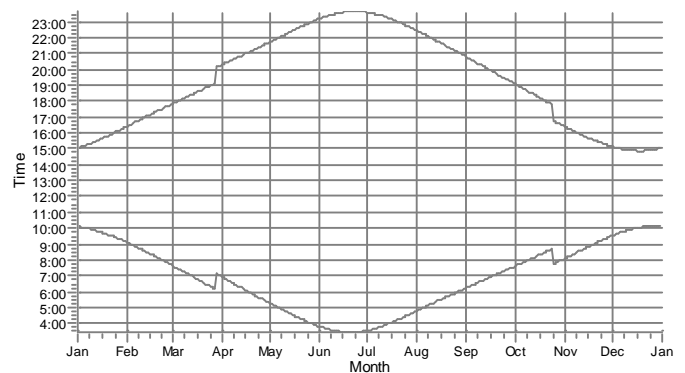
J: Asuinrakennus (Murrontie 99)










K: Lomarakennus (Vähäjärvi)



L: Lomarakennus (Poutunmäki)



WTGs

| | | | | | | | |
|---|------------|---|------------|---|-------------|---|------------|
|  | 29: WEA 55 |  | 33: WEA 62 |  | 38: WEA 101 |  | 44: WEA 74 |
|  | 31: WEA 60 |  | 36: WEA 69 |  | 39: WEA 109 | | |

Project:

Kattiharju

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Calculated:

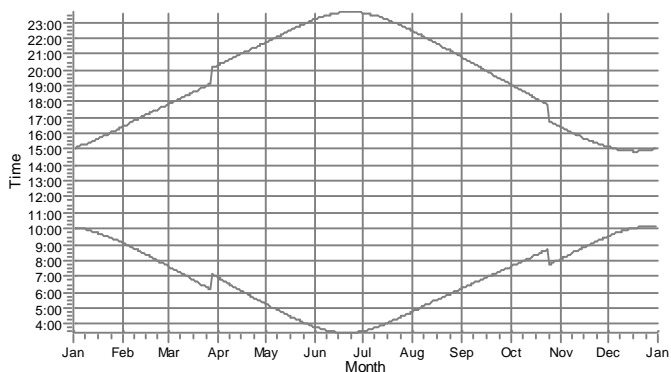
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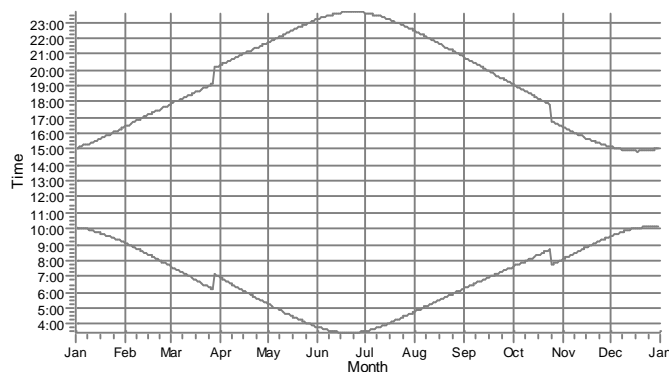
SHADOW - Calendar, graphical

Calculation: Kattiharju Nordex N131 x 45 x HH144_VE1 (no forest)

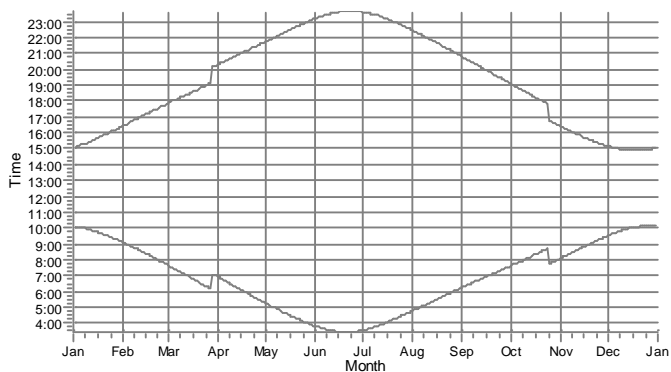
M: Asuinrakennus (Kinnartammentie 110)



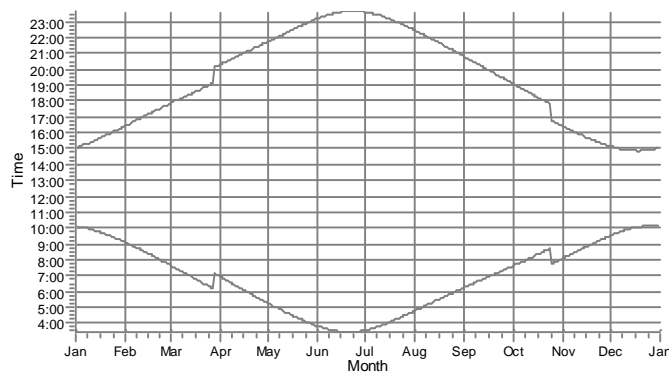
N: Lomarakennus (Kinnartammentie 215)



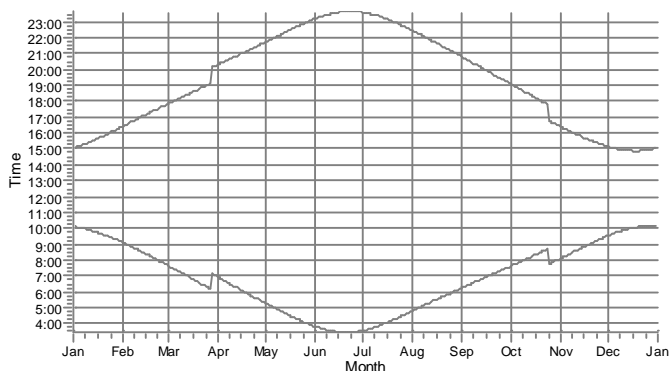
O: Asuinrakennus (Åbergintie 665)



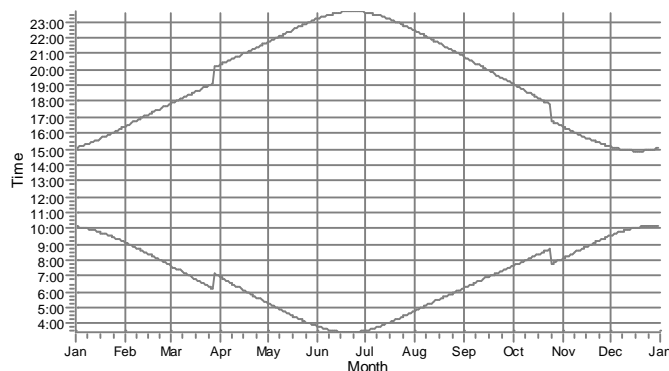
P: Asuinrakennus (Karjanmaantie 88)



Q: Asuinrakennus (Fronkantie 224)



R: Asuinrakennus (Konnonperäntie, Hakomäki)



WTGs

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Kattiharju

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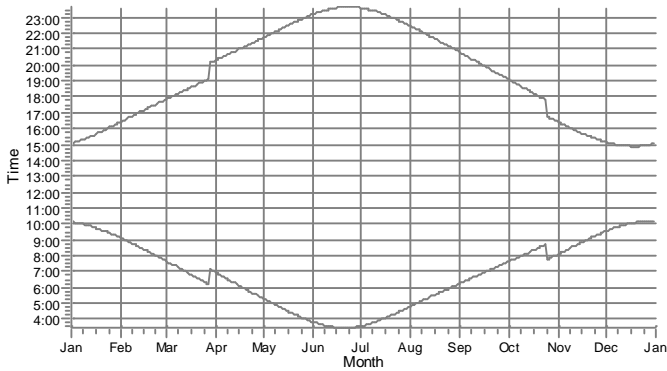


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Calculated:
10.10.2014 9:39/2.8.579

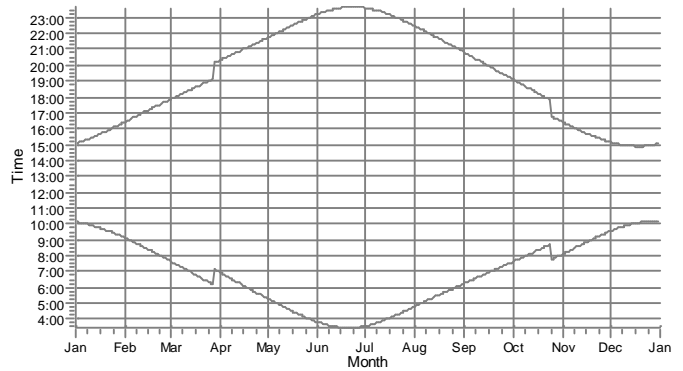
SHADOW - Calendar, graphical

Calculation: Kattiharju Nordex N131 x 45 x HH144_VE1 (no forest)

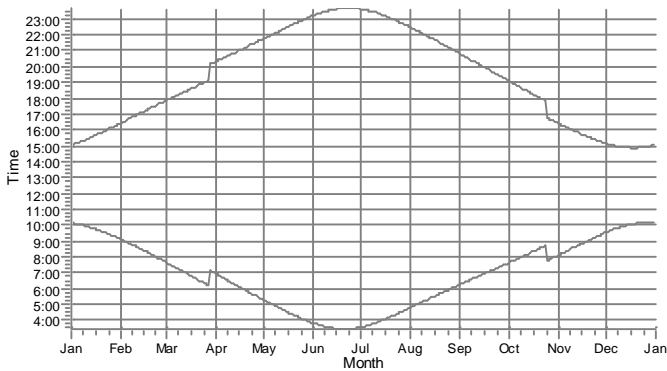
S: Asuinrakennus (Konnonperäntie 106)



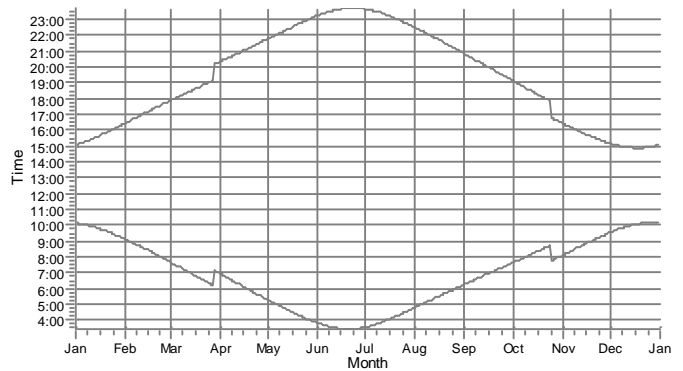
T: Asuinrakennus (Tampereentie 1584)



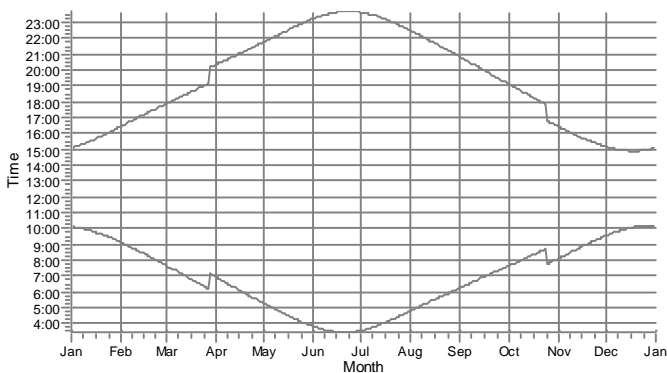
U: Asuinrakennus (Malkmäentie 178)



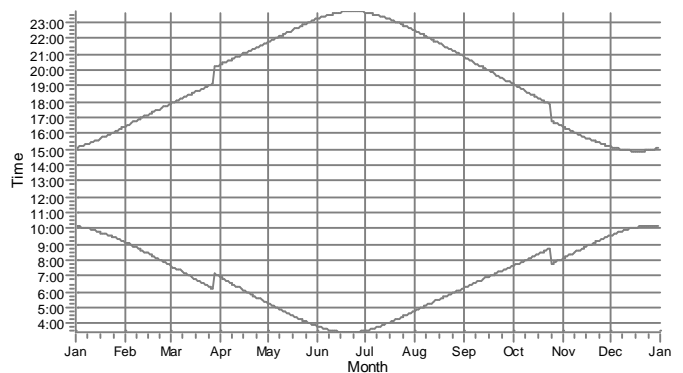
V: Asuinrakennus (Sahakuja 25)



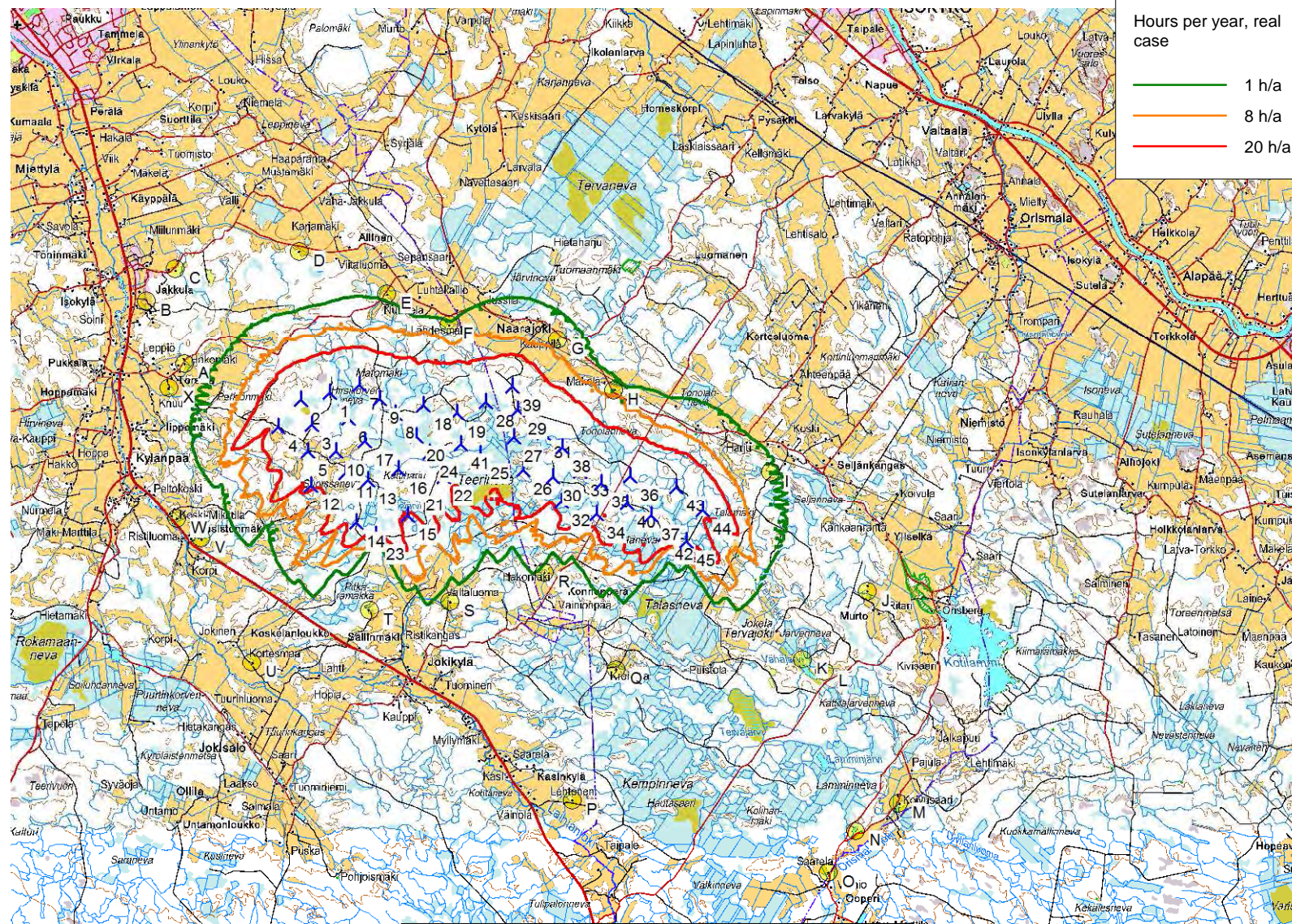
W: Asuinrakennus (Tampereentie 1160)



X: Asuinrakennus (Torstilanatie 99)



WTGs



Hours per year, real case

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

Project:
Kattiharju

SHADOW - Map Calculation:
 Kattiharju Nordex N131 x 45 x HH144_VE1 (no forest)

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 Hans Vadback / hans.vadback@fcg.fi

Calculated:
 10.10.2014 9:39/2.8.579



Map: Maastokartta 1_100 000 , Print scale 1:120 000, Map center Finish TM ETRS-TM35FIN-ETRS89 East: 259 000 North: 6 983 000

New WTG Shadow receptor

Flicker map level: Height Contours: Kattiharju height contour lines.wpo (1)

Project:

Kattiharju

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Calculated:

10.10.2014 10:46/2.8.579



SUUNNITTELU JA TEKNIikka

SHADOW - Main Result

Calculation: Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

Assumptions for shadow calculations

Maximum distance for influence

Calculate only when more than 20 % of sun is covered by the blade

Please look in WTG table

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

Sunshine probability S (Average daily sunshine hours) [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_N63.000

Operational time

| | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|------|------|-----|-----|-----|-----|------|
| N | NNE | ENE | E | ESE | SSE | S | SSW | WSW | W | WNW | NNW | Sum |
| 734 | 529 | 428 | 418 | 546 | 822 | 1041 | 1206 | 883 | 767 | 618 | 643 | 8635 |

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: Kattiharju height contour lines.wpo (1

Obstacles not used in calculation

Eye height: 1,5 m

Grid resolution: 10,0 m



Scale 1:175 000

▲ New WTG

● Shadow receptor

WTGs

| | Finish TM ETRS-TM35FIN-ETRS89 | | | | WTG type | Valid | Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | Shadow data | |
|----|-------------------------------|-----------|------|------------------|----------|--------|-----------------|----------------|--------------|----------------|------------|----------------------|-------|
| | East | North | Z | Row | | | | | | | | Calculation distance | RPM |
| | | | | | | | | | [kW] | [m] | [m] | [m] | [RPM] |
| | | | | data/Description | | | | | | | | | |
| | | | | [m] | | | | | | | | | |
| 1 | 253 483 | 6 985 584 | 45,0 | WEA 10 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 2 | 252 916 | 6 985 443 | 44,3 | WEA 11 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 3 | 253 135 | 6 984 959 | 47,5 | WEA 12 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 4 | 252 479 | 6 984 909 | 42,5 | WEA 13 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 5 | 253 058 | 6 984 432 | 40,0 | WEA 19 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 6 | 253 845 | 6 985 076 | 45,0 | WEA 20 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 7 | 254 057 | 6 985 724 | 48,5 | WEA 21 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 8 | 254 763 | 6 985 166 | 45,1 | WEA 22 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 9 | 254 459 | 6 985 451 | 47,5 | WEA 23 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 10 | 253 599 | 6 984 443 | 42,5 | WEA 24 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 11 | 253 787 | 6 984 016 | 43,3 | WEA 25 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 12 | 253 107 | 6 983 769 | 40,0 | WEA 26 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 13 | 254 222 | 6 983 867 | 42,5 | WEA 31 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 14 | 254 003 | 6 983 038 | 46,1 | WEA 32 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 15 | 255 682 | 6 983 430 | 47,5 | WEA 36 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 16 | 255 007 | 6 983 175 | 48,8 | WEA 37 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 17 | 254 821 | 6 984 085 | 42,5 | WEA 38 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 18 | 254 170 | 6 984 626 | 42,5 | WEA 39 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 19 | 255 310 | 6 985 328 | 50,0 | WEA 40 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 20 | 255 973 | 6 985 180 | 51,9 | WEA 43 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 21 | 255 175 | 6 984 732 | 46,2 | WEA 44 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 22 | 255 158 | 6 983 743 | 47,5 | WEA 45 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 23 | 255 710 | 6 983 927 | 47,5 | WEA 46 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 24 | 255 963 | 6 982 989 | 50,0 | WEA 47 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 25 | 254 386 | 6 982 785 | 47,5 | WEA 48 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 26 | 256 274 | 6 983 739 | 47,5 | WEA 49 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 27 | 255 439 | 6 984 410 | 46,8 | WEA 50 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 28 | 256 430 | 6 984 372 | 50,0 | WEA 51 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |
| 29 | 257 259 | 6 984 067 | 50,0 | WEA 52 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 | |

To be continued on next page...

Project:

Kattiharju

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Calculated:

10.10.2014 10:46/2.8.579

SHADOW - Main Result**Calculation:** Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

...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 [kW] | Rotor diameter [m] | Hub height [m] | Calculation distance [m] | RPM [RPM] |
| 30 | 257 074 | 6 984 715 | 50,0 | WEA 53 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 31 | 256 536 | 6 985 396 | 49,5 | WEA 54 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 32 | 257 149 | 6 985 250 | 50,0 | WEA 55 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 33 | 257 843 | 6 983 925 | 52,5 | WEA 57 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 34 | 257 959 | 6 984 530 | 50,0 | WEA 60 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 35 | 258 755 | 6 983 901 | 50,0 | WEA 61 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 36 | 259 320 | 6 984 035 | 47,5 | WEA 62 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 37 | 259 205 | 6 983 422 | 50,9 | WEA 63 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 38 | 259 929 | 6 982 929 | 52,2 | WEA 67 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 39 | 260 538 | 6 982 298 | 52,5 | WEA 69 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 40 | 260 737 | 6 982 137 | 47,5 | WEA 70 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 41 | 261 103 | 6 982 700 | 47,5 | WEA 72 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 42 | 261 740 | 6 982 675 | 47,5 | WEA 73 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 43 | 262 233 | 6 982 558 | 49,8 | WEA 74 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 44 | 261 705 | 6 982 137 | 47,5 | WEA 75 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 45 | 262 195 | 6 982 008 | 50,4 | WEA 76 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 46 | 262 840 | 6 981 837 | 52,5 | WEA 77 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 47 | 262 866 | 6 982 402 | 48,4 | WEA 78 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 48 | 260 800 | 6 979 979 | 57,5 | WEA 81 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 49 | 261 485 | 6 979 940 | 55,0 | WEA 82 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 50 | 261 870 | 6 979 436 | 52,5 | WEA 83 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 51 | 262 795 | 6 978 454 | 57,0 | WEA 84 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 52 | 262 181 | 6 978 319 | 55,0 | WEA 85 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 53 | 260 357 | 6 978 773 | 57,9 | WEA 86 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 54 | 260 825 | 6 979 306 | 57,5 | WEA 87 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 55 | 259 344 | 6 978 953 | 59,5 | WEA 89 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 56 | 259 933 | 6 979 041 | 56,4 | WEA 90 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 57 | 259 792 | 6 978 428 | 57,5 | WEA 91 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 58 | 261 602 | 6 977 880 | 60,0 | WEA 92 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 59 | 261 223 | 6 977 307 | 60,0 | WEA 93 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 60 | 262 213 | 6 977 614 | 57,5 | WEA 94 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 61 | 262 300 | 6 976 992 | 57,5 | WEA 95 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 62 | 261 707 | 6 976 926 | 59,1 | WEA 96 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 63 | 262 824 | 6 977 809 | 62,1 | WEA 97 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 64 | 258 348 | 6 984 079 | 52,5 | WEA 101 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 65 | 261 234 | 6 981 789 | 51,2 | WEA 104 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 66 | 261 805 | 6 981 354 | 50,0 | WEA 105 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 67 | 261 310 | 6 980 503 | 49,7 | WEA 107 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 68 | 260 573 | 6 983 399 | 45,0 | WEA 108 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 69 | 257 055 | 6 985 702 | 47,8 | WEA 109 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 70 | 256 038 | 6 984 579 | 50,0 | WEA 110 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 71 | 261 203 | 6 979 017 | 57,5 | WEA 111 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 72 | 259 639 | 6 983 326 | 47,5 | WEA 113 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 73 | 260 255 | 6 983 735 | 45,0 | WEA 114 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 74 | 262 352 | 6 981 257 | 51,3 | WEA 115 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |
| 75 | 262 788 | 6 980 882 | 50,0 | WEA 116 | Yes | NORDEX | N131/3000-3 000 | 3 000 | 131,0 | 144,0 | 1 721 | 10,3 |

Shadow receptor-Input

| No. | Name | Finish TM ETRS-TM35FIN-ETRS89 | | | | Height a.g.l. [m] | Degrees from south cw [°] | Slope of window [°] | Direction mode |
|-----|----------------------------------|-------------------------------|-----------|------|-------|-------------------|---------------------------|---------------------|--------------------|
| | | East | North | Z | Width | | | | |
| A | Asuinrakennus (Torstilantie 141) | 250 645 | 6 986 140 | 27,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| B | Asuinrakennus (Vatilo) | 249 902 | 6 987 373 | 23,7 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| C | Asuinrakennus (Allisentie 95) | 250 470 | 6 988 007 | 22,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| D | Asuinrakennus (Allisentie 393) | 252 879 | 6 988 341 | 22,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| E | Asuinrakennus (Torstilantie 627) | 254 594 | 6 987 512 | 27,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |
| F | Asuinrakennus (Naarajoentie 135) | 255 815 | 6 986 912 | 27,5 | 5,0 | 5,0 | 1,0 | 0,0 | "Green house mode" |

To be continued on next page...

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Kattiharju

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SHADOW - Main Result**Calculation:** Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

...continued from previous page

| No. | Name | Finish TM ETRS-TM35FIN-ETRS89 | | | | | | | | |
|-----|--|-------------------------------|-----------|------|-------|--------|------------------|--------------------------|--------------------|--------------------|
| | | East | North | Z | Width | Height | Height a.g.l. | Degrees from south cw | Slope of window | Direction mode |
| | | | | [m] | [m] | [m] | [m] | [°] | [°] | |
| G | Asuinrakennus (Naarajoentie 385) | 257 928 | 6 986 614 | 27,5 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| H | Asuinrakennus (Naarajoentie 534) | 259 029 | 6 985 627 | 32,1 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| I | Asuinrakennus (Perätie 63) | 262 098 | 6 984 027 | 40,0 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| J | Asuinrakennus (Murrontie 99) | 263 976 | 6 981 696 | 39,8 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| K | Lomarakennus (Vähäjärvi) | 262 717 | 6 980 366 | 47,5 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| L | Lomarakennus (Poutunmäki) | 263 150 | 6 980 129 | 50,1 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| M | Asuinrakennus (Kinnartammentie 110) | 264 590 | 6 977 562 | 47,5 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| N | Lomarakennus (Kinnartammentie 215) | 263 750 | 6 977 014 | 55,0 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| O | Asuinrakennus (Åbergintie 665) | 263 219 | 6 976 206 | 55,0 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| P | Asuinrakennus (Karjanmaantie 88) | 258 214 | 6 977 627 | 47,4 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| Q | Asuinrakennus (Fronkantie 224) | 259 077 | 6 980 164 | 52,8 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| R | Asuinrakennus (Konnonperäntie, Hakomäki) | 257 676 | 6 982 064 | 50,0 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| S | Asuinrakennus (Konnonperäntie 106) | 255 820 | 6 981 491 | 41,9 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| T | Asuinrakennus (Tampereentie 1584) | 254 255 | 6 981 325 | 42,5 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| U | Asuinrakennus (Malkamäentie 178) | 251 960 | 6 980 298 | 35,0 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| V | Asuinrakennus (Sahakuja 25) | 250 968 | 6 982 726 | 35,0 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| W | Asuinrakennus (Tampereentie 1160) | 250 495 | 6 983 107 | 30,2 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |
| X | Asuinrakennus (Torstiantie 99) | 250 345 | 6 985 669 | 26,8 | 5,0 | 5,0 | 1,0 | 0,0 | 0,0 | "Green house mode" |

Calculation Results

Shadow receptor

| No. | Name | Shadow, expected values | |
|-----|--|--------------------------------------|--|
| | | Shadow hours per year [h/year] | |
| A | Asuinrakennus (Torstiantie 141) | 0:00 | |
| B | Asuinrakennus (Vatilo) | 0:00 | |
| C | Asuinrakennus (Allisentie 95) | 0:00 | |
| D | Asuinrakennus (Allisentie 393) | 0:00 | |
| E | Asuinrakennus (Torstiantie 627) | 0:00 | |
| F | Asuinrakennus (Naarajoentie 135) | 2:54 | |
| G | Asuinrakennus (Naarajoentie 385) | 3:49 | |
| H | Asuinrakennus (Naarajoentie 534) | 4:45 | |
| I | Asuinrakennus (Perätie 63) | 7:10 | |
| J | Asuinrakennus (Murrontie 99) | 9:37 | |
| K | Lomarakennus (Vähäjärvi) | 11:19 | |
| L | Lomarakennus (Poutunmäki) | 4:56 | |
| M | Asuinrakennus (Kinnartammentie 110) | 0:00 | |
| N | Lomarakennus (Kinnartammentie 215) | 11:11 | |
| O | Asuinrakennus (Åbergintie 665) | 10:07 | |
| P | Asuinrakennus (Karjanmaantie 88) | 0:00 | |
| Q | Asuinrakennus (Fronkantie 224) | 4:24 | |
| R | Asuinrakennus (Konnonperäntie, Hakomäki) | 0:00 | |
| S | Asuinrakennus (Konnonperäntie 106) | 0:00 | |
| T | Asuinrakennus (Tampereentie 1584) | 0:00 | |
| U | Asuinrakennus (Malkamäentie 178) | 0:00 | |
| V | Asuinrakennus (Sahakuja 25) | 0:00 | |
| W | Asuinrakennus (Tampereentie 1160) | 0:00 | |
| X | Asuinrakennus (Torstiantie 99) | 0:00 | |

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

| No. | Name | Worst case [h/year] | Expected [h/year] |
|-----|--------|------------------------|----------------------|
| 1 | WEA 10 | 0:00 | 0:00 |
| 2 | WEA 11 | 0:00 | 0:00 |
| 3 | WEA 12 | 0:00 | 0:00 |
| 4 | WEA 13 | 0:00 | 0:00 |

To be continued on next page...

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SHADOW - Main Result

Calculation: Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

...continued from previous page

| No. | Name | Worst case [h/year] | Expected [h/year] |
|-----|---------|------------------------|----------------------|
| 5 | WEA 19 | 0:00 | 0:00 |
| 6 | WEA 20 | 0:00 | 0:00 |
| 7 | WEA 21 | 0:00 | 0:00 |
| 8 | WEA 22 | 0:00 | 0:00 |
| 9 | WEA 23 | 0:00 | 0:00 |
| 10 | WEA 24 | 0:00 | 0:00 |
| 11 | WEA 25 | 0:00 | 0:00 |
| 12 | WEA 26 | 0:00 | 0:00 |
| 13 | WEA 31 | 0:00 | 0:00 |
| 14 | WEA 32 | 0:00 | 0:00 |
| 15 | WEA 36 | 0:00 | 0:00 |
| 16 | WEA 37 | 0:00 | 0:00 |
| 17 | WEA 38 | 0:00 | 0:00 |
| 18 | WEA 39 | 0:00 | 0:00 |
| 19 | WEA 40 | 12:50 | 1:39 |
| 20 | WEA 43 | 0:00 | 0:00 |
| 21 | WEA 44 | 0:00 | 0:00 |
| 22 | WEA 45 | 0:00 | 0:00 |
| 23 | WEA 46 | 0:00 | 0:00 |
| 24 | WEA 47 | 0:00 | 0:00 |
| 25 | WEA 48 | 0:00 | 0:00 |
| 26 | WEA 49 | 0:00 | 0:00 |
| 27 | WEA 50 | 0:00 | 0:00 |
| 28 | WEA 51 | 0:00 | 0:00 |
| 29 | WEA 52 | 0:00 | 0:00 |
| 30 | WEA 53 | 0:00 | 0:00 |
| 31 | WEA 54 | 8:29 | 1:15 |
| 32 | WEA 55 | 10:21 | 1:27 |
| 33 | WEA 57 | 0:00 | 0:00 |
| 34 | WEA 60 | 8:31 | 1:36 |
| 35 | WEA 61 | 0:00 | 0:00 |
| 36 | WEA 62 | 13:25 | 1:43 |
| 37 | WEA 63 | 0:00 | 0:00 |
| 38 | WEA 67 | 0:00 | 0:00 |
| 39 | WEA 69 | 0:00 | 0:00 |
| 40 | WEA 70 | 0:00 | 0:00 |
| 41 | WEA 72 | 8:32 | 1:16 |
| 42 | WEA 73 | 18:09 | 2:21 |
| 43 | WEA 74 | 17:43 | 2:17 |
| 44 | WEA 75 | 0:00 | 0:00 |
| 45 | WEA 76 | 0:00 | 0:00 |
| 46 | WEA 77 | 12:48 | 2:45 |
| 47 | WEA 78 | 15:44 | 4:03 |
| 48 | WEA 81 | 0:00 | 0:00 |
| 49 | WEA 82 | 14:49 | 2:51 |
| 50 | WEA 83 | 20:31 | 4:00 |
| 51 | WEA 84 | 17:12 | 2:12 |
| 52 | WEA 85 | 0:00 | 0:00 |
| 53 | WEA 86 | 0:00 | 0:00 |
| 54 | WEA 87 | 0:00 | 0:00 |
| 55 | WEA 89 | 18:13 | 2:30 |
| 56 | WEA 90 | 9:49 | 1:53 |
| 57 | WEA 91 | 0:00 | 0:00 |
| 58 | WEA 92 | 0:00 | 0:00 |
| 59 | WEA 93 | 0:00 | 0:00 |
| 60 | WEA 94 | 6:49 | 1:26 |
| 61 | WEA 95 | 37:42 | 10:02 |
| 62 | WEA 96 | 7:04 | 1:34 |
| 63 | WEA 97 | 29:17 | 8:20 |
| 64 | WEA 101 | 10:46 | 1:24 |
| 65 | WEA 104 | 0:00 | 0:00 |

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SHADOW - Main Result

Calculation: Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

...continued from previous page

| No. | Name | Worst case [h/year] | Expected [h/year] |
|-----|---------|------------------------|----------------------|
| 66 | WEA 105 | 18:28 | 5:22 |
| 67 | WEA 107 | 8:09 | 1:44 |
| 68 | WEA 108 | 5:55 | 1:11 |
| 69 | WEA 109 | 11:49 | 2:20 |
| 70 | WEA 110 | 0:00 | 0:00 |
| 71 | WEA 111 | 0:00 | 0:00 |
| 72 | WEA 113 | 0:00 | 0:00 |
| 73 | WEA 114 | 0:00 | 0:00 |
| 74 | WEA 115 | 5:33 | 1:04 |
| 75 | WEA 116 | 8:26 | 1:43 |

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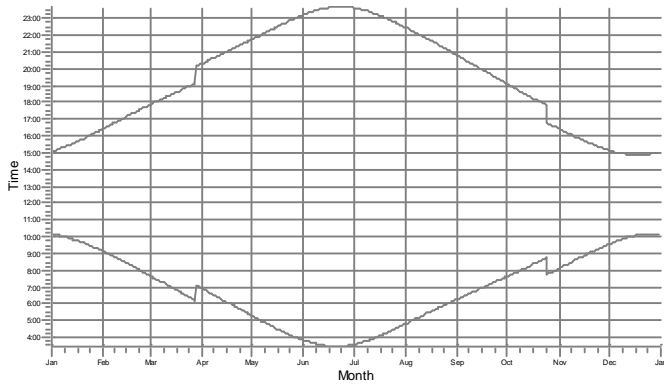


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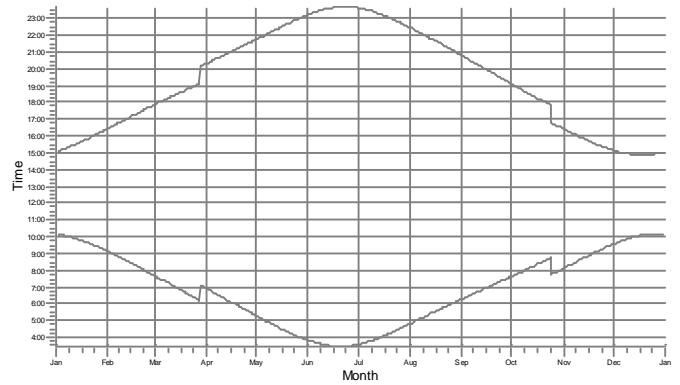
SHADOW - Calendar, graphical

Calculation: Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

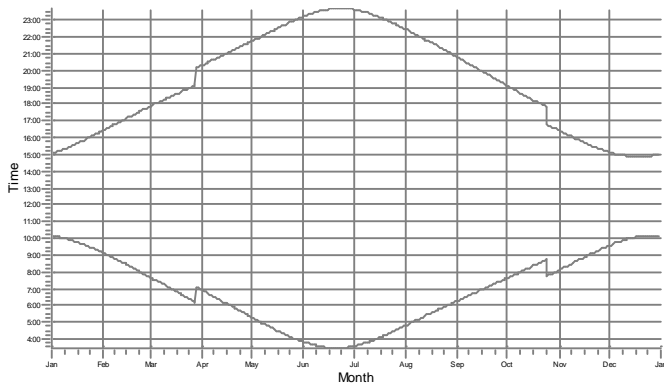
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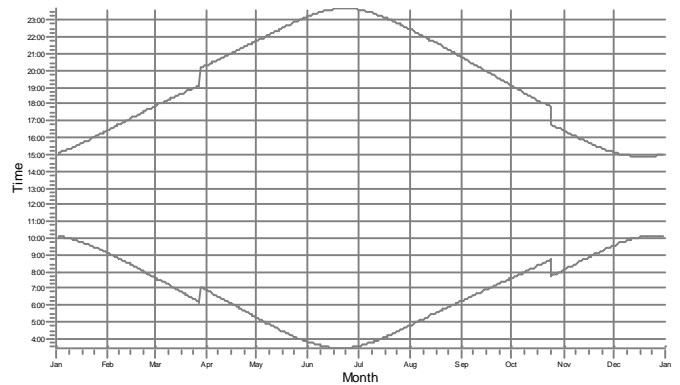
B: Asuinrakennus (Vatilo)



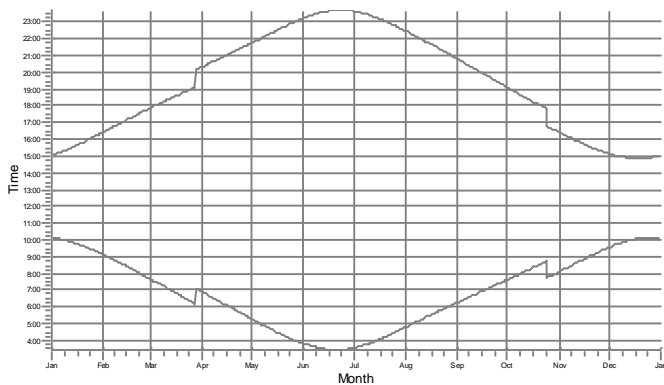
C: Asuinrakennus (Allisentie 95)



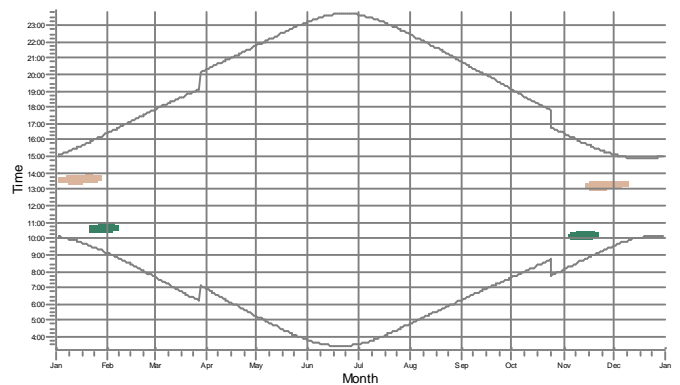
D: Asuinrakennus (Allisentie 393)



E: Asuinrakennus (Torstiantie 627)



F: Asuinrakennus (Naarajontie 135)



WTGs

19: WEA 40 31: WEA 54

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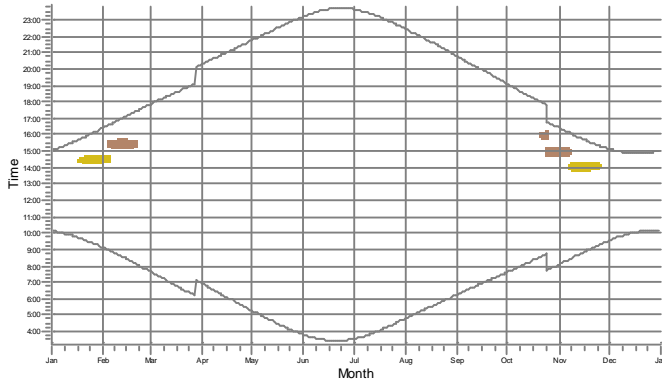


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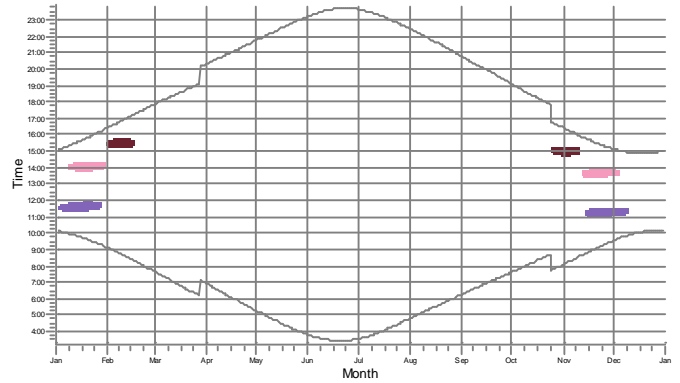
SHADOW - Calendar, graphical

Calculation: Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

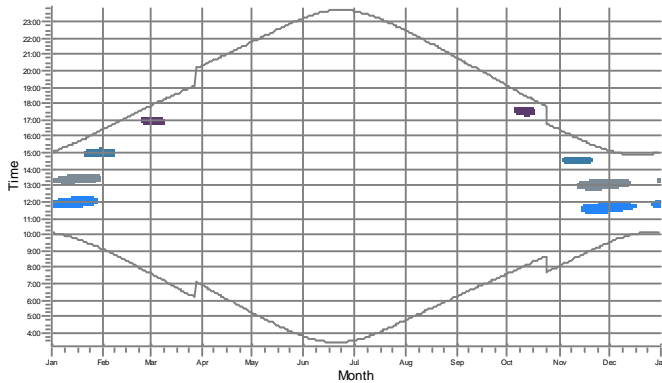
G: Asuinrakennus (Naarajoentie 385)



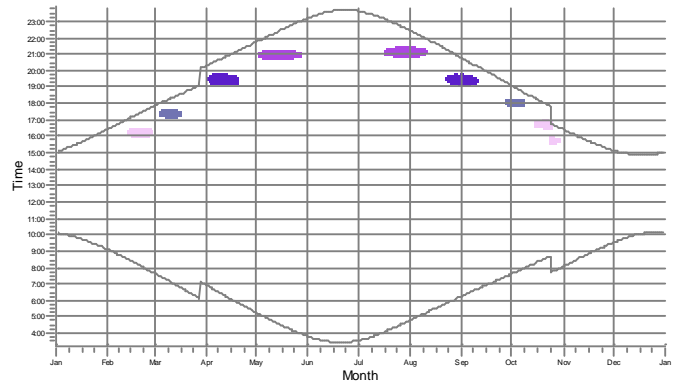
H: Asuinrakennus (Naarajoentie 534)



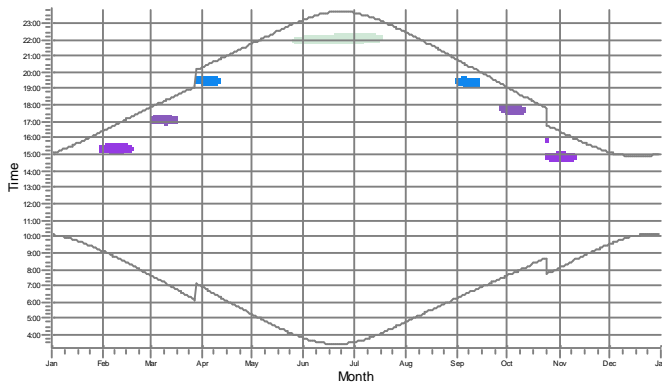
I: Asuinrakennus (Perätie 63)



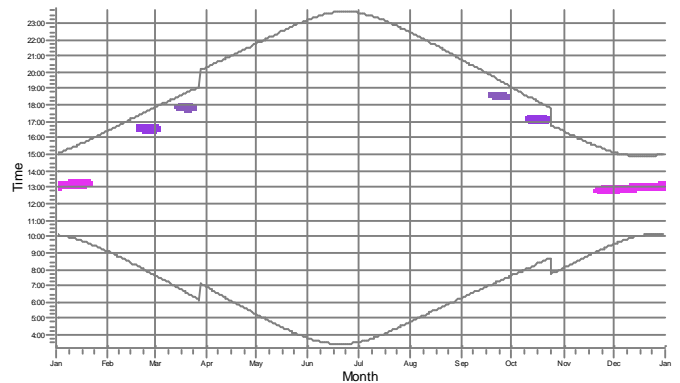
J: Asuinrakennus (Murrantie 99)



K: Lomarakennus (Vähäjärvi)



L: Lomarakennus (Poutunmäki)



WTGs

| | | | | | |
|------------|------------|------------|-------------|-------------|-------------|
| 32: WEA 55 | 41: WEA 72 | 46: WEA 77 | 50: WEA 83 | 66: WEA 105 | 69: WEA 109 |
| 34: WEA 60 | 42: WEA 73 | 47: WEA 78 | 51: WEA 84 | 67: WEA 107 | 74: WEA 115 |
| 36: WEA 62 | 43: WEA 74 | 49: WEA 82 | 64: WEA 101 | 68: WEA 108 | 75: WEA 116 |

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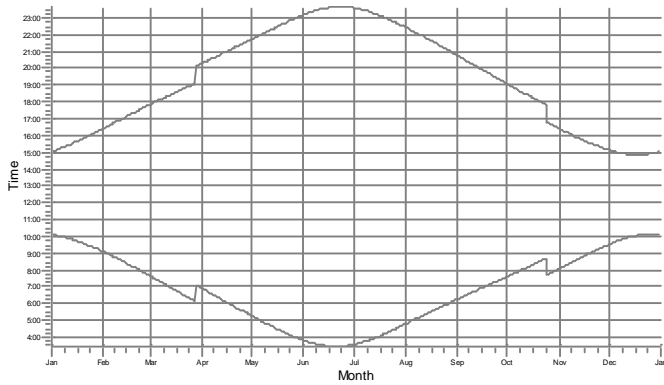


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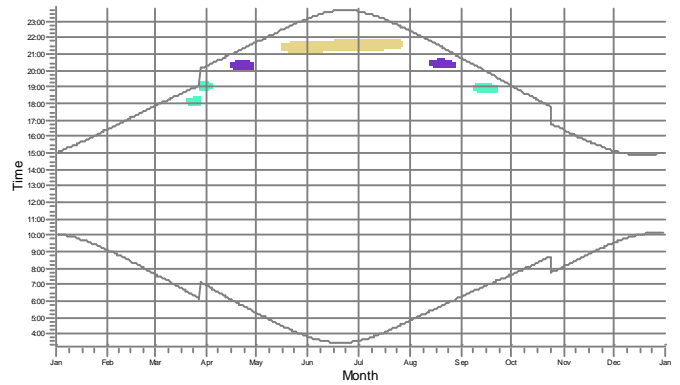
SHADOW - Calendar, graphical

Calculation: Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

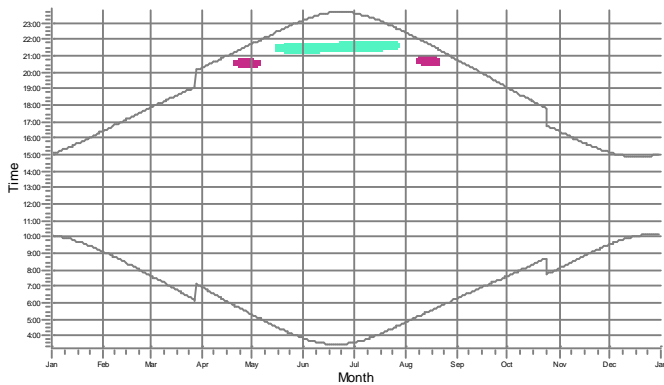
M: Asuinrakennus (Kinnartammentie 110)



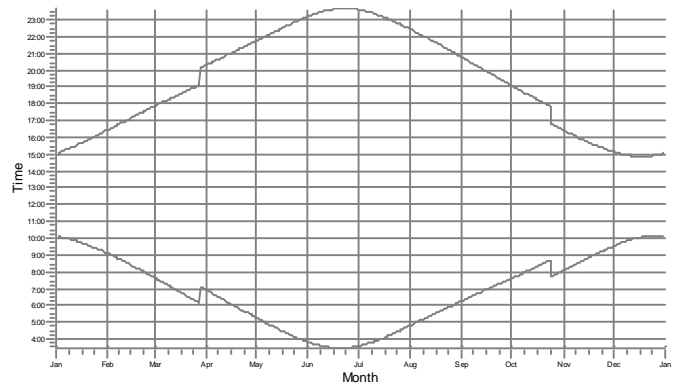
N: Lomarakennus (Kinnartammentie 215)



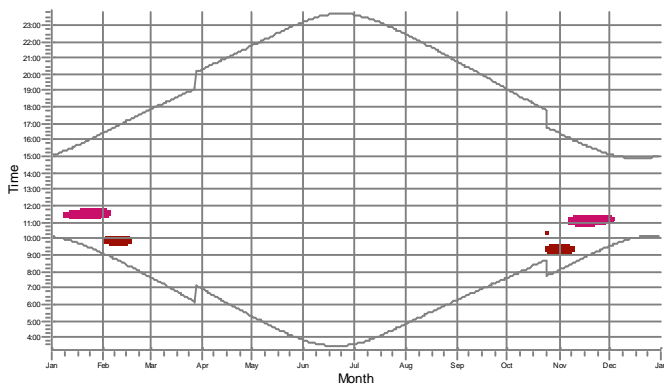
O: Asuinrakennus (Åbergintie 665)



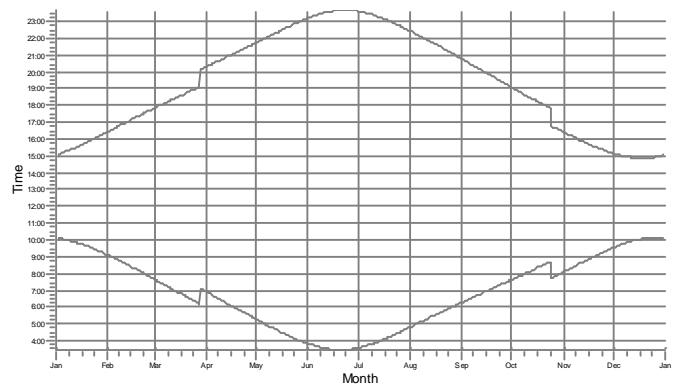
P: Asuinrakennus (Karjanmaantie 88)



Q: Asuinrakennus (Fronkantie 224)



R: Asuinrakennus (Konnonperäntie, Hakomäki)



WTGs

- 55: WEA 89
- 56: WEA 90
- 60: WEA 94
- 61: WEA 95
- 62: WEA 96
- 63: WEA 97

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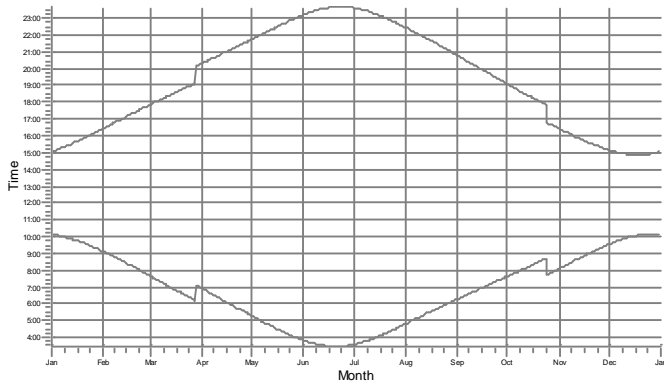


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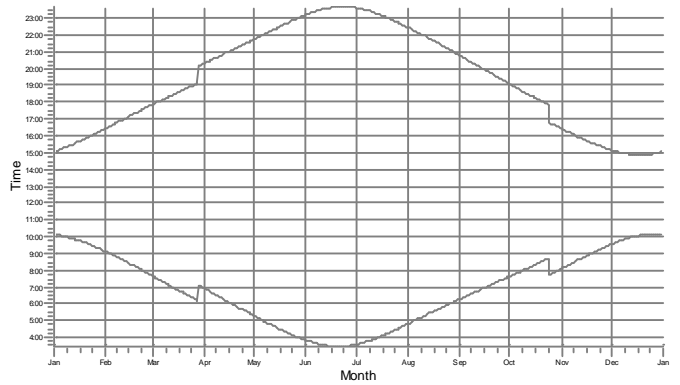
SHADOW - Calendar, graphical

Calculation: Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

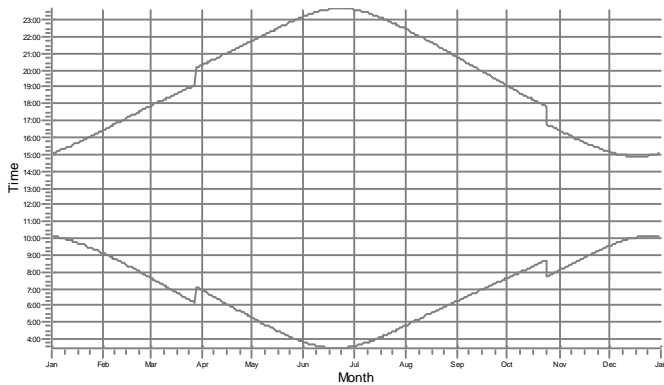
S: Asuinrakennus (Konnonperäntie 106)



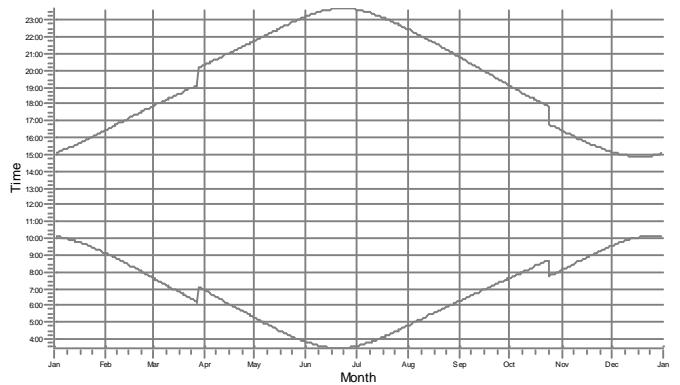
T: Asuinrakennus (Tampereentie 1584)



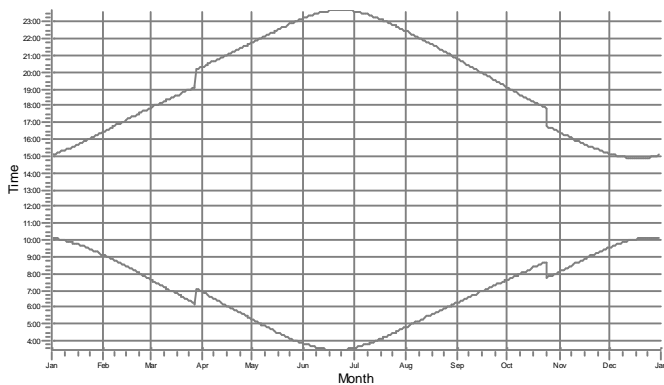
U: Asuinrakennus (Malkamäentie 178)



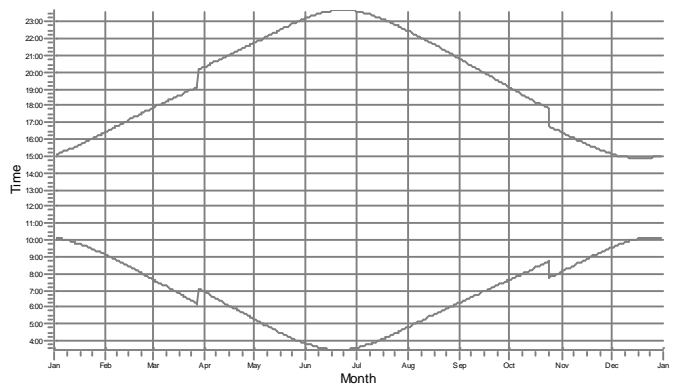
V: Asuinrakennus (Sahakuja 25)



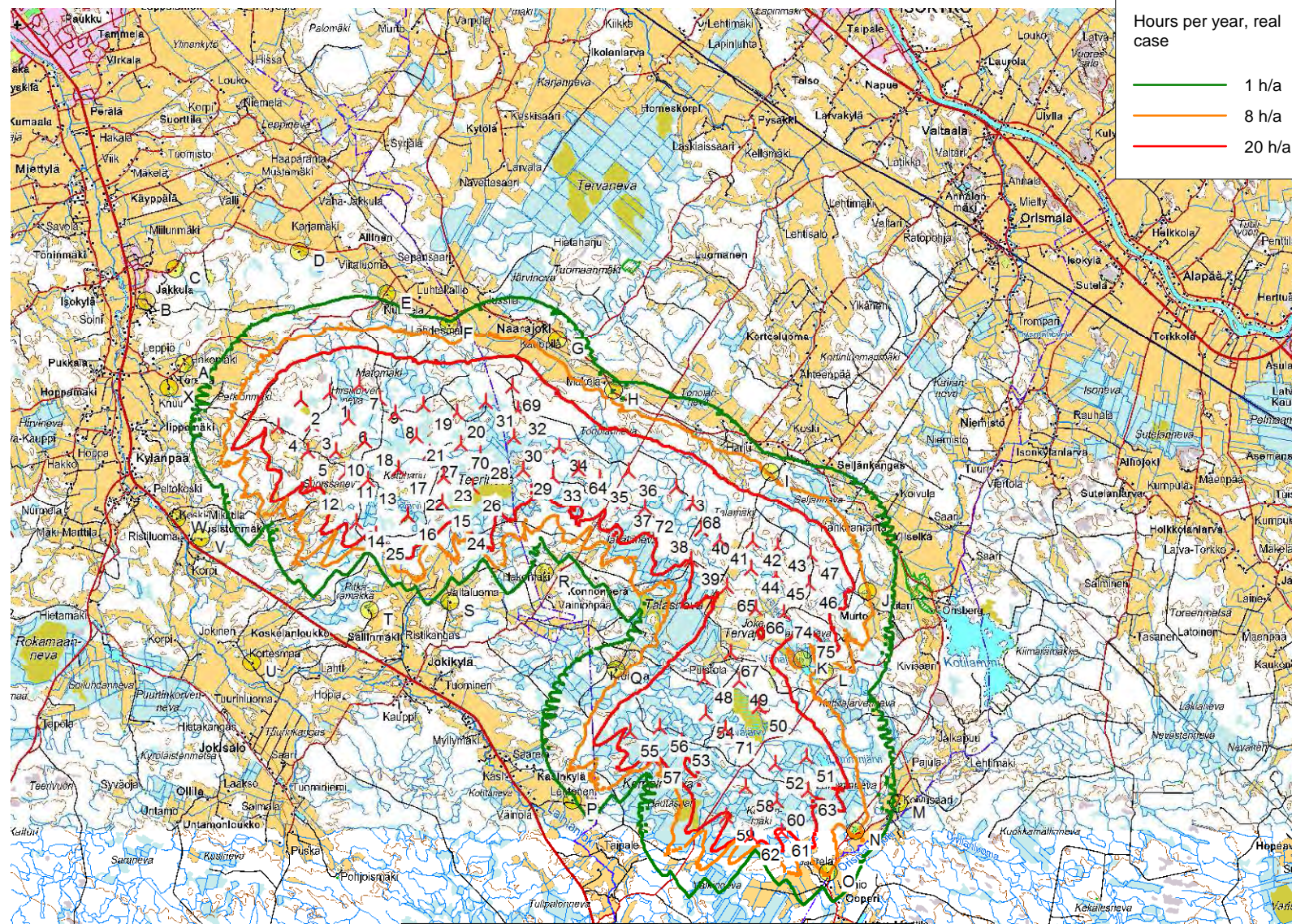
W: Asuinrakennus (Tampereentie 1160)



X: Asuinrakennus (Torstiantie 99)



WTGs



Hours per year, real case

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

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SHADOW - Map Calculation:
 Kattiharju Nordex N131 x 75 x HH144_VE2 (no forest)

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Map: Maastokartta 1_100 000 , Print scale 1:120 000 , Map center Finish TM ETRS-TM35FIN-ETRS89 East: 259 000 North: 6 983 000

▲ New WTG
 ● Shadow receptor

Flicker map level: Height Contours: Kattiharju height contour lines.wpo (1)