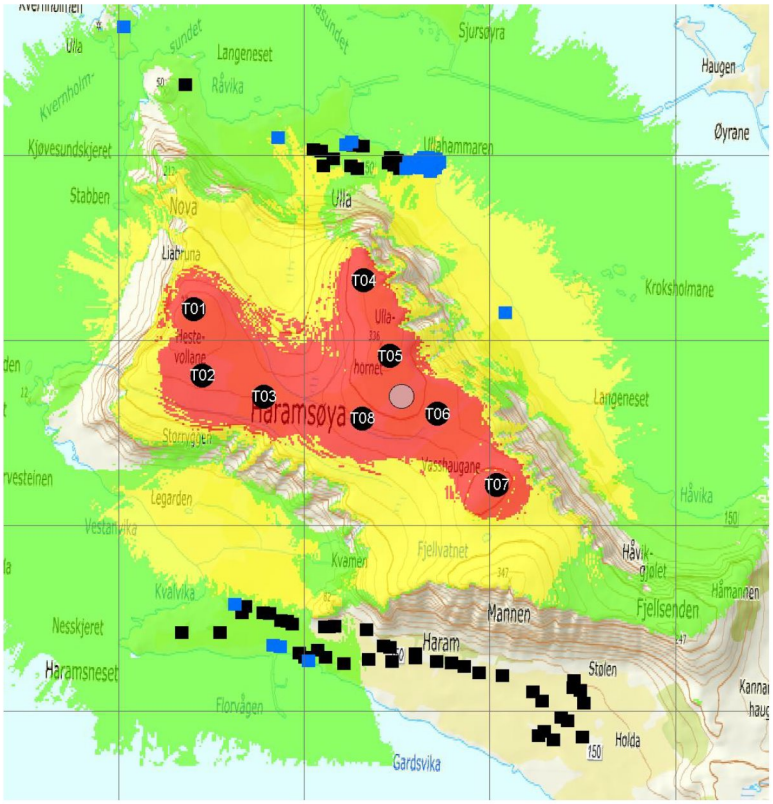
KJELLER VINDTEKNIKK

Haramsfjellet, Sunnmøre Municipality, Møre og Romsdal, Norway

Noise and shadow calculation

Report number: KVT/MEH/2018/R119 Rev4



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Objectives

The main objective of this study is to calculate the noise level and shadow flickering generated by the planned Haramsfjellet wind farm. The layout used in the present study consists of 8 Vestas V136-4.2 MW turbines with a hub height of 82 m. Results are given as a noise map and shadow flickering map of the surrounding area. There are also tables covering the noise and shadow sensitive locations.

This report has been subject to a comprehensive quality control according to Kjeller Vindteknikk's quality assessment system.

Revision history

Rev. number	Date	Number of copies	Comment	Distribution
0	23.11.2018	Electronic	Final	Client
1	21.12.2018	Electronic	Updated list of noise sensitive locations. Added shadow calculations and list of shadow sensitive locations. Energy loss estimation is calculated.	Client
2	01.02.2019	Electronic	Highlighting all NSA over sound limit. Shorten shadow calculations.	Client
3	15.03.2019	Electronic	Updated Sound Curve and Power Curve for mode P01 with high wind operation. Updated Power Curve for mode S01 with high wind operation,	Client
4	29.03.2019	Electronic	Real Case Noise calculation for PO1. Detailed maps.	Client

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Contents

1 Summary and conclusions

The noise and shadow generated by the turbines planned to be installed in the Haramsfjellet wind farm has been calculated. A layout composed by 8 Vestas V136-4.2 MW wind turbines has been considered. Two different power modes has been used for the calculations; one is optimized for power production (PO1) and the other is optimized with respect to noise restrictions (SO1). The turbines run in High Wind Operation (HWO) which means a nominal power of 4.2 MW for the power optimized mode (PO1, HWO) and 4.0 MW for the sound optimized mode (SO1, HWO). The information about the mode settings have been provided by the client. The turbines have a hub height of 82 m, and a total tip height of 150 m. The applied turbine has a noise source level of 103.9 dB(A) in mode PO1 (HWO) and 102.0 dB(A) in mode SO1 (HWO), both at 8 m/s at 10 m height. The wind farm layouts, the noise and shadow sensitive locations are presented in Figure 1-1.

The noise calculations are carried out using the Nord2000 noise propagation model implemented in WindPRO and a constant terrain type of D (Crop field spring, autumn, grass (normal)). With this input, the noise level generated by the turbines exceeds the L_{den} 45 dB(A) limit for 5 houses in mode PO1 and for 1 house for mode SO1 for worst case calculations. When real case calculations are carried out, the noise level is not exceeding L_{den} 45 dB(A) at any house.

The shadow flickering has been calculated using WindPRO. The Norwegian recommendations require maximum expected shadow flickering to be below 8 h/year and maximum daily shadow flicker to be below 30 minutes per day. At least one of these criteria is exceeded for 38 houses. The calculations are also done with sun probability values specific to the area close to Haramsfjellet.

In order to keep the expected shadow flickering level below the allowed limit for all receptors, it will be necessary to install an automatic regulation system on the turbines, a so called shadow counter. The estimated shadow curtailment loss with shadow counter on the turbines when using the specific sun probabilities are close to zero. A curtailment loss of 0.1 % is estimated for the worst case without shadow counters on the turbines.

The energy loss for the worst case is estimated. The energy loss when using SO1 (HWO) instead of PO1 (HWO) to fulfill noise restrictions is 4.5 %. If a SO1 mode is only applied for sectors 150°-280°, corresponding to upwind conditions for the most affected houses, the loss is reduced to 3.3 %.

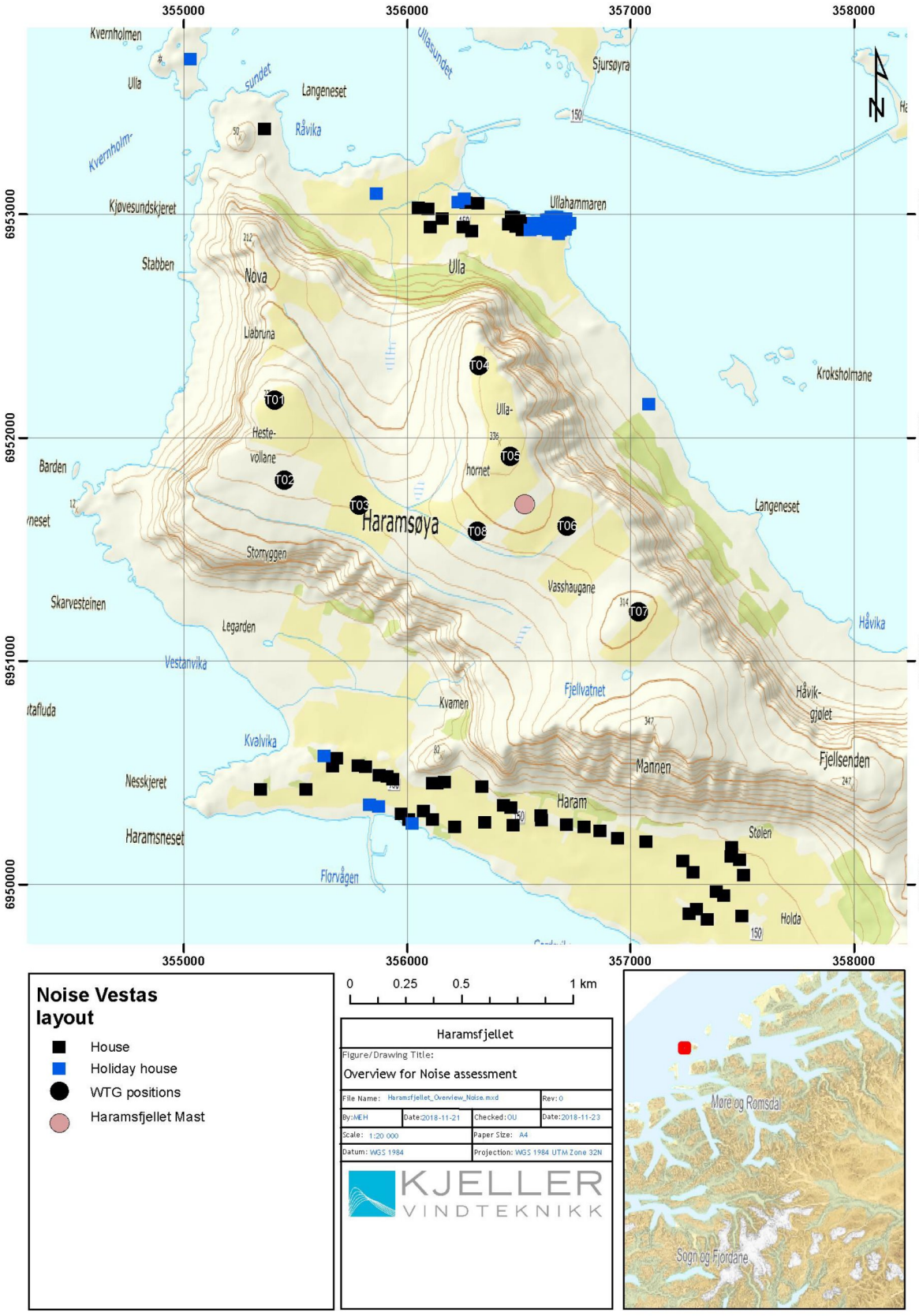

Figure 1-1 Vestas developed layout consisting of 8 Vestas V136 wind turbines. The surrounding noise sensitive locations of houses and holiday houses are also shown.

2 Noise calculations

2.1 Methodology

The noise calculations have been performed using the Nord2000 module available through the WindPRO 3.2.737 software (EMD, 2018). This is an advanced methodology originally developed for traffic noise, but in the later years it has also been used for calculations of noise from wind turbines. The methodology takes the topography, the terrain surface properties, the frequency spectrum of the noise and meteorological parameters into account. It is also possible to do calculations with regards to different wind directions.

According to the noise emission regulations T-1442/2016 defined by Miljøverndepartementet, all noise calculations for wind turbines shall be performed for a wind speed of 8 m/s at 10 m height (Miljødirektoratet, 2018) (Klima- og Miljødepartementet, 2016). The reason is that the noise generated by a wind turbine is expected to be loudest at this wind speed, and that the background ambient noise is expected to exceed the noise from the wind turbines at higher wind speeds.

The Norwegian regulations define two different zones of noise levels. These are the following:

- **Red zone.** Zone closest to the noise source. This zone is not suitable for noise sensitive use. According to the regulations defined in T-1442/2016 (Klima- og Miljødepartementet, 2016), the L_{den} noise limit for this zone is 55 dB(A).

- **Yellow zone.** This noise zone is dependent on the activity developed inside the zone. According to the regulations T-1442/2016 (Klima- og Miljødepartementet, 2016), the L_{den} noise limit for this zone is 45 dB(A).

The L_{den} value is defined as the noise level calculated for an annual period and weighted for day-evening-night (den) with a 5 dB(A) weight factor for evening (19-23), and a 10 dB(A) weight factor for night (23-07). The regulation also requires an assumption of continuous operation. In Haramsfjellet wind farm no turbines are operated in modes that depends on the time of the day. The correction going from dB(A) to dB(A) L_{den} then corresponds to an addition of 6.4 dB(A) to the results.

The above described methodology is the worst case simulation which is the main decision basis (Miljødirektoratet, 2018).

2.2 Methodology, real case

In the real case methodology the frequency distribution for wind direction and wind speeds is applied (Miljødirektoratet, 2018) (EMD, 2018). The calculated noise is the average expected L_{DEN} noise level (EMD), which is the noise level obtained with 50 % probability.

2.3 Input data

The noise level has been calculated for a layout consisting of 8 Vestas V136 4.2 MW turbines. First, noise calculations are made using power optimized (PO1) power curves in high wind operation (HWO) and sound emission data. Secondly, noise calculations are made using sound optimized (SO1) power curves in HWO and sound emission data, but then the turbines are

running as 4.0MW turbines instead of 4.2MW. The main characteristics of the layout are presented in Table 2-1.

Table 2-1: Main characteristics of the layout considered in this study.

Layout	No wtgs	Turbine model	Nominal power	Rotor diameter	Hub height	Upper tip height
Vestas layout	8	V136	4.2 MW (PO1) 4.0 MW (SO1)	136 m	82 m	150 m

The octave data for the considered turbine model has been provided by the Client (Vestas Wind Systems A/S, 2018), and is given for Power optimized mode PO1 (HWO) in Table 2-2 and sound optimized mode SO1 (HWO) in Table 2-3. The used noise source level for noise estimates covering 8 m/s at 10 m height is the value at 11.0 m/s at hub height.

Table 2-2: Octave data for different wind speed levels at hub height for power optimized mode (PO1,HWO).

Wind speed [m/s]	**63Hz [dB(A)]**	**125Hz [dB(A)]**	**250Hz [dB(A)]**	**500Hz [dB(A)]**	**1kHz [dB(A)]**	**2kHz [dB(A)]**	**4kHz [dB(A)]**	**8kHz [dB(A)]**	**Total [dB(A)]**
3	71.5	79.3	84.2	86.1	85.0	80.9	73.8	63.6	90.9
4	71.6	79.5	84.4	86.3	85.2	81.0	73.9	63.7	91.1
5	73.3	81.3	86.2	88.1	86.9	82.7	75.4	65.0	92.9
6	76.5	84.5	89.3	91.2	90.0	85.8	78.6	68.3	96.0
7	80.2	88.1	93.0	94.8	93.6	89.4	82.2	71.9	99.6
8	83.7	91.4	96.2	97.9	96.8	92.7	85.7	75.5	102.8
9	84.8	92.5	97.2	99.0	97.9	93.8	86.9	76.8	103.9
10	84.9	92.5	97.2	99.0	97.9	93.8	86.9	76.9	103.9
11	84.9	92.6	97.2	99.0	97.9	93.8	87.0	77.1	103.9
12	85.0	92.6	97.2	99.0	97.9	93.9	87.0	77.3	103.9
13	85.2	92.6	97.2	99.0	97.9	93.9	87.2	77.5	103.9
14	85.3	92.6	97.2	98.9	97.9	94.0	87.3	77.8	103.9
15	85.3	92.6	97.2	98.9	97.9	94.0	87.5	78.1	103.9
16	85.5	92.7	97.2	98.9	97.9	94.1	87.6	78.3	103.9
17	85.5	92.7	97.2	98.9	97.9	94.1	87.7	78.5	103.9
18	85.6	92.8	97.2	98.9	97.9	94.2	87.8	78.7	103.9
19	85.7	92.8	97.1	98.8	97.9	94.2	87.9	78.8	103.9
20	85.8	92.8	97.1	98.8	97.9	94.2	88.0	79.0	103.9

Table 2-3: Octave data for different wind speed levels at hub height for sound optimized mode (SO1, HWO).

Wind speed [m/s]	63Hz [dB(A)]	125Hz [dB(A)]	250Hz [dB(A)]	500Hz [dB(A)]	1kHz [dB(A)]	2kHz [dB(A)]	4kHz [dB(A)]	8kHz [dB(A)]	Total [dB(A)]
3	71.5	79.3	84.2	86.1	85.0	80.9	73.8	63.6	90.9
4	71.6	79.5	84.4	86.3	85.2	81.0	73.9	63.7	91.1
5	73.2	81.2	86.1	88.0	86.8	82.6	75.3	64.9	92.8
6	76.4	84.4	89.2	91.1	89.9	85.7	78.5	68.1	95.9
7	80.0	87.9	92.8	94.6	93.4	89.2	82.0	71.7	99.4
8	82.3	90.1	94.9	96.7	95.5	91.4	84.4	74.2	101.5
9	82.6	90.4	95.3	97.1	95.9	91.7	84.5	74.3	101.9
10	82.6	90.3	95.2	97.0	95.8	91.7	84.6	74.4	101.8
11	82.9	90.6	95.3	97.1	96.0	91.9	85.0	74.9	102.0
12	83.1	90.7	95.3	97.1	96.0	92.0	85.1	75.3	102.0
13	83.2	90.7	95.3	97.1	96.0	92.0	85.3	75.6	102.0
14	83.4	90.7	95.3	97.0	96.0	92.1	85.5	75.9	102.0
15	83.4	90.7	95.3	97.0	96.0	92.1	85.6	76.2	102.0
16	83.6	90.8	95.3	97.0	96.0	92.2	85.7	76.5	102.0
17	83.7	90.8	95.3	97.0	96.0	92.2	85.8	76.6	102.0
18	83.7	90.9	95.3	97.0	96.0	92.3	85.9	76.8	102.0
19	83.8	90.9	95.2	96.9	96.0	92.3	86.0	77.0	102.0
20	83.9	90.9	95.2	96.9	96.0	92.4	86.1	77.1	102.0

The most important noise model data are summarized in Table 2-4. Calculations are done for uniform ground cover; Crop field spring, autumn, grass (normal) (class D) with hardness 200. No map is presented, since it is found reasonable to use the same value for the entire area. Only locations in between the turbines and the noise sensitive locations will influence the noise level at the locations. Areas with exposed rock (higher hardness) are in shadow zones in the direction of the noise propagation and thus these areas are not considered to affect the noise level at the houses and holiday houses. The meteorological parameters are selected in accordance to WindPRO recommendations of standard parameters. These parameters are regarded to be relevant for a general Norwegian site, and conservative in the estimate of noise conditions during the most sensitive occasions; outside or open windows during summer evenings and nights. The noise level will tend to increase with decreasing temperature and increasing humidity. Some more parameters are given in Appendix B: WindPRO printouts noise.

Table 2-4: Input data to worst case noise calculation (main).

Parameter	Value
Directive	Norwegian, T-1442/2016
Height differences	Height contours for the entire area (5 m between contours)
Wind speed at hub height	11.0 m/s
Noise source level at given wind speed (11.0 m/s at hub height)	103.9 dB(A) /102.0 dB(A)
Noise mode	PO1 Serrated blades / SO1 Serrated blades
Assumed operational time	8760 hours/year
Height noise receptors	4 m
Limiting value (yellow zone)	45 dB(A) L_{den}
Ground cover (Attenuation class)	D
Relative humidity	70 %
Air temperature 2 m	10 °C
Stability parameters	Night; Clear sky

The location of noise sensitive receptors has been set according to the documentation provided by the client. The noise sensitive locations are of three categories; homes, holiday homes and schools/nurseries. A detailed list is given in Appendix A: Coordinates of noise and shadow receptors. The location of the receptors is presented in Figure 1-1 above.

Additionally to the parameters in Table 2-4 the frequency distribution of wind directions for the long term climate (KVT/BB/2018/R098, 2018) is used for the real case. The wind directions are applied in 30˚sectors as according to the standard settings for real case in WindPRO (EMD, 2018). The wind speeds of the frequency distribution are divided into 25 bins of 1.0 m/s from 1.0 m/s to 25.0 m/s, also according to standard settings for real case in WindPRO (EMD, 2018).

2.4 Results

The obtained results from the two cases; PO1 and SO1, are presented in the tables and figures below. The calculation results are also attached in Appendix B: WindPRO printouts noise. Be aware that these values are corrected by 6.4 dB(A) in the conversion from dB(A) to dB(A) L_{den}.

When using the turbines in mode PO1 with 4.2 MW there are 5 houses that are above the noise limit of 45 dB(A) L_{den}. W and AQ are houses, while BK, BM and CG are holiday houses. When using the turbines in mode SO1 with 4.0 MW there is 1 house above the noise limit; BK, a holiday house.

The consequence of changing the temperature from the standard settings (EMD, 2018) has been tested. This shows the result will increase with up to 0.4 dB(A) L_{den} at the houses when the temperature is decreased to 6˚C. When the temperature is increased from standard of 10˚C the noise level at the houses will decrease. Similarly changes of the relative humidity (RH) has been tested. The noise level will decrease with up to 0.5 dB(A) L_{den} when the RH is decreased to 50 % and correspondingly the noise level will increase if the humidity is increased.

When the frequency of wind directions and wind speeds are applied in the real case, no houses are above the noise limit of 45 dB(A) L_{den} in mode PO1. The noise level at the houses W and AQ and holiday houses BK, BM and CG is decreased with at least 2.4 dB(A) L_{den}.

Table 2-5: Estimated L_{den} noise levels in dB(A) at the location of each building for worst case in mode PO1 and in mode SO1 and for real case in mode PO1.

#	PO1 (L_{den}), worst case	SO1 (L_{den}), worst case	PO1 (L_{den}), real case	#	PO1 (L_{den}), worst case	SO1 (L_{den}), worst case	PO1 (L_{den}), real case
A	18.5	16.6	12.3	AT	44.0	42.1	37.1
B	29.0	27.1	15.5	AU	21.7	19.8	16.4
C	44.0	42.1	39.0	AV	18.6	16.7	12.3
D	44.1	42.2	42.1	AW	43.8	41.9	39.7
E	43.8	41.9	41.9	AX	43.8	41.9	39.1
F	34.7	32.8	16.8	AY	42.3	40.4	38.9
G	43.8	41.9	40.9	AZ	36.7	34.8	30.6
H	44.8	42.9	42.5	BA	20.4	18.5	15.3
I	44.6	42.7	35.6	BB	44.3	42.4	40.3
J	28.4	26.5	15.0	BC	20.5	18.6	15.1
K	20.9	19.0	15.6	BD	43.0	41.1	39.4
L	19.4	17.5	14.6	BE	42.5	40.6	36.3
M	43.7	41.8	39.5	BF	43.8	41.9	36.2
N	22.0	20.1	14.3	BG	37.4	35.4	27.8
O	42.8	40.9	37.6	BH	42.3	40.4	36.4
P	43.2	41.3	38.4	BI	43.5	41.6	36.7
Q	44.4	42.5	41.2	BJ	44.4	42.5	41.6
R	19.1	17.2	13.1	BK	47.2	45.2	44.2
S	44.6	42.7	40.9	BL	44.9	43.0	42.1
T	21.8	19.9	14.3	BM	45.5	43.6	42.6
U	29.0	27.1	15.0	BN	42.5	40.6	37.4
V	28.3	26.4	13.6	BO	44.9	43.0	42.2
W	45.3	43.4	42.9	BP	44.7	42.8	42.1
X	43.8	41.9	35.9	BQ	44.7	42.8	42.0
Y	40.7	38.8	32.0	BR	44.1	42.2	41.0
Z	19.2	17.3	13.2	BS	44	42.1	42.2
AA	20.1	18.2	15.2	BT	43.3	41.4	39.0
AB	34.2	32.2	23.6	BU	44.2	42.3	38.7
AC	44.2	42.3	40.9	BV	45.0	43.1	41.4
AD	37.3	35.4	30.0	BW	44.7	42.8	42.0
AE	44.1	42.2	41.3	BX	44.6	42.7	42.5
AF	44.1	42.2	41.3	BY	44.6	42.7	41.3
AG	24.1	22.2	17.8	BZ	40.4	38.4	35.9
AH	20.8	18.9	15.2	CA	43.5	41.6	36.6
AI	20.1	18.2	14.9	CB	44.6	42.7	42.6
AJ	23.9	22.0	18.9	CC	43.6	41.7	38.7
AK	21.5	19.6	16.3	CD	44.8	42.9	42.6
AL	41.8	39.9	34.1	CE	43.9	42.0	40.3
AM	44.2	42.3	37.4	CF	44.9	43.0	41.3
AN	43.6	41.7	39.8	CG	45.5	43.6	42.6
AO	43.8	41.9	40.2				
AP	31.5	29.6	16.4				
AQ	45.3	43.4	37.5				
AR	43.9	42.0	41.2				
AS	44.1	16.6	41.3				

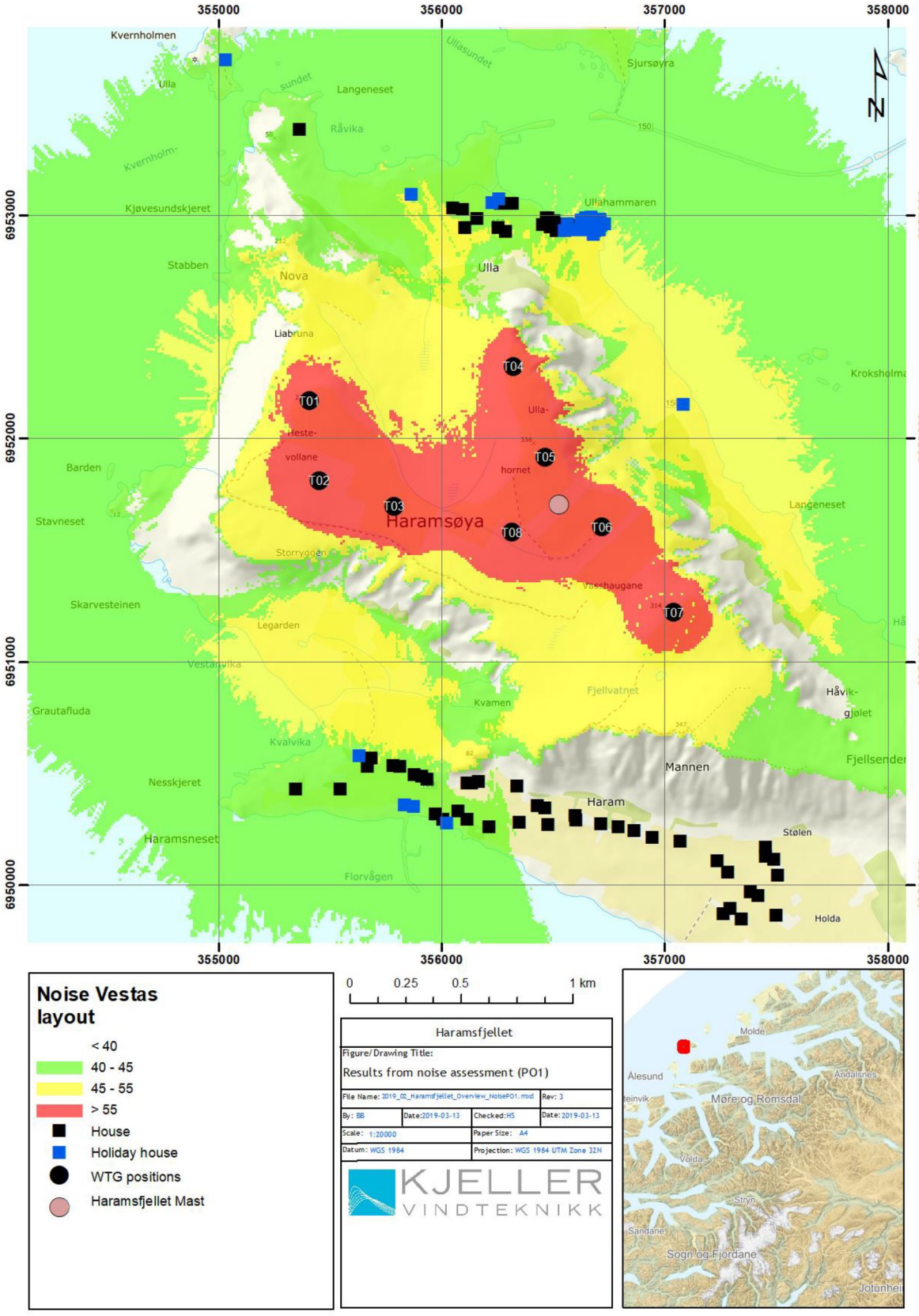

Figure 2-1 Map showing the noise level in worst case weighted to Lden generated by the Vestas V136-4.2MW (PO1,HWO) turbines in the Vestas layout. The location of the wind turbines is also shown together with the location of the noise sensitive receptors.

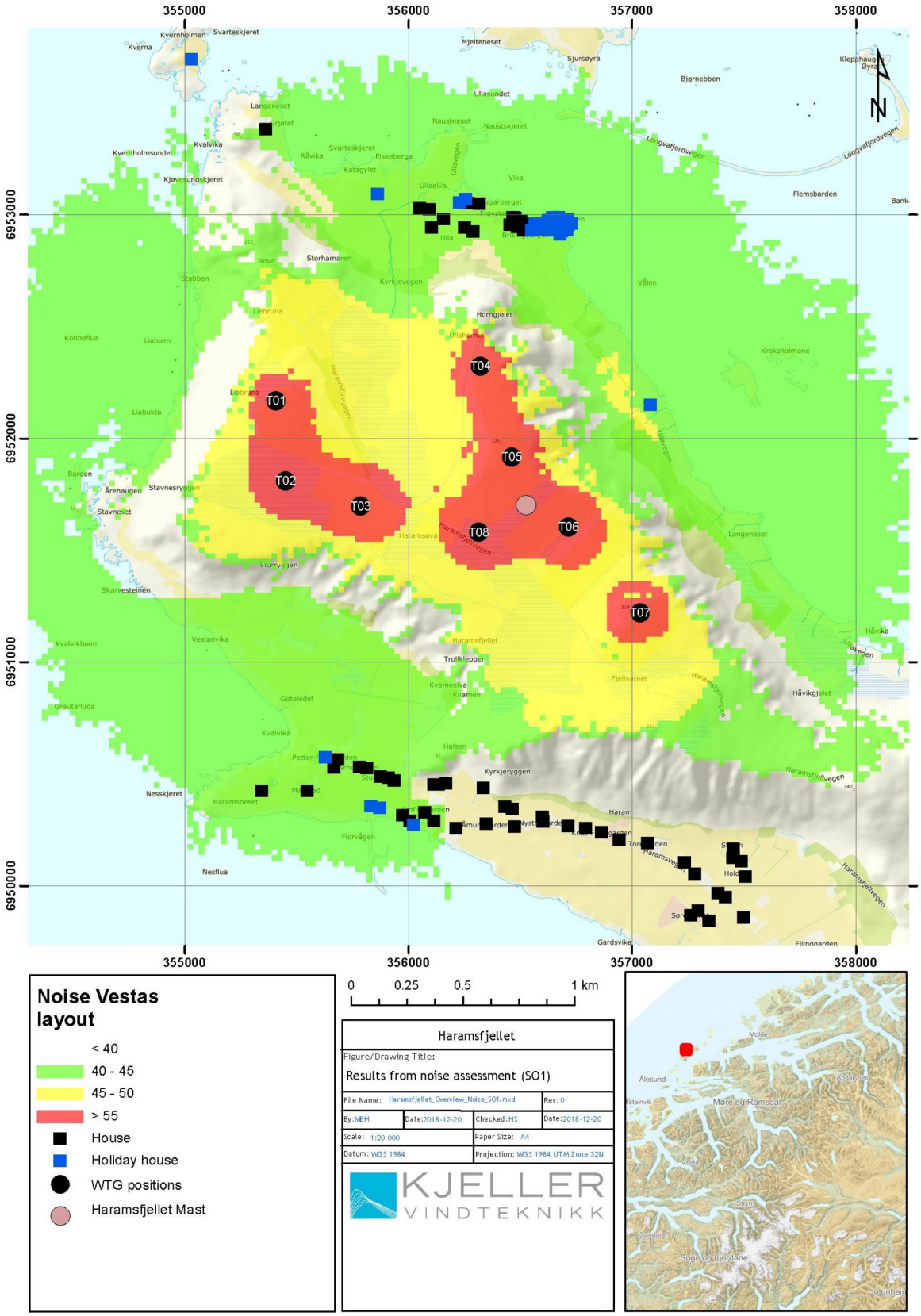

Figure 2-2 Map showing the noise level in worst case weighted to Lden generated by the Vestas V136-4.2MW (SO1,HWO) turbines in the Vestas layout. The location of the wind turbines is also shown together with the location of the noise sensitive receptors.

3 Shadow flickering calculations

3.1 Methodology

An energy producing wind turbine produces a visual effect called shadow flickering which consists of alternating periods of shadow and light. These may be considered as a nuisance by people living or working in buildings located close to the wind turbines. These buildings are hereafter designated as shadow flickering sensitive receptors, or just receptors. The shadow generated by a non-rotating turbine is though normally not a problem. When and where the shadow flickering occurs depends on the location of the receptor relative to the wind turbines, on the terrain characteristics, on the position of the sun, on the cloud cover, and on the wind conditions. The effect of the shadow flickering decreases with distance from the turbines, because the shadow becomes more diffuse.

The calculations of shadow flickering have been performed using the SHADOW module of the WindPRO 3.2.723 software (EMD, 2018). The real shadow case at Haramsfjellet is calculated using the real sun probabilities and the real operational time to have the most realistic results. The following parameters are used in the calculations:

- The turbine is defined to be operational 7926 h pr year.
- The sunshine probability is set to values specific for the area, see Table 3-1.
- Situations when the sun is located lower than 3° above the horizon, and the rotor blades cover less than 20 % of the sun's area, have not been included in the calculations, since shadow flickering is expected to be diffuse in these occasions, and therefore not problematic.
- The receptor is defined as a vertical plane of 2x2 m located 2 m above the ground level always pointing towards the turbine (corresponds to windows in all directions). The receptor list is given in Appendix A, and a further description of the classification is given in Section 2.3.
- Locations with more than 1500 m distance to nearest turbine are ignored.

The recommended limit of shadow flickering for relevant buildings is given by the following conditions (NVE, 2014):

- Expected number of hours per year with shadow flickering lower than or equal to 8 hours per year.
- Maximum number of minutes per day with shadow flickering lower than or equal to 30 minutes per day.

The expected number of hours with shadow flickering has been estimated based on the above presented assumptions. The sun probability for Haramsfjellet is taken to be the same as for Vigra which is located in close proximity, and the probabilities can be seen in Table 3-1 (KVT/BB/2018/N076, 2018).

Table 3-1: Sun probability for each month at Vigra.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Sun probability	0.31	0.33	0.33	0.35	0.39	0.33	0.29	0.30	0.28	0.29	0.32	0.30

3.2 Results

In order to keep the expected shadow flickering level below the allowed limit for all receptors, it will be necessary to install an automatic regulation system on the turbines. This system shuts down the turbines in question when the number of minutes per day with shadow flickering becomes larger than 30 minutes, and when the total number of hours per year of shadow flickering becomes larger than 8 hours. In this way it is guaranteed that the recommended maximum levels are not exceeded.

Table 3-2 below presents the expected number of hours per year with shadow flickering at the location of each receptor, together with the expected number of hours per day. There are a total of 38 houses affected by shadow flickering according to the calculations. If an automatic regulation system is installed (shadow counter), the maximum number of hours per year with shadow flickering, and the maximum time of shadow flickering in one day can be controlled.

Table 3-2: Expected number of hours per year and per day with shadow flickering at each of the shadow sensitive locations. An automatic shadow regulation system will reduce the real shadow hours per year to below 8 hours.

#	Max shadow [h/day]	Real case sun.pro. [h/year]	#	Max shadow [h/day]	Real case sun.pro. [h/year]
A	0.0	0	AR	0.7	5
B	0.0	0	AS	0.7	5
C	0.0	0	AT	0.7	5
D	0.7	5	AU	0.0	0
E	0.7	6	AV	0.0	0
F	0.0	0	AW	0.0	0
G	0.7	6	AX	0.6	5
H	0.7	6	AY	0.0	0
I	0.7	5	AZ	0.0	0
J	0.0	0	BA	0.0	0
K	0.0	0	BB	0.0	0
L	0.0	0	BC	0.0	0
M	0.0	0	BD	0.2	1
N	0.0	0	BE	0.0	0
O	0.0	0	BF	0.6	5
P	0.0	0	BG	0.0	0
Q	0.1	0	BH	0.4	1
R	0.0	0	BI	0.6	5
S	0.7	7	BJ	0.7	7
T	0.0	0	BK	0.7	12
U	0.0	0	BL	0.6	8
V	0.0	0	BM	0.7	8
W	0.7	9	BN	0.0	0
X	0.6	5	BO	0.6	9
Y	0.0	0	BP	0.6	8
Z	0.0	0	BQ	0.7	9
AA	0.0	0	BR	0.6	7
AB	0.0	0	BS	0.7	6
AC	0.0	0	BT	0.0	0
AD	0.0	0	BU	0.6	5
AE	0.7	8	BV	0.7	7
AF	0.7	6	BW	0.7	7
AG	0.0	0	BX	0.7	9
AH	0.0	0	BY	0.7	9
AI	0.0	0	BZ	0.4	1
AJ	0.0	0	CA	0.6	5
AK	0.0	0	CB	0.6	7
AL	0.0	0	CC	0.0	0
AM	0.7	4	CD	0.6	8
AN	0.0	0	CE	0.2	1
AO	0.6	5	CF	0.7	8
AP	0.0	0	CG	0.7	9
AQ	0.7	4			

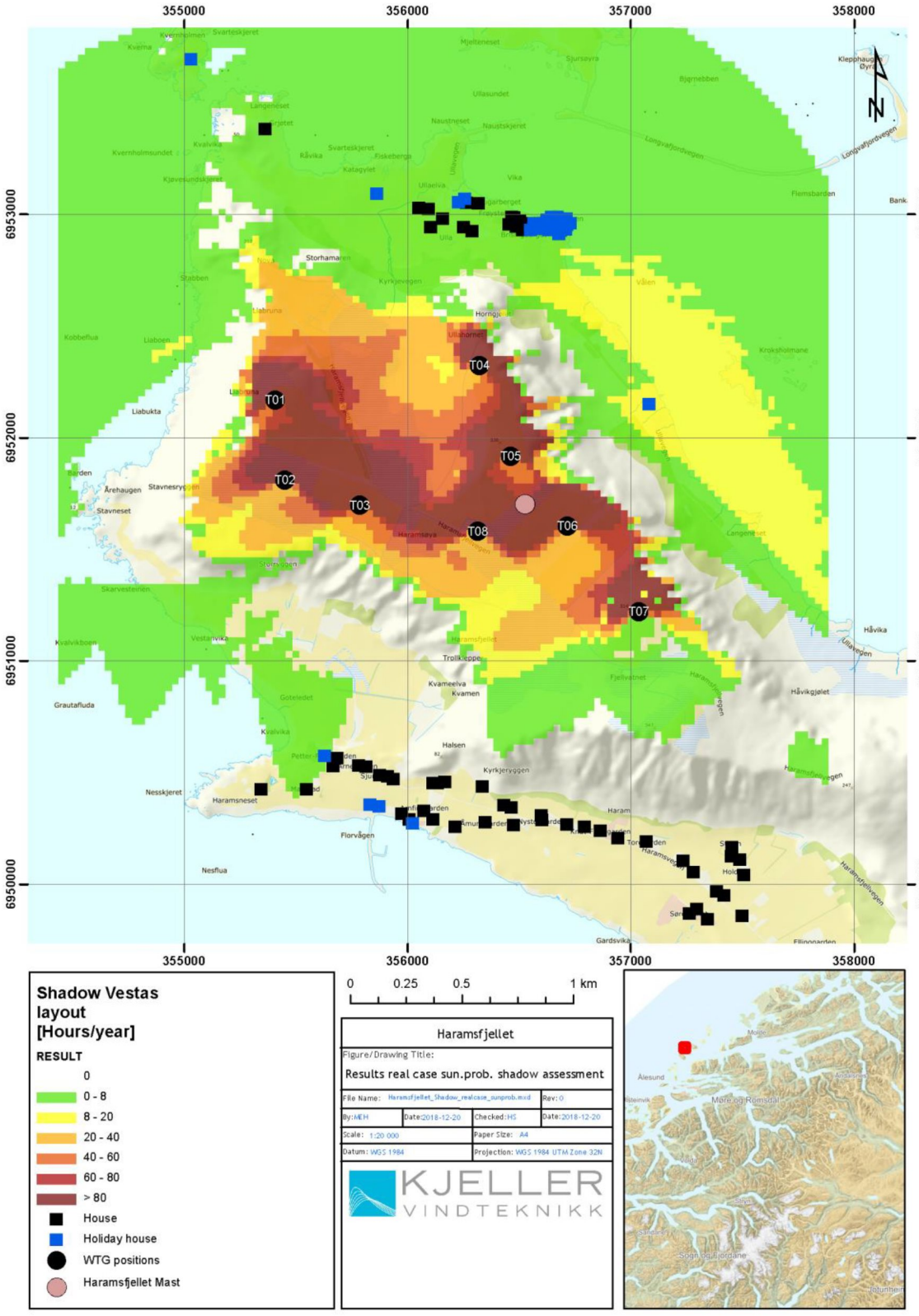

Figure 3-1 Map showing the expected number of hours per year with shadow flickering generated by the turbines in the case where sun probability for Haramsfjellet is taken into account. With an automatic shadow flickering regulation system installed on the turbines, the number of shadow hours per year will not exceed 8 hours for any receptors. Note that there is a yellow area around Ullahammeren which is covered by the house symbols on the map.

3.3 Shadow flicker loss

The shadow counter curtailment loss is estimated based on the time series of shadow flicker at each shadow sensitive location calculated using WindPRO. If the time with shadow flicker exceeds 0.5 h a day or 8 h a year, the turbine shuts down during the remaining period of shadow flicker.

The average production during a period of shadow flicker is assumed to be equal to the average production. The estimated losses for each turbine are presented in Table 3-3. The total estimated loss due to shadow flickering with the assumption of an installed shadow counter system is close to zero (0.02 %) when using sun probability specific to Haramsfjellet. Only turbines 2, 3 and 8 will never cause shadow flicker above 0.5 h. The corresponding loss without shadow counters is represented by the worst case percentage of 0.1 %. The worst case represents a situation where the turbines are always shut down when they potentially could cause more than 0.5 h of shadow flickering a day for a receptor. The losses that occur due to the shut down and start up of the turbines in connection with a shadow curtailment stop have not been taken into account.

Table 3-3. Energy losses due to shadow flicker in worst case and real case with specific sun probability to Haramsfjellet.

Turbine	Worst case [%]	Real case sun.prob. [%]
1	0.1	0.0
2	0.0	0.0
3	0.0	0.0
4	0.5	0.1
5	0.3	0.0
6	0.2	0.0
7	0.1	0.0
8	0.0	0.0
Average	0.1	0.0*

*The loss for the real case is not exactly zero, but very close.

4 Energy losses due to noise and shadow

The energy yield calculations are based on a previous data analysis on Haramsfjellet (KVT/BB/2018/R098, 2018). Basic information about the (new) energy production calculation is presented in Table 4-1. The resulting WindPRO printouts showing the obtained gross AEP values are attached in Appendix E. The difference in the two energy production estimates is presented.

Table 4-1: Basic information about the energy production calculation.

	Description
Energy calculation model:	The gross annual energy production (gross AEP) has been calculated in WindPRO version 3.2.743 [14].
Wind climate:	The wind map from EYA report (KVT/BB/2018/R098, 2018).
Layout:	A turbine layout described in EYA report (KVT/BB/2018/R098, 2018).
Power curve:	Specific power curves have been used in the calculations. Power optimized mode is found in Table 2-2 and sound optimized mode is found in Table 2-3.

The difference between the modes PO1 (HWO) and SO1 (HWO) is the nominal power of PO1 (HWO) is 4.2 MW and for SO1 (HWO) 4.0 MW. This will lead to less energy production when the turbines are operated in mode SO1 (HWO).

The buildings that exceed the noise restrictions when turbines are in PO1 (HWO) mode are according to Table 2-5 building W, AQ, BK, BM, and CG. If assuming that the sound level is highest downwind of the turbines and that SO1 mode is only needed for those cases a combination of SO1 and PO1 can be applied based on sectors. For all houses where noise limits are exceeded the turbines are located downwind within the directions 150° to 280°. This means that the turbines are assumed to operate in the sound optimized mode S01 (HWO) when the wind is from 150° to 280°, and in all other directions the turbines can operate in mode PO1 (HWO).

An estimate of the power loss for each turbine due to change in power mode to SO1 (HWO) for all directions and for directions discussed above is presented in Table 4-2 together with the estimated total loss for the park. The energy loss due to shadow flicker using a shadow counter has also been estimated.

Table 4-2: Energy losses in energy for Haramsfjellet with 8 x V136 turbines. The losses from changing the power mode of the turbines due to noise have been estimated, together with the losses due to shadow flicker and total losses.

Turbine	Energy loss due to noise and change of power mode to SO1 (HWO) in all directions [%]	Energy loss due to directional noise and power mode [%]	Energy loss due to real case shadow flicker [%]
1	4.6	3.2	0.0
2	4.6	3.6	0.0
3	4.6	3.7	0.0
4	4.5	3.0	0.1
5	4.4	3.0	0.0
6	4.6	3.3	0.0
7	4.6	3.2	0.0
8	4.4	3.7	0.0
Park	4.5	3.3	0.0

References

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Appendix A: Coordinates of noise and shadow receptors

Coordinates are given in WGS84 UTM32

#	E	N		#	E	N	
A	357490	6950111	House	AR	356469	6952988	House
B	357263	6949868	House	AS	356478	6952987	House
C	355912	6950483	House	AT	356159	6952982	House
D	356455	6952956	House	AU	356602	6950288	House
E	356503	6952972	House	AV	357454	6950166	House
F	356167	6950459	House	AW	355877	6950490	House
G	356540	6952961	House	AX	356095	6953023	House
H	356488	6952946	House	AY	355345	6950425	House
I	356104	6952943	House	AZ	356476	6950266	House
J	357295	6949890	House	BA	356863	6950240	House
K	356599	6950309	House	BB	355782	6950531	House
L	357235	6950105	House	BC	356794	6950258	House
M	355937	6950470	House	BD	355547	6950425	House
N	357418	6949949	House	BE	356073	6950329	House
O	356007	6950290	House	BF	356264	6953051	House
P	355974	6950315	House	BG	356337	6950438	House
Q	355685	6950564	House	BH	355363	6953382	House
R	357452	6950125	House	BI	356256	6953071	Holiday house
S	356598	6952952	House	BJ	356626	6952977	Holiday house
T	357384	6949967	House	BK	357083	6952151	Holiday house
U	357343	6949843	House	BL	356730	6952960	Holiday house
V	357500	6949860	House	BM	356709	6952932	Holiday house
W	356687	6952944	House	BN	356024	6950273	Holiday house
X	356317	6953050	House	BO	356713	6952953	Holiday house
Y	356214	6950257	House	BP	356717	6952961	Holiday house
Z	357507	6950041	House	BQ	356632	6952931	Holiday house
AA	356944	6950208	House	BR	356646	6952988	Holiday house
AB	356431	6950353	House	BS	356551	6952929	Holiday house
AC	355814	6950526	House	BT	355874	6950349	Holiday house
AD	356348	6950278	House	BU	355863	6953093	Holiday house
AE	356648	6952960	House	BV	356580	6952934	Holiday house
AF	356516	6952929	House	BW	356567	6952961	Holiday house
AG	356135	6950453	House	BX	356642	6952940	Holiday house
AH	357070	6950192	House	BY	356671	6952938	Holiday house
AI	357282	6950054	House	BZ	355030	6953694	Holiday house
AJ	356114	6950453	House	CA	356228	6953055	Holiday house
AK	356715	6950269	House	CB	356711	6952980	Holiday house
AL	356115	6950290	House	CC	355834	6950356	Holiday house
AM	356289	6952926	House	CD	356670	6952989	Holiday house
AN	355668	6950529	House	CE	355629	6950575	Holiday house
AO	356051	6953030	House	CF	356679	6952912	Holiday house
AP	356465	6950343	House	CG	356687	6952928	Holiday house
AQ	356253	6952942	House				

Appendix B: WindPRO printouts noise, PO1, worst case

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Calculated:
2019-03-13 07:52/3.2.737

NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m

Assumptions

Weather stability	
Relative humidity	70.0 %
Air temperature	10.0 °C
Height for air temperature	2.0 m
Stability parameters	Night;Clear sky
Inverse Monin Obukhov lenght	0.0100
Temperature scale T*	0.0500
Terrain	
Elevation based on object	
Height Contours: Haram_Height.map (2)	
Uniform roughness length	0.0500 m
Uniform roughness class	1.4
Uniform terrain type	D
Wind speed criteria	
Uniform wind speed at 10 m agl.	
Wind speed	Max noise wind speed
Max noise wind speed	All receptors downwind
Wind direction	4.0 m
Height above ground level for receiver	
Wind speed has been extrapolated to calculation height using	
IEC profile shear (z0 = 0.05m)	
No stability correction	5.022
Version	

All coordinates are in
UTM WGS84 Zone: 32

Scale 1:75,000

New WTG Noise sensitive area

WTGs

	X(East)	Y(North)	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Setting	Creator	Name
1	355,408	6,952,169	270.0	T01	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
2	355,452	6,951,811	251.1	T02	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
3	355,787	6,951,697	245.0	T03	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
4	356,322	6,952,324	323.1	T04	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
5	356,463	6,951,917	330.0	T05	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
6	356,717	6,951,604	292.3	T06	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
7	357,038	6,951,221	310.0	T07	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
8	356,315	6,951,580	289.7	T08	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03

Calculation Results

Sound level

Noise sensitive area No.	Name	X(East)	Y(North)	Z [m]	Imission height [m]	Demands Noise [dB(A)]	Sound level From WTGs [dB(A)]	Demands fulfilled? Noise [dB(A)]
A	Noise sensitive point: Demands defined in calculation setup. (733)	357,490	6,950,111	17.4	4.0	45.0	18.5	Yes
A	Day						12.1	
A	Evening						12.1	
A	Night						12.1	
B	Noise sensitive point: Demands defined in calculation setup. (734)	357,263	6,949,868	5.7	4.0	45.0	29.0	Yes

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m

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Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
			[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
B Day						22.6	
B Evening						22.6	
B Night						22.6	
C Noise sensitive point: Demands defined in calculation setup. (735)	355,912	6,950,483	11.7	4.0	45.0	44.0	Yes
C Day						37.6	
C Evening						37.6	
C Night						37.6	
D Noise sensitive point: Demands defined in calculation setup. (736)	356,455	6,952,956	7.7	4.0	45.0	44.1	Yes
D Day						37.7	
D Evening						37.7	
D Night						37.7	
E Noise sensitive point: Demands defined in calculation setup. (737)	356,503	6,952,972	6.4	4.0	45.0	43.8	Yes
E Day						37.4	
E Evening						37.4	
E Night						37.4	
F Noise sensitive point: Demands defined in calculation setup. (738)	356,167	6,950,459	16.7	4.0	45.0	34.7	Yes
F Day						28.3	
F Evening						28.3	
F Night						28.3	
G Noise sensitive point: Demands defined in calculation setup. (739)	356,540	6,952,961	10.0	4.0	45.0	43.8	Yes
G Day						37.4	
G Evening						37.4	
G Night						37.4	
H Noise sensitive point: Demands defined in calculation setup. (740)	356,488	6,952,946	10.5	4.0	45.0	44.8	Yes
H Day						38.4	
H Evening						38.4	
H Night						38.4	
I Noise sensitive point: Demands defined in calculation setup. (741)	356,104	6,952,943	9.8	4.0	45.0	44.6	Yes
I Day						38.2	
I Evening						38.2	
I Night						38.2	
J Noise sensitive point: Demands defined in calculation setup. (742)	357,295	6,949,890	6.8	4.0	45.0	28.4	Yes
J Day						22.0	
J Evening						22.0	
J Night						22.0	
K Noise sensitive point: Demands defined in calculation setup. (743)	356,599	6,950,309	16.3	4.0	45.0	20.9	Yes
K Day						14.5	
K Evening						14.5	
K Night						14.5	
L Noise sensitive point: Demands defined in calculation setup. (744)	357,235	6,950,105	12.7	4.0	45.0	19.4	Yes
L Day						13.0	
L Evening						13.0	
L Night						13.0	
M Noise sensitive point: Demands defined in calculation setup. (745)	355,937	6,950,470	11.1	4.0	45.0	43.7	Yes
M Day						37.3	
M Evening						37.3	
M Night						37.3	
N Noise sensitive point: Demands defined in calculation setup. (746)	357,418	6,949,949	11.5	4.0	45.0	22.0	Yes
N Day						15.6	
N Evening						15.6	
N Night						15.6	
O Noise sensitive point: Demands defined in calculation setup. (747)	356,007	6,950,290	2.4	4.0	45.0	42.8	Yes
O Day						36.4	
O Evening						36.4	
O Night						36.4	
P Noise sensitive point: Demands defined in calculation setup. (748)	355,974	6,950,315	2.8	4.0	45.0	43.2	Yes
P Day						36.8	
P Evening						36.8	
P Night						36.8	
Q Noise sensitive point: Demands defined in calculation setup. (749)	355,685	6,950,564	15.0	4.0	45.0	44.4	Yes
Q Day						38.0	
Q Evening						38.0	
Q Night						38.0	
R Noise sensitive point: Demands defined in calculation setup. (750)	357,452	6,950,125	17.0	4.0	45.0	19.1	Yes
R Day						12.7	
R Evening						12.7	
R Night						12.7	

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m

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Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
S	Noise sensitive point: Demands defined in calculation setup. (751)	356,598	6,952,952	10.0	4.0	45.0	44.6	Yes
S	Day						38.2	
S	Evening						38.2	
S	Night						38.2	
T	Noise sensitive point: Demands defined in calculation setup. (752)	357,384	6,949,967	11.1	4.0	45.0	21.8	Yes
T	Day						15.4	
T	Evening						15.4	
T	Night						15.4	
U	Noise sensitive point: Demands defined in calculation setup. (753)	357,343	6,949,843	9.6	4.0	45.0	29.0	Yes
U	Day						22.6	
U	Evening						22.6	
U	Night						22.6	
V	Noise sensitive point: Demands defined in calculation setup. (754)	357,500	6,949,860	10.9	4.0	45.0	28.3	Yes
V	Day						21.9	
V	Evening						21.9	
V	Night						21.9	
W	Noise sensitive point: Demands defined in calculation setup. (755)	356,687	6,952,944	10.4	4.0	45.0	45.3	No
W	Day						38.9	
W	Evening						38.9	
W	Night						38.9	
X	Noise sensitive point: Demands defined in calculation setup. (756)	356,317	6,953,050	1.9	4.0	45.0	43.8	Yes
X	Day						37.4	
X	Evening						37.4	
X	Night						37.4	
Y	Noise sensitive point: Demands defined in calculation setup. (757)	356,214	6,950,257	5.8	4.0	45.0	40.7	Yes
Y	Day						34.3	
Y	Evening						34.3	
Y	Night						34.3	
Z	Noise sensitive point: Demands defined in calculation setup. (758)	357,507	6,950,041	16.1	4.0	45.0	19.2	Yes
Z	Day						12.8	
Z	Evening						12.8	
Z	Night						12.8	
AA	Noise sensitive point: Demands defined in calculation setup. (759)	356,944	6,950,208	14.8	4.0	45.0	20.1	Yes
AA	Day						13.7	
AA	Evening						13.7	
AA	Night						13.7	
AB	Noise sensitive point: Demands defined in calculation setup. (760)	356,431	6,950,353	15.0	4.0	45.0	34.2	Yes
AB	Day						27.8	
AB	Evening						27.8	
AB	Night						27.8	
AC	Noise sensitive point: Demands defined in calculation setup. (761)	355,814	6,950,526	12.0	4.0	45.0	44.2	Yes
AC	Day						37.9	
AC	Evening						37.9	
AC	Night						37.9	
AD	Noise sensitive point: Demands defined in calculation setup. (762)	356,348	6,950,278	10.0	4.0	45.0	37.3	Yes
AD	Day						30.9	
AD	Evening						30.9	
AD	Night						30.9	
AE	Noise sensitive point: Demands defined in calculation setup. (763)	356,648	6,952,960	13.1	4.0	45.0	44.1	Yes
AE	Day						37.7	
AE	Evening						37.7	
AE	Night						37.7	
AF	Noise sensitive point: Demands defined in calculation setup. (764)	356,516	6,952,929	15.0	4.0	45.0	44.1	Yes
AF	Day						37.7	
AF	Evening						37.7	
AF	Night						37.7	
AG	Noise sensitive point: Demands defined in calculation setup. (765)	356,135	6,950,453	15.0	4.0	45.0	24.1	Yes
AG	Day						17.7	
AG	Evening						17.7	
AG	Night						17.7	
AH	Noise sensitive point: Demands defined in calculation setup. (766)	357,070	6,950,192	15.2	4.0	45.0	20.8	Yes
AH	Day						14.4	
AH	Evening						14.4	
AH	Night						14.4	
AI	Noise sensitive point: Demands defined in calculation setup. (767)	357,282	6,950,054	12.0	4.0	45.0	20.1	Yes
AI	Day						13.7	
AI	Evening						13.7	

To be continued on next page...

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m

...continued from previous page

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
AI	Night						13.7	
AJ	Noise sensitive point: Demands defined in calculation setup. (768)	356,114	6,950,453	14.3	4.0	45.0	23.9	Yes
AJ	Day						17.5	
AJ	Evening						17.5	
AJ	Night						17.5	
AK	Noise sensitive point: Demands defined in calculation setup. (769)	356,715	6,950,269	15.8	4.0	45.0	21.5	Yes
AK	Day						15.1	
AK	Evening						15.1	
AK	Night						15.1	
AL	Noise sensitive point: Demands defined in calculation setup. (770)	356,115	6,950,290	5.7	4.0	45.0	41.8	Yes
AL	Day						35.5	
AL	Evening						35.5	
AL	Night						35.5	
AM	Noise sensitive point: Demands defined in calculation setup. (771)	356,289	6,952,926	9.6	4.0	45.0	44.2	Yes
AM	Day						37.8	
AM	Evening						37.8	
AM	Night						37.8	
AN	Noise sensitive point: Demands defined in calculation setup. (772)	355,668	6,950,529	13.4	4.0	45.0	43.6	Yes
AN	Day						37.2	
AN	Evening						37.2	
AN	Night						37.2	
AO	Noise sensitive point: Demands defined in calculation setup. (773)	356,051	6,953,030	5.0	4.0	45.0	43.8	Yes
AO	Day						37.4	
AO	Evening						37.4	
AO	Night						37.4	
AP	Noise sensitive point: Demands defined in calculation setup. (774)	356,465	6,950,343	15.0	4.0	45.0	31.5	Yes
AP	Day						25.1	
AP	Evening						25.1	
AP	Night						25.1	
AQ	Noise sensitive point: Demands defined in calculation setup. (775)	356,253	6,952,942	8.3	4.0	45.0	45.3	No
AQ	Day						38.9	
AQ	Evening						38.9	
AQ	Night						38.9	
AR	Noise sensitive point: Demands defined in calculation setup. (776)	356,469	6,952,988	3.5	4.0	45.0	43.9	Yes
AR	Day						37.5	
AR	Evening						37.5	
AR	Night						37.5	
AS	Noise sensitive point: Demands defined in calculation setup. (777)	356,478	6,952,987	3.7	4.0	45.0	44.1	Yes
AS	Day						37.7	
AS	Evening						37.7	
AS	Night						37.7	
AT	Noise sensitive point: Demands defined in calculation setup. (778)	356,159	6,952,982	6.6	4.0	45.0	44.0	Yes
AT	Day						37.6	
AT	Evening						37.6	
AT	Night						37.6	
AU	Noise sensitive point: Demands defined in calculation setup. (779)	356,602	6,950,288	15.0	4.0	45.0	21.7	Yes
AU	Day						15.3	
AU	Evening						15.3	
AU	Night						15.3	
AV	Noise sensitive point: Demands defined in calculation setup. (780)	357,454	6,950,166	18.8	4.0	45.0	18.6	Yes
AV	Day						12.2	
AV	Evening						12.2	
AV	Night						12.2	
AW	Noise sensitive point: Demands defined in calculation setup. (781)	355,877	6,950,490	11.6	4.0	45.0	43.8	Yes
AW	Day						37.4	
AW	Evening						37.4	
AW	Night						37.4	
AX	Noise sensitive point: Demands defined in calculation setup. (782)	356,095	6,953,023	5.3	4.0	45.0	43.8	Yes
AX	Day						37.4	
AX	Evening						37.4	
AX	Night						37.4	
AY	Noise sensitive point: Demands defined in calculation setup. (783)	355,345	6,950,425	8.3	4.0	45.0	42.3	Yes
AY	Day						35.9	
AY	Evening						35.9	
AY	Night						35.9	
AZ	Noise sensitive point: Demands defined in calculation setup. (784)	356,476	6,950,266	11.3	4.0	45.0	36.7	Yes
AZ	Day						30.3	

To be continued on next page...

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2019-03-13 07:52/3.2.737

NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m

...continued from previous page

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
AZ	Evening						30.3	
AZ	Night						30.3	
BA	Noise sensitive point: Demands defined in calculation setup. (785)	356,863	6,950,240	15.1	4.0	45.0	20.4	Yes
BA	Day						14.0	
BA	Evening						14.0	
BA	Night						14.0	
BB	Noise sensitive point: Demands defined in calculation setup. (786)	355,782	6,950,531	10.1	4.0	45.0	44.3	Yes
BB	Day						37.9	
BB	Evening						37.9	
BB	Night						37.9	
BC	Noise sensitive point: Demands defined in calculation setup. (787)	356,794	6,950,258	15.6	4.0	45.0	20.5	Yes
BC	Day						14.1	
BC	Evening						14.1	
BC	Night						14.1	
BD	Noise sensitive point: Demands defined in calculation setup. (788)	355,547	6,950,425	8.6	4.0	45.0	43.0	Yes
BD	Day						36.6	
BD	Evening						36.6	
BD	Night						36.6	
BE	Noise sensitive point: Demands defined in calculation setup. (789)	356,073	6,950,329	6.2	4.0	45.0	42.5	Yes
BE	Day						36.1	
BE	Evening						36.1	
BE	Night						36.1	
BF	Noise sensitive point: Demands defined in calculation setup. (846)	356,264	6,953,051	3.1	4.0	45.0	43.8	Yes
BF	Day						37.4	
BF	Evening						37.4	
BF	Night						37.4	
BG	Noise sensitive point: Demands defined in calculation setup. (847)	356,337	6,950,438	20.0	4.0	45.0	37.4	Yes
BG	Day						31.0	
BG	Evening						31.0	
BG	Night						31.0	
BH	Noise sensitive point: Demands defined in calculation setup. (848)	355,363	6,953,382	13.3	4.0	45.0	42.3	Yes
BH	Day						35.9	
BH	Evening						35.9	
BH	Night						35.9	
BI	Noise sensitive point: Demands defined in calculation setup. (849)	356,256	6,953,071	2.4	4.0	45.0	43.5	Yes
BI	Day						37.2	
BI	Evening						37.2	
BI	Night						37.2	
BJ	Noise sensitive point: Demands defined in calculation setup. (850)	356,626	6,952,977	8.4	4.0	45.0	44.4	Yes
BJ	Day						38.0	
BJ	Evening						38.0	
BJ	Night						38.0	
BK	Noise sensitive point: Demands defined in calculation setup. (851)	357,083	6,952,151	9.2	4.0	45.0	47.2	No
BK	Day						40.8	
BK	Evening						40.8	
BK	Night						40.8	
BL	Noise sensitive point: Demands defined in calculation setup. (852)	356,730	6,952,960	5.2	4.0	45.0	44.9	Yes
BL	Day						38.5	
BL	Evening						38.5	
BL	Night						38.5	
BM	Noise sensitive point: Demands defined in calculation setup. (853)	356,709	6,952,932	6.5	4.0	45.0	45.5	No
BM	Day						39.1	
BM	Evening						39.1	
BM	Night						39.1	
BN	Noise sensitive point: Demands defined in calculation setup. (854)	356,024	6,950,273	1.9	4.0	45.0	42.5	Yes
BN	Day						36.2	
BN	Evening						36.2	
BN	Night						36.2	
BO	Noise sensitive point: Demands defined in calculation setup. (855)	356,713	6,952,953	8.5	4.0	45.0	44.9	Yes
BO	Day						38.5	
BO	Evening						38.5	
BO	Night						38.5	
BP	Noise sensitive point: Demands defined in calculation setup. (856)	356,717	6,952,961	8.4	4.0	45.0	44.7	Yes
BP	Day						38.3	
BP	Evening						38.3	
BP	Night						38.3	
BQ	Noise sensitive point: Demands defined in calculation setup. (857)	356,632	6,952,931	10.0	4.0	45.0	44.7	Yes

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m

...continued from previous page

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
BQ	Day						38.3	
BQ	Evening						38.3	
BQ	Night						38.3	
BR	Noise sensitive point: Demands defined in calculation setup. (858)	356,646	6,952,988	5.5	4.0	45.0	44.1	Yes
BR	Day						37.7	
BR	Evening						37.7	
BR	Night						37.7	
BS	Noise sensitive point: Demands defined in calculation setup. (859)	356,551	6,952,929	15.0	4.0	45.0	44.0	Yes
BS	Day						37.6	
BS	Evening						37.6	
BS	Night						37.6	
BT	Noise sensitive point: Demands defined in calculation setup. (860)	355,874	6,950,349	4.3	4.0	45.0	43.3	Yes
BT	Day						36.9	
BT	Evening						36.9	
BT	Night						36.9	
BU	Noise sensitive point: Demands defined in calculation setup. (861)	355,863	6,953,093	9.1	4.0	45.0	44.2	Yes
BU	Day						37.8	
BU	Evening						37.8	
BU	Night						37.8	
BV	Noise sensitive point: Demands defined in calculation setup. (862)	356,580	6,952,934	12.2	4.0	45.0	45.0	Yes
BV	Day						38.6	
BV	Evening						38.6	
BV	Night						38.6	
BW	Noise sensitive point: Demands defined in calculation setup. (863)	356,567	6,952,961	10.9	4.0	45.0	44.7	Yes
BW	Day						38.3	
BW	Evening						38.3	
BW	Night						38.3	
BX	Noise sensitive point: Demands defined in calculation setup. (864)	356,642	6,952,940	11.3	4.0	45.0	44.6	Yes
BX	Day						38.2	
BX	Evening						38.2	
BX	Night						38.2	
BY	Noise sensitive point: Demands defined in calculation setup. (865)	356,671	6,952,938	12.1	4.0	45.0	44.6	Yes
BY	Day						38.2	
BY	Evening						38.2	
BY	Night						38.2	
BZ	Noise sensitive point: Demands defined in calculation setup. (866)	355,030	6,953,694	3.6	4.0	45.0	40.4	Yes
BZ	Day						34.0	
BZ	Evening						34.0	
BZ	Night						34.0	
CA	Noise sensitive point: Demands defined in calculation setup. (867)	356,228	6,953,055	3.8	4.0	45.0	43.5	Yes
CA	Day						37.1	
CA	Evening						37.1	
CA	Night						37.1	
CB	Noise sensitive point: Demands defined in calculation setup. (868)	356,711	6,952,980	7.8	4.0	45.0	44.6	Yes
CB	Day						38.2	
CB	Evening						38.2	
CB	Night						38.2	
CC	Noise sensitive point: Demands defined in calculation setup. (869)	355,834	6,950,356	4.6	4.0	45.0	43.6	Yes
CC	Day						37.2	
CC	Evening						37.2	
CC	Night						37.2	
CD	Noise sensitive point: Demands defined in calculation setup. (870)	356,670	6,952,989	10.1	4.0	45.0	44.8	Yes
CD	Day						38.4	
CD	Evening						38.4	
CD	Night						38.4	
CE	Noise sensitive point: Demands defined in calculation setup. (871)	355,629	6,950,575	10.6	4.0	45.0	43.9	Yes
CE	Day						37.5	
CE	Evening						37.5	
CE	Night						37.5	
CF	Noise sensitive point: Demands defined in calculation setup. (872)	356,679	6,952,912	6.0	4.0	45.0	44.9	Yes
CF	Day						38.5	
CF	Evening						38.5	
CF	Night						38.5	
CG	Noise sensitive point: Demands defined in calculation setup. (873)	356,687	6,952,928	8.3	4.0	45.0	45.5	No
CG	Day						39.2	
CG	Evening						39.2	
CG	Night						39.2	

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m

Appendix C: WindPRO printouts noise, SO1, worst case

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, SO1 - 8 WTG

Assumptions

Weather stability	
Relative humidity	70.0 %
Air temperature	10.0 °C
Height for air temperature	2.0 m
Stability parameters	Night;Clear sky
Inverse Monin Obukhov lenght	0.0100
Temperature scale T*	0.0500
Terrain	
Elevation based on object	
Height Contours: Haram_Height.map (2)	
Uniform roughness length	0.0500 m
Uniform roughness class	1.4
Uniform terrain type	D
Wind speed criteria	
Uniform wind speed at 10 m agl.	
Wind speed	Max noise wind speed
Max noise wind speed	All receptors downwind
Wind direction	4.0 m
Height above ground level for receiver	
Wind speed has been extrapolated to calculation height using	
IEC profile shear (z0 = 0.05m)	
No stability correction	5.022
Version	

All coordinates are in
UTM WGS84 Zone: 32

Scale 1:75,000
New WTG
Noise sensitive area

WTGs

	X(East)	Y(North)	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Setting	Creator	Name
1	355,408	6,952,169	270.0	T01	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	Day	USER	Noise SO1
											Evening	USER	Noise SO1
											Night	USER	Noise SO1
2	355,452	6,951,811	251.1	T02	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	Day	USER	Noise SO1
											Evening	USER	Noise SO1
											Night	USER	Noise SO1
3	355,787	6,951,697	245.0	T03	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	Day	USER	Noise SO1
											Evening	USER	Noise SO1
											Night	USER	Noise SO1
4	356,322	6,952,324	323.1	T04	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	Day	USER	Noise SO1
											Evening	USER	Noise SO1
											Night	USER	Noise SO1
5	356,463	6,951,917	330.0	T05	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	Day	USER	Noise SO1
											Evening	USER	Noise SO1
											Night	USER	Noise SO1
6	356,717	6,951,604	292.3	T06	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	Day	USER	Noise SO1
											Evening	USER	Noise SO1
											Night	USER	Noise SO1
7	357,038	6,951,221	310.0	T07	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	Day	USER	Noise SO1
											Evening	USER	Noise SO1
											Night	USER	Noise SO1
8	356,315	6,951,580	289.7	T08	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	Day	USER	Noise SO1
											Evening	USER	Noise SO1
											Night	USER	Noise SO1

Calculation Results

Sound level

Noise sensitive area No.	Name	X(East)	Y(North)	Z [m]	Imission height [m]	Demands Noise [dB(A)]	Sound level From WTGs [dB(A)]	Demands fulfilled? Noise [dB(A)]
A	Noise sensitive point: Demands defined in calculation setup. (733)	357,490	6,950,111	17.4	4.0	45.0	16.6	Yes
A	Day						10.2	
A	Evening						10.2	
A	Night						10.2	
B	Noise sensitive point: Demands defined in calculation setup. (734)	357,263	6,949,868	5.7	4.0	45.0	27.1	Yes

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2018-12-18 09:39/3.2.723

NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, SO1 - 8 WTG

...continued from previous page

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
B	Day						20.7	
B	Evening						20.7	
B	Night						20.7	
C	Noise sensitive point: Demands defined in calculation setup. (735)	355,912	6,950,483	11.7	4.0	45.0	42.1	Yes
C	Day						35.7	
C	Evening						35.7	
C	Night						35.7	
D	Noise sensitive point: Demands defined in calculation setup. (736)	356,455	6,952,956	7.7	4.0	45.0	42.2	Yes
D	Day						35.8	
D	Evening						35.8	
D	Night						35.8	
E	Noise sensitive point: Demands defined in calculation setup. (737)	356,503	6,952,972	6.4	4.0	45.0	41.9	Yes
E	Day						35.5	
E	Evening						35.5	
E	Night						35.5	
F	Noise sensitive point: Demands defined in calculation setup. (738)	356,167	6,950,459	16.7	4.0	45.0	32.8	Yes
F	Day						26.4	
F	Evening						26.4	
F	Night						26.4	
G	Noise sensitive point: Demands defined in calculation setup. (739)	356,540	6,952,961	10.0	4.0	45.0	41.9	Yes
G	Day						35.5	
G	Evening						35.5	
G	Night						35.5	
H	Noise sensitive point: Demands defined in calculation setup. (740)	356,488	6,952,946	10.5	4.0	45.0	42.9	Yes
H	Day						36.5	
H	Evening						36.5	
H	Night						36.5	
I	Noise sensitive point: Demands defined in calculation setup. (741)	356,104	6,952,943	9.8	4.0	45.0	42.7	Yes
I	Day						36.3	
I	Evening						36.3	
I	Night						36.3	
J	Noise sensitive point: Demands defined in calculation setup. (742)	357,295	6,949,890	6.8	4.0	45.0	26.5	Yes
J	Day						20.1	
J	Evening						20.1	
J	Night						20.1	
K	Noise sensitive point: Demands defined in calculation setup. (743)	356,599	6,950,309	16.3	4.0	45.0	19.0	Yes
K	Day						12.6	
K	Evening						12.6	
K	Night						12.6	
L	Noise sensitive point: Demands defined in calculation setup. (744)	357,235	6,950,105	12.7	4.0	45.0	17.5	Yes
L	Day						11.1	
L	Evening						11.1	
L	Night						11.1	
M	Noise sensitive point: Demands defined in calculation setup. (745)	355,937	6,950,470	11.1	4.0	45.0	41.8	Yes
M	Day						35.4	
M	Evening						35.4	
M	Night						35.4	
N	Noise sensitive point: Demands defined in calculation setup. (746)	357,418	6,949,949	11.5	4.0	45.0	20.1	Yes
N	Day						13.7	
N	Evening						13.7	
N	Night						13.7	
O	Noise sensitive point: Demands defined in calculation setup. (747)	356,007	6,950,290	2.4	4.0	45.0	40.9	Yes
O	Day						34.5	
O	Evening						34.5	
O	Night						34.5	
P	Noise sensitive point: Demands defined in calculation setup. (748)	355,974	6,950,315	2.8	4.0	45.0	41.3	Yes
P	Day						34.9	
P	Evening						34.9	
P	Night						34.9	
Q	Noise sensitive point: Demands defined in calculation setup. (749)	355,685	6,950,564	15.0	4.0	45.0	42.5	Yes
Q	Day						36.1	
Q	Evening						36.1	
Q	Night						36.1	
R	Noise sensitive point: Demands defined in calculation setup. (750)	357,452	6,950,125	17.0	4.0	45.0	17.2	Yes
R	Day						10.8	
R	Evening						10.8	
R	Night						10.8	

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, SO1 - 8 WTG

...continued from previous page

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
S	Noise sensitive point: Demands defined in calculation setup. (751)	356,598	6,952,952	10.0	4.0	45.0	42.7	Yes
S	Day						36.3	
S	Evening						36.3	
S	Night						36.3	
T	Noise sensitive point: Demands defined in calculation setup. (752)	357,384	6,949,967	11.1	4.0	45.0	19.9	Yes
T	Day						13.5	
T	Evening						13.5	
T	Night						13.5	
U	Noise sensitive point: Demands defined in calculation setup. (753)	357,343	6,949,843	9.6	4.0	45.0	27.1	Yes
U	Day						20.7	
U	Evening						20.7	
U	Night						20.7	
V	Noise sensitive point: Demands defined in calculation setup. (754)	357,500	6,949,860	10.9	4.0	45.0	26.4	Yes
V	Day						20.0	
V	Evening						20.0	
V	Night						20.0	
W	Noise sensitive point: Demands defined in calculation setup. (755)	356,687	6,952,944	10.4	4.0	45.0	43.4	Yes
W	Day						37.0	
W	Evening						37.0	
W	Night						37.0	
X	Noise sensitive point: Demands defined in calculation setup. (756)	356,317	6,953,050	1.9	4.0	45.0	41.9	Yes
X	Day						35.5	
X	Evening						35.5	
X	Night						35.5	
Y	Noise sensitive point: Demands defined in calculation setup. (757)	356,214	6,950,257	5.8	4.0	45.0	38.8	Yes
Y	Day						32.4	
Y	Evening						32.4	
Y	Night						32.4	
Z	Noise sensitive point: Demands defined in calculation setup. (758)	357,507	6,950,041	16.1	4.0	45.0	17.3	Yes
Z	Day						10.9	
Z	Evening						10.9	
Z	Night						10.9	
AA	Noise sensitive point: Demands defined in calculation setup. (759)	356,944	6,950,208	14.8	4.0	45.0	18.2	Yes
AA	Day						11.8	
AA	Evening						11.8	
AA	Night						11.8	
AB	Noise sensitive point: Demands defined in calculation setup. (760)	356,431	6,950,353	15.0	4.0	45.0	32.2	Yes
AB	Day						25.8	
AB	Evening						25.8	
AB	Night						25.8	
AC	Noise sensitive point: Demands defined in calculation setup. (761)	355,814	6,950,526	12.0	4.0	45.0	42.3	Yes
AC	Day						35.9	
AC	Evening						35.9	
AC	Night						35.9	
AD	Noise sensitive point: Demands defined in calculation setup. (762)	356,348	6,950,278	10.0	4.0	45.0	35.4	Yes
AD	Day						29.0	
AD	Evening						29.0	
AD	Night						29.0	
AE	Noise sensitive point: Demands defined in calculation setup. (763)	356,648	6,952,960	13.1	4.0	45.0	42.2	Yes
AE	Day						35.8	
AE	Evening						35.8	
AE	Night						35.8	
AF	Noise sensitive point: Demands defined in calculation setup. (764)	356,516	6,952,929	15.0	4.0	45.0	42.2	Yes
AF	Day						35.8	
AF	Evening						35.8	
AF	Night						35.8	
AG	Noise sensitive point: Demands defined in calculation setup. (765)	356,135	6,950,453	15.0	4.0	45.0	22.2	Yes
AG	Day						15.8	
AG	Evening						15.8	
AG	Night						15.8	
AH	Noise sensitive point: Demands defined in calculation setup. (766)	357,070	6,950,192	15.2	4.0	45.0	18.9	Yes
AH	Day						12.5	
AH	Evening						12.5	
AH	Night						12.5	
AI	Noise sensitive point: Demands defined in calculation setup. (767)	357,282	6,950,054	12.0	4.0	45.0	18.2	Yes
AI	Day						11.8	
AI	Evening						11.8	

To be continued on next page...

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Calculated:
2018-12-18 09:39/3.2.723

NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, SO1 - 8 WTG

...continued from previous page

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
AI	Night						11.8	
AJ	Noise sensitive point: Demands defined in calculation setup. (768)	356,114	6,950,453	14.3	4.0	45.0	22.0	Yes
AJ	Day						15.6	
AJ	Evening						15.6	
AJ	Night						15.6	
AK	Noise sensitive point: Demands defined in calculation setup. (769)	356,715	6,950,269	15.8	4.0	45.0	19.6	Yes
AK	Day						13.2	
AK	Evening						13.2	
AK	Night						13.2	
AL	Noise sensitive point: Demands defined in calculation setup. (770)	356,115	6,950,290	5.7	4.0	45.0	39.9	Yes
AL	Day						33.5	
AL	Evening						33.5	
AL	Night						33.5	
AM	Noise sensitive point: Demands defined in calculation setup. (771)	356,289	6,952,926	9.6	4.0	45.0	42.3	Yes
AM	Day						35.9	
AM	Evening						35.9	
AM	Night						35.9	
AN	Noise sensitive point: Demands defined in calculation setup. (772)	355,668	6,950,529	13.4	4.0	45.0	41.7	Yes
AN	Day						35.3	
AN	Evening						35.3	
AN	Night						35.3	
AO	Noise sensitive point: Demands defined in calculation setup. (773)	356,051	6,953,030	5.0	4.0	45.0	41.9	Yes
AO	Day						35.5	
AO	Evening						35.5	
AO	Night						35.5	
AP	Noise sensitive point: Demands defined in calculation setup. (774)	356,465	6,950,343	15.0	4.0	45.0	29.6	Yes
AP	Day						23.2	
AP	Evening						23.2	
AP	Night						23.2	
AQ	Noise sensitive point: Demands defined in calculation setup. (775)	356,253	6,952,942	8.3	4.0	45.0	43.4	Yes
AQ	Day						37.0	
AQ	Evening						37.0	
AQ	Night						37.0	
AR	Noise sensitive point: Demands defined in calculation setup. (776)	356,469	6,952,988	3.5	4.0	45.0	42.0	Yes
AR	Day						35.6	
AR	Evening						35.6	
AR	Night						35.6	
AS	Noise sensitive point: Demands defined in calculation setup. (777)	356,478	6,952,987	3.7	4.0	45.0	42.2	Yes
AS	Day						35.8	
AS	Evening						35.8	
AS	Night						35.8	
AT	Noise sensitive point: Demands defined in calculation setup. (778)	356,159	6,952,982	6.6	4.0	45.0	42.1	Yes
AT	Day						35.7	
AT	Evening						35.7	
AT	Night						35.7	
AU	Noise sensitive point: Demands defined in calculation setup. (779)	356,602	6,950,288	15.0	4.0	45.0	19.8	Yes
AU	Day						13.4	
AU	Evening						13.4	
AU	Night						13.4	
AV	Noise sensitive point: Demands defined in calculation setup. (780)	357,454	6,950,166	18.8	4.0	45.0	16.7	Yes
AV	Day						10.3	
AV	Evening						10.3	
AV	Night						10.3	
AW	Noise sensitive point: Demands defined in calculation setup. (781)	355,877	6,950,490	11.6	4.0	45.0	41.9	Yes
AW	Day						35.5	
AW	Evening						35.5	
AW	Night						35.5	
AX	Noise sensitive point: Demands defined in calculation setup. (782)	356,095	6,953,023	5.3	4.0	45.0	41.9	Yes
AX	Day						35.5	
AX	Evening						35.5	
AX	Night						35.5	
AY	Noise sensitive point: Demands defined in calculation setup. (783)	355,345	6,950,425	8.3	4.0	45.0	40.4	Yes
AY	Day						34.0	
AY	Evening						34.0	
AY	Night						34.0	
AZ	Noise sensitive point: Demands defined in calculation setup. (784)	356,476	6,950,266	11.3	4.0	45.0	34.8	Yes
AZ	Day						28.4	

To be continued on next page...

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, SO1 - 8 WTG

...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
			[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
AZ Evening						28.4	
AZ Night						28.4	
BA Noise sensitive point: Demands defined in calculation setup. (785)	356,863	6,950,240	15.1	4.0	45.0	18.5	Yes
BA Day						12.1	
BA Evening						12.1	
BA Night						12.1	
BB Noise sensitive point: Demands defined in calculation setup. (786)	355,782	6,950,531	10.1	4.0	45.0	42.4	Yes
BB Day						36.0	
BB Evening						36.0	
BB Night						36.0	
BC Noise sensitive point: Demands defined in calculation setup. (787)	356,794	6,950,258	15.6	4.0	45.0	18.6	Yes
BC Day						12.2	
BC Evening						12.2	
BC Night						12.2	
BD Noise sensitive point: Demands defined in calculation setup. (788)	355,547	6,950,425	8.6	4.0	45.0	41.1	Yes
BD Day						34.7	
BD Evening						34.7	
BD Night						34.7	
BE Noise sensitive point: Demands defined in calculation setup. (789)	356,073	6,950,329	6.2	4.0	45.0	40.6	Yes
BE Day						34.2	
BE Evening						34.2	
BE Night						34.2	
BF Noise sensitive point: Demands defined in calculation setup. (846)	356,264	6,953,051	3.1	4.0	45.0	41.9	Yes
BF Day						35.5	
BF Evening						35.5	
BF Night						35.5	
BG Noise sensitive point: Demands defined in calculation setup. (847)	356,337	6,950,438	20.0	4.0	45.0	35.4	Yes
BG Day						29.0	
BG Evening						29.0	
BG Night						29.0	
BH Noise sensitive point: Demands defined in calculation setup. (848)	355,363	6,953,382	13.3	4.0	45.0	40.4	Yes
BH Day						34.0	
BH Evening						34.0	
BH Night						34.0	
BI Noise sensitive point: Demands defined in calculation setup. (849)	356,256	6,953,071	2.4	4.0	45.0	41.6	Yes
BI Day						35.2	
BI Evening						35.2	
BI Night						35.2	
BJ Noise sensitive point: Demands defined in calculation setup. (850)	356,626	6,952,977	8.4	4.0	45.0	42.5	Yes
BJ Day						36.1	
BJ Evening						36.1	
BJ Night						36.1	
BK Noise sensitive point: Demands defined in calculation setup. (851)	357,083	6,952,151	9.2	4.0	45.0	45.2	No
BK Day						38.8	
BK Evening						38.8	
BK Night						38.8	
BL Noise sensitive point: Demands defined in calculation setup. (852)	356,730	6,952,960	5.2	4.0	45.0	43.0	Yes
BL Day						36.6	
BL Evening						36.6	
BL Night						36.6	
BM Noise sensitive point: Demands defined in calculation setup. (853)	356,709	6,952,932	6.5	4.0	45.0	43.6	Yes
BM Day						37.2	
BM Evening						37.2	
BM Night						37.2	
BN Noise sensitive point: Demands defined in calculation setup. (854)	356,024	6,950,273	1.9	4.0	45.0	40.6	Yes
BN Day						34.2	
BN Evening						34.2	
BN Night						34.2	
BO Noise sensitive point: Demands defined in calculation setup. (855)	356,713	6,952,953	8.5	4.0	45.0	43.0	Yes
BO Day						36.6	
BO Evening						36.6	
BO Night						36.6	
BP Noise sensitive point: Demands defined in calculation setup. (856)	356,717	6,952,961	8.4	4.0	45.0	42.8	Yes
BP Day						36.4	
BP Evening						36.4	
BP Night						36.4	
BQ Noise sensitive point: Demands defined in calculation setup. (857)	356,632	6,952,931	10.0	4.0	45.0	42.8	Yes

To be continued on next page...

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2018-12-18 09:39/3.2.723

NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, SO1 - 8 WTG

...continued from previous page

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Noise	From WTGs	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
BQ	Day						36.4	
BQ	Evening						36.4	
BQ	Night						36.4	
BR	Noise sensitive point: Demands defined in calculation setup. (858)	356,646	6,952,988	5.5	4.0	45.0	42.2	Yes
BR	Day						35.8	
BR	Evening						35.8	
BR	Night						35.8	
BS	Noise sensitive point: Demands defined in calculation setup. (859)	356,551	6,952,929	15.0	4.0	45.0	42.1	Yes
BS	Day						35.7	
BS	Evening						35.7	
BS	Night						35.7	
BT	Noise sensitive point: Demands defined in calculation setup. (860)	355,874	6,950,349	4.3	4.0	45.0	41.4	Yes
BT	Day						35.0	
BT	Evening						35.0	
BT	Night						35.0	
BU	Noise sensitive point: Demands defined in calculation setup. (861)	355,863	6,953,093	9.1	4.0	45.0	42.3	Yes
BU	Day						35.9	
BU	Evening						35.9	
BU	Night						35.9	
BV	Noise sensitive point: Demands defined in calculation setup. (862)	356,580	6,952,934	12.2	4.0	45.0	43.1	Yes
BV	Day						36.7	
BV	Evening						36.7	
BV	Night						36.7	
BW	Noise sensitive point: Demands defined in calculation setup. (863)	356,567	6,952,961	10.9	4.0	45.0	42.8	Yes
BW	Day						36.4	
BW	Evening						36.4	
BW	Night						36.4	
BX	Noise sensitive point: Demands defined in calculation setup. (864)	356,642	6,952,940	11.3	4.0	45.0	42.7	Yes
BX	Day						36.3	
BX	Evening						36.3	
BX	Night						36.3	
BY	Noise sensitive point: Demands defined in calculation setup. (865)	356,671	6,952,938	12.1	4.0	45.0	42.7	Yes
BY	Day						36.3	
BY	Evening						36.3	
BY	Night						36.3	
BZ	Noise sensitive point: Demands defined in calculation setup. (866)	355,030	6,953,694	3.6	4.0	45.0	38.4	Yes
BZ	Day						32.1	
BZ	Evening						32.1	
BZ	Night						32.1	
CA	Noise sensitive point: Demands defined in calculation setup. (867)	356,228	6,953,055	3.8	4.0	45.0	41.6	Yes
CA	Day						35.2	
CA	Evening						35.2	
CA	Night						35.2	
CB	Noise sensitive point: Demands defined in calculation setup. (868)	356,711	6,952,980	7.8	4.0	45.0	42.7	Yes
CB	Day						36.3	
CB	Evening						36.3	
CB	Night						36.3	
CC	Noise sensitive point: Demands defined in calculation setup. (869)	355,834	6,950,356	4.6	4.0	45.0	41.7	Yes
CC	Day						35.3	
CC	Evening						35.3	
CC	Night						35.3	
CD	Noise sensitive point: Demands defined in calculation setup. (870)	356,670	6,952,989	10.1	4.0	45.0	42.9	Yes
CD	Day						36.5	
CD	Evening						36.5	
CD	Night						36.5	
CE	Noise sensitive point: Demands defined in calculation setup. (871)	355,629	6,950,575	10.6	4.0	45.0	42.0	Yes
CE	Day						35.6	
CE	Evening						35.6	
CE	Night						35.6	
CF	Noise sensitive point: Demands defined in calculation setup. (872)	356,679	6,952,912	6.0	4.0	45.0	43.0	Yes
CF	Day						36.6	
CF	Evening						36.6	
CF	Night						36.6	
CG	Noise sensitive point: Demands defined in calculation setup. (873)	356,687	6,952,928	8.3	4.0	45.0	43.6	Yes
CG	Day						37.2	
CG	Evening						37.2	
CG	Night						37.2	

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, SO1 - 8 WTG

Appendix D: WindPRO printouts noise, PO1, real case

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2019-03-27 12:22/3.2.737

NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, Real Case

Assumptions

Weather stability	
Relative humidity	70.0 %
Air temperature	10.0 °C
Height for air temperature	2.0 m
Stability parameters	Night;Clear sky
Inverse Monin Obukhov lenght	0.0100
Temperature scale T*	0.0500
Terrain	
Elevation based on object	
Height Contours: Haram_Height.map (2)	
Uniform roughness length	0.0500 m
Uniform roughness class	1.4
Uniform terrain type	D
Wind speed criteria	
Uniform wind speed at 10 m agl.	
Wind speed distribution	Haramsfjellet synth 1998-2017.84.00m -
Probability of exceedance	
Wind direction	0.0 ° - 330.0 ° - 30.0 °
Height above ground level for receiver	4.0 m
Wind speed has been extrapolated to calculation height using	
IEC profile shear (z0 = 0.05m)	
No stability correction	
Version	5.022

All coordinates are in
UTM WGS84 Zone: 32

Scale 1:75,000

New WTG Noise sensitive area

WTGs

	X(East)	Y(North)	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Setting	Creator	Name
1	355,408	6,952,169	270.0	T01	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
2	355,452	6,951,811	251.1	T02	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
3	355,787	6,951,697	245.0	T03	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
4	356,322	6,952,324	323.1	T04	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
5	356,463	6,951,917	330.0	T05	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
6	356,717	6,951,604	292.3	T06	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
7	357,038	6,951,221	310.0	T07	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03
8	356,315	6,951,580	289.7	T08	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03
											Evening	USER	Haramsfjellet_2019_03
											Night	USER	Haramsfjellet_2019_03

Calculation Results

Sound level

Noise sensitive area No.	Name	X(East)	Y(North)	Z [m]	Imission height [m]	Demands Noise [dB(A)]	Sound level L50 [dB(A)]	Demands fulfilled? Noise [dB(A)]
A	Noise sensitive point: Demands defined in calculation setup. (733)	357,490	6,950,111	17.4	4.0	45.0	12.3	Yes
A	Day						5.9	
A	Evening						5.9	
A	Night						5.9	
B	Noise sensitive point: Demands defined in calculation setup. (734)	357,263	6,949,868	5.7	4.0	45.0	15.5	Yes
B	Day						9.1	

To be continued on next page...

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2019-03-27 12:22/3.2.737

NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, Real Case

...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	X(East)	Y(North)	Z	Imission height	Noise	L50	Noise
			[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
B Evening						9.1	
B Night						9.1	
C Noise sensitive point: Demands defined in calculation setup. (735)	355,912	6,950,483	11.7	4.0	45.0	39.0	Yes
C Day						32.6	
C Evening						32.6	
C Night						32.6	
D Noise sensitive point: Demands defined in calculation setup. (736)	356,455	6,952,956	7.7	4.0	45.0	42.1	Yes
D Day						35.7	
D Evening						35.7	
D Night						35.7	
E Noise sensitive point: Demands defined in calculation setup. (737)	356,503	6,952,972	6.4	4.0	45.0	41.9	Yes
E Day						35.5	
E Evening						35.5	
E Night						35.5	
F Noise sensitive point: Demands defined in calculation setup. (738)	356,167	6,950,459	16.7	4.0	45.0	16.8	Yes
F Day						10.4	
F Evening						10.4	
F Night						10.4	
G Noise sensitive point: Demands defined in calculation setup. (739)	356,540	6,952,961	10.0	4.0	45.0	40.9	Yes
G Day						34.5	
G Evening						34.5	
G Night						34.5	
H Noise sensitive point: Demands defined in calculation setup. (740)	356,488	6,952,946	10.5	4.0	45.0	42.5	Yes
H Day						36.1	
H Evening						36.1	
H Night						36.1	
I Noise sensitive point: Demands defined in calculation setup. (741)	356,104	6,952,943	9.8	4.0	45.0	35.6	Yes
I Day						29.2	
I Evening						29.2	
I Night						29.2	
J Noise sensitive point: Demands defined in calculation setup. (742)	357,295	6,949,890	6.8	4.0	45.0	15.0	Yes
J Day						8.6	
J Evening						8.6	
J Night						8.6	
K Noise sensitive point: Demands defined in calculation setup. (743)	356,599	6,950,309	16.3	4.0	45.0	15.6	Yes
K Day						9.2	
K Evening						9.2	
K Night						9.2	
L Noise sensitive point: Demands defined in calculation setup. (744)	357,235	6,950,105	12.7	4.0	45.0	14.6	Yes
L Day						8.2	
L Evening						8.2	
L Night						8.2	
M Noise sensitive point: Demands defined in calculation setup. (745)	355,937	6,950,470	11.1	4.0	45.0	39.5	Yes
M Day						33.1	
M Evening						33.1	
M Night						33.1	
N Noise sensitive point: Demands defined in calculation setup. (746)	357,418	6,949,949	11.5	4.0	45.0	14.3	Yes
N Day						7.9	
N Evening						7.9	
N Night						7.9	
O Noise sensitive point: Demands defined in calculation setup. (747)	356,007	6,950,290	2.4	4.0	45.0	37.6	Yes
O Day						31.2	
O Evening						31.2	
O Night						31.2	
P Noise sensitive point: Demands defined in calculation setup. (748)	355,974	6,950,315	2.8	4.0	45.0	38.4	Yes
P Day						32.0	
P Evening						32.0	
P Night						32.0	
Q Noise sensitive point: Demands defined in calculation setup. (749)	355,685	6,950,564	15.0	4.0	45.0	41.2	Yes
Q Day						34.8	
Q Evening						34.8	
Q Night						34.8	
R Noise sensitive point: Demands defined in calculation setup. (750)	357,452	6,950,125	17.0	4.0	45.0	13.1	Yes
R Day						6.7	
R Evening						6.7	
R Night						6.7	
S Noise sensitive point: Demands defined in calculation setup. (751)	356,598	6,952,952	10.0	4.0	45.0	40.9	Yes

To be continued on next page...

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, Real Case

...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	X(East)	Y(North)	Z	Imission height	Noise	L50	Noise
			[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
S Day						34.5	
S Evening						34.5	
S Night						34.5	
T Noise sensitive point: Demands defined in calculation setup. (752)	357,384	6,949,967	11.1	4.0	45.0	14.3	Yes
T Day						7.9	
T Evening						7.9	
T Night						7.9	
U Noise sensitive point: Demands defined in calculation setup. (753)	357,343	6,949,843	9.6	4.0	45.0	15.0	Yes
U Day						8.6	
U Evening						8.6	
U Night						8.6	
V Noise sensitive point: Demands defined in calculation setup. (754)	357,500	6,949,860	10.9	4.0	45.0	13.6	Yes
V Day						7.2	
V Evening						7.2	
V Night						7.2	
W Noise sensitive point: Demands defined in calculation setup. (755)	356,687	6,952,944	10.4	4.0	45.0	42.9	Yes
W Day						36.5	
W Evening						36.5	
W Night						36.5	
X Noise sensitive point: Demands defined in calculation setup. (756)	356,317	6,953,050	1.9	4.0	45.0	35.9	Yes
X Day						29.5	
X Evening						29.5	
X Night						29.5	
Y Noise sensitive point: Demands defined in calculation setup. (757)	356,214	6,950,257	5.8	4.0	45.0	32.0	Yes
Y Day						25.6	
Y Evening						25.6	
Y Night						25.6	
Z Noise sensitive point: Demands defined in calculation setup. (758)	357,507	6,950,041	16.1	4.0	45.0	13.2	Yes
Z Day						6.9	
Z Evening						6.9	
Z Night						6.9	
AA Noise sensitive point: Demands defined in calculation setup. (759)	356,944	6,950,208	14.8	4.0	45.0	15.2	Yes
AA Day						8.8	
AA Evening						8.8	
AA Night						8.8	
AB Noise sensitive point: Demands defined in calculation setup. (760)	356,431	6,950,353	15.0	4.0	45.0	23.6	Yes
AB Day						17.2	
AB Evening						17.2	
AB Night						17.2	
AC Noise sensitive point: Demands defined in calculation setup. (761)	355,814	6,950,526	12.0	4.0	45.0	40.9	Yes
AC Day						34.5	
AC Evening						34.5	
AC Night						34.5	
AD Noise sensitive point: Demands defined in calculation setup. (762)	356,348	6,950,278	10.0	4.0	45.0	30.0	Yes
AD Day						23.6	
AD Evening						23.6	
AD Night						23.6	
AE Noise sensitive point: Demands defined in calculation setup. (763)	356,648	6,952,960	13.1	4.0	45.0	41.3	Yes
AE Day						35.0	
AE Evening						35.0	
AE Night						35.0	
AF Noise sensitive point: Demands defined in calculation setup. (764)	356,516	6,952,929	15.0	4.0	45.0	41.3	Yes
AF Day						34.9	
AF Evening						34.9	
AF Night						34.9	
AG Noise sensitive point: Demands defined in calculation setup. (765)	356,135	6,950,453	15.0	4.0	45.0	17.8	Yes
AG Day						11.4	
AG Evening						11.4	
AG Night						11.4	
AH Noise sensitive point: Demands defined in calculation setup. (766)	357,070	6,950,192	15.2	4.0	45.0	15.2	Yes
AH Day						8.8	
AH Evening						8.8	
AH Night						8.8	
AI Noise sensitive point: Demands defined in calculation setup. (767)	357,282	6,950,054	12.0	4.0	45.0	14.9	Yes
AI Day						8.5	
AI Evening						8.5	
AI Night						8.5	

To be continued on next page...

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, Real Case

...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	X(East)	Y(North)	Z	Imission height	Noise	L50	Noise
			[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
AJ Noise sensitive point: Demands defined in calculation setup. (768)	356,114	6,950,453	14.3	4.0	45.0	18.9	Yes
AJ Day						12.5	
AJ Evening						12.5	
AJ Night						12.5	
AK Noise sensitive point: Demands defined in calculation setup. (769)	356,715	6,950,269	15.8	4.0	45.0	16.3	Yes
AK Day						9.9	
AK Evening						9.9	
AK Night						9.9	
AL Noise sensitive point: Demands defined in calculation setup. (770)	356,115	6,950,290	5.7	4.0	45.0	34.1	Yes
AL Day						27.7	
AL Evening						27.7	
AL Night						27.7	
AM Noise sensitive point: Demands defined in calculation setup. (771)	356,289	6,952,926	9.6	4.0	45.0	37.4	Yes
AM Day						31.0	
AM Evening						31.0	
AM Night						31.0	
AN Noise sensitive point: Demands defined in calculation setup. (772)	355,668	6,950,529	13.4	4.0	45.0	39.8	Yes
AN Day						33.4	
AN Evening						33.4	
AN Night						33.4	
AO Noise sensitive point: Demands defined in calculation setup. (773)	356,051	6,953,030	5.0	4.0	45.0	40.2	Yes
AO Day						33.8	
AO Evening						33.8	
AO Night						33.8	
AP Noise sensitive point: Demands defined in calculation setup. (774)	356,465	6,950,343	15.0	4.0	45.0	16.4	Yes
AP Day						10.0	
AP Evening						10.0	
AP Night						10.0	
AQ Noise sensitive point: Demands defined in calculation setup. (775)	356,253	6,952,942	8.3	4.0	45.0	37.5	Yes
AQ Day						31.1	
AQ Evening						31.1	
AQ Night						31.1	
AR Noise sensitive point: Demands defined in calculation setup. (776)	356,469	6,952,988	3.5	4.0	45.0	41.2	Yes
AR Day						34.8	
AR Evening						34.8	
AR Night						34.8	
AS Noise sensitive point: Demands defined in calculation setup. (777)	356,478	6,952,987	3.7	4.0	45.0	41.3	Yes
AS Day						34.9	
AS Evening						34.9	
AS Night						34.9	
AT Noise sensitive point: Demands defined in calculation setup. (778)	356,159	6,952,982	6.6	4.0	45.0	37.1	Yes
AT Day						30.7	
AT Evening						30.7	
AT Night						30.7	
AU Noise sensitive point: Demands defined in calculation setup. (779)	356,602	6,950,288	15.0	4.0	45.0	16.4	Yes
AU Day						10.0	
AU Evening						10.0	
AU Night						10.0	
AV Noise sensitive point: Demands defined in calculation setup. (780)	357,454	6,950,166	18.8	4.0	45.0	12.3	Yes
AV Day						5.9	
AV Evening						5.9	
AV Night						5.9	
AW Noise sensitive point: Demands defined in calculation setup. (781)	355,877	6,950,490	11.6	4.0	45.0	39.7	Yes
AW Day						33.3	
AW Evening						33.3	
AW Night						33.3	
AX Noise sensitive point: Demands defined in calculation setup. (782)	356,095	6,953,023	5.3	4.0	45.0	39.1	Yes
AX Day						32.7	
AX Evening						32.7	
AX Night						32.7	
AY Noise sensitive point: Demands defined in calculation setup. (783)	355,345	6,950,425	8.3	4.0	45.0	38.9	Yes
AY Day						32.6	
AY Evening						32.6	
AY Night						32.6	
AZ Noise sensitive point: Demands defined in calculation setup. (784)	356,476	6,950,266	11.3	4.0	45.0	30.6	Yes
AZ Day						24.2	
AZ Evening						24.2	

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, Real Case

...continued from previous page

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Noise	L50	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
AZ	Night						24.2	
BA	Noise sensitive point: Demands defined in calculation setup. (785)	356,863	6,950,240	15.1	4.0	45.0	15.3	Yes
BA	Day						8.9	
BA	Evening						8.9	
BA	Night						8.9	
BB	Noise sensitive point: Demands defined in calculation setup. (786)	355,782	6,950,531	10.1	4.0	45.0	40.3	Yes
BB	Day						33.9	
BB	Evening						33.9	
BB	Night						33.9	
BC	Noise sensitive point: Demands defined in calculation setup. (787)	356,794	6,950,258	15.6	4.0	45.0	15.1	Yes
BC	Day						8.7	
BC	Evening						8.7	
BC	Night						8.7	
BD	Noise sensitive point: Demands defined in calculation setup. (788)	355,547	6,950,425	8.6	4.0	45.0	39.4	Yes
BD	Day						33.0	
BD	Evening						33.0	
BD	Night						33.0	
BE	Noise sensitive point: Demands defined in calculation setup. (789)	356,073	6,950,329	6.2	4.0	45.0	36.3	Yes
BE	Day						29.9	
BE	Evening						29.9	
BE	Night						29.9	
BF	Noise sensitive point: Demands defined in calculation setup. (846)	356,264	6,953,051	3.1	4.0	45.0	36.2	Yes
BF	Day						29.8	
BF	Evening						29.8	
BF	Night						29.8	
BG	Noise sensitive point: Demands defined in calculation setup. (847)	356,337	6,950,438	20.0	4.0	45.0	27.8	Yes
BG	Day						21.5	
BG	Evening						21.5	
BG	Night						21.5	
BH	Noise sensitive point: Demands defined in calculation setup. (848)	355,363	6,953,382	13.3	4.0	45.0	36.4	Yes
BH	Day						30.0	
BH	Evening						30.0	
BH	Night						30.0	
BI	Noise sensitive point: Demands defined in calculation setup. (849)	356,256	6,953,071	2.4	4.0	45.0	36.7	Yes
BI	Day						30.3	
BI	Evening						30.3	
BI	Night						30.3	
BJ	Noise sensitive point: Demands defined in calculation setup. (850)	356,626	6,952,977	8.4	4.0	45.0	41.6	Yes
BJ	Day						35.2	
BJ	Evening						35.2	
BJ	Night						35.2	
BK	Noise sensitive point: Demands defined in calculation setup. (851)	357,083	6,952,151	9.2	4.0	45.0	44.2	Yes
BK	Day						37.8	
BK	Evening						37.8	
BK	Night						37.8	
BL	Noise sensitive point: Demands defined in calculation setup. (852)	356,730	6,952,960	5.2	4.0	45.0	42.1	Yes
BL	Day						35.7	
BL	Evening						35.7	
BL	Night						35.7	
BM	Noise sensitive point: Demands defined in calculation setup. (853)	356,709	6,952,932	6.5	4.0	45.0	42.6	Yes
BM	Day						36.2	
BM	Evening						36.2	
BM	Night						36.2	
BN	Noise sensitive point: Demands defined in calculation setup. (854)	356,024	6,950,273	1.9	4.0	45.0	37.4	Yes
BN	Day						31.0	
BN	Evening						31.0	
BN	Night						31.0	
BO	Noise sensitive point: Demands defined in calculation setup. (855)	356,713	6,952,953	8.5	4.0	45.0	42.2	Yes
BO	Day						35.8	
BO	Evening						35.8	
BO	Night						35.8	
BP	Noise sensitive point: Demands defined in calculation setup. (856)	356,717	6,952,961	8.4	4.0	45.0	42.1	Yes
BP	Day						35.7	
BP	Evening						35.7	
BP	Night						35.7	
BQ	Noise sensitive point: Demands defined in calculation setup. (857)	356,632	6,952,931	10.0	4.0	45.0	42.0	Yes
BQ	Day						35.6	

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, Real Case

...continued from previous page

Noise sensitive area					Demands	Sound level	Demands fulfilled?
No. Name	X(East)	Y(North)	Z	Imission height	Noise	L50	Noise
			[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
BQ Evening						35.6	
BQ Night						35.6	
BR Noise sensitive point: Demands defined in calculation setup. (858)	356,646	6,952,988	5.5	4.0	45.0	41.0	Yes
BR Day						34.6	
BR Evening						34.6	
BR Night						34.6	
BS Noise sensitive point: Demands defined in calculation setup. (859)	356,551	6,952,929	15.0	4.0	45.0	42.2	Yes
BS Day						35.8	
BS Evening						35.8	
BS Night						35.8	
BT Noise sensitive point: Demands defined in calculation setup. (860)	355,874	6,950,349	4.3	4.0	45.0	39.0	Yes
BT Day						32.6	
BT Evening						32.6	
BT Night						32.6	
BU Noise sensitive point: Demands defined in calculation setup. (861)	355,863	6,953,093	9.1	4.0	45.0	38.7	Yes
BU Day						32.3	
BU Evening						32.3	
BU Night						32.3	
BV Noise sensitive point: Demands defined in calculation setup. (862)	356,580	6,952,934	12.2	4.0	45.0	41.4	Yes
BV Day						35.0	
BV Evening						35.0	
BV Night						35.0	
BW Noise sensitive point: Demands defined in calculation setup. (863)	356,567	6,952,961	10.9	4.0	45.0	42.0	Yes
BW Day						35.6	
BW Evening						35.6	
BW Night						35.6	
BX Noise sensitive point: Demands defined in calculation setup. (864)	356,642	6,952,940	11.3	4.0	45.0	42.5	Yes
BX Day						36.1	
BX Evening						36.1	
BX Night						36.1	
BY Noise sensitive point: Demands defined in calculation setup. (865)	356,671	6,952,938	12.1	4.0	45.0	41.3	Yes
BY Day						34.9	
BY Evening						34.9	
BY Night						34.9	
BZ Noise sensitive point: Demands defined in calculation setup. (866)	355,030	6,953,694	3.6	4.0	45.0	35.9	Yes
BZ Day						29.5	
BZ Evening						29.5	
BZ Night						29.5	
CA Noise sensitive point: Demands defined in calculation setup. (867)	356,228	6,953,055	3.8	4.0	45.0	36.6	Yes
CA Day						30.2	
CA Evening						30.2	
CA Night						30.2	
CB Noise sensitive point: Demands defined in calculation setup. (868)	356,711	6,952,980	7.8	4.0	45.0	42.6	Yes
CB Day						36.2	
CB Evening						36.2	
CB Night						36.2	
CC Noise sensitive point: Demands defined in calculation setup. (869)	355,834	6,950,356	4.6	4.0	45.0	38.7	Yes
CC Day						32.3	
CC Evening						32.3	
CC Night						32.3	
CD Noise sensitive point: Demands defined in calculation setup. (870)	356,670	6,952,989	10.1	4.0	45.0	42.6	Yes
CD Day						36.2	
CD Evening						36.2	
CD Night						36.2	
CE Noise sensitive point: Demands defined in calculation setup. (871)	355,629	6,950,575	10.6	4.0	45.0	40.3	Yes
CE Day						33.9	
CE Evening						33.9	
CE Night						33.9	
CF Noise sensitive point: Demands defined in calculation setup. (872)	356,679	6,952,912	6.0	4.0	45.0	41.3	Yes
CF Day						34.9	
CF Evening						34.9	
CF Night						34.9	
CG Noise sensitive point: Demands defined in calculation setup. (873)	356,687	6,952,928	8.3	4.0	45.0	42.6	Yes
CG Day						36.2	
CG Evening						36.2	
CG Night						36.2	

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NORD2000 - Main Result

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, Real Case

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NORD2000 - Assumptions for NORD2000 calculation

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, Real Case

Assumptions

Weather stability	
Relative humidity	70.0 %
Air temperature	10.0 °C
Height for air temperature	2.0 m
Stability parameters	Night;Clear sky
Inverse Monin Obukhov lenght	0.0100
Temperature scale T*	0.0500
Terrain	
Elevation based on object	
Height Contours: Haram_Height.map (2)	
Uniform roughness length	0.0500 m
Uniform roughness class	1.4
Uniform terrain type	D
Wind speed criteria	
Uniform wind speed at 10 m agl.	
Wind speed distribution	Haramsfjellet synth 1998-2017.84.00m -
Probability of exceedance	
Wind direction	0.0 ° - 330.0 ° - 30.0 °
Height above ground level for receiver	4.0 m
Wind speed has been extrapolated to calculation height using	
IEC profile shear (z0 = 0.05m)	
No stability correction	
Version	5.022

All coordinates are in
UTM WGS84 Zone: 32

Setup for Lden calculation

Variant	Name	From hour	To hour	Hours	Penalty [dB]	Days per year
1	Day	7	19	12	0	365
2	Evening	19	23	4	5	365
3	Night	23	7	8	10	365

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NORD2000 - Assumptions for NORD2000 calculation

Calculation: Haramsfjellet 8 x V136 HH 82 m, Relevant NSA, Default Temp 10,0 degC, res 10m, Real Case
WTG: VESTAS V136-4.2 4200 136.0 !O!
Noise: Haramsfjellet_2019_03

Source	Source/Date	Creator	Edited
Manufacturer	2019-03-12	USER	2019-03-12 11:11

Data received from Client in document HKAS B_05_2_Noise Emission Waranty_MR 20190301

		Octave data							
Wind speed [m/s]	LwA,ref [dB(A)]	63 [dB(A)]	125 [dB(A)]	250 [dB(A)]	500 [dB(A)]	1000 [dB(A)]	2000 [dB(A)]	4000 [dB(A)]	8000 [dB(A)]
3.0	90.9	71.5	79.3	84.2	86.1	85.0	80.9	73.8	63.6
4.0	91.1	71.6	79.5	84.4	86.3	85.2	81.0	73.9	63.7
5.0	92.9	73.3	81.3	86.2	88.1	86.9	82.7	75.4	65.0
6.0	96.0	76.5	84.5	89.3	91.2	90.0	85.8	78.6	68.3
7.0	99.6	80.2	88.1	93.0	94.8	93.6	89.4	82.2	71.9
8.0	102.8	83.7	91.4	96.2	97.9	96.8	92.7	85.7	75.5
9.0	103.9	84.8	92.5	97.2	99.0	97.9	93.8	86.9	76.8
10.0	103.9	84.9	92.5	97.2	99.0	97.9	93.8	86.9	76.9
11.0	103.9	84.9	92.6	97.2	99.0	97.9	93.8	87.0	77.1
12.0	103.9	85.0	92.6	97.2	99.0	97.9	93.9	87.0	77.3
13.0	103.9	85.2	92.6	97.2	99.0	97.9	93.9	87.2	77.5
14.0	103.9	85.3	92.6	97.2	98.9	97.9	94.0	87.3	77.8
15.0	103.9	85.3	92.6	97.2	98.9	97.9	94.0	87.5	78.1
16.0	103.9	85.5	92.7	97.2	98.9	97.9	94.1	87.6	78.3
17.0	103.9	85.5	92.7	97.2	98.9	97.9	94.1	87.7	78.5
18.0	103.9	85.6	92.8	97.2	98.9	97.9	94.2	87.8	78.7
19.0	103.9	85.7	92.8	97.1	98.8	97.9	94.2	87.9	78.8
20.0	103.9	85.8	92.8	97.1	98.8	97.9	94.2	88.0	79.0

NSA: Noise sensitive point: Demands defined in calculation setup. (733)-A
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Demands defined in calculation setup. (734)-B
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Demands defined in calculation setup. (735)-C
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Demands defined in calculation setup. (736)-D
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Demands defined in calculation setup. (737)-E
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

NSA: Noise sensitive point: Demands defined in calculation setup. (738)-F
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model

Distance demand: 0.0 m

Appendix E: WindPRO printouts shadow

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Calculated:
2018-12-19 13:45/3.2.723

SHADOW - Main Result

Calculation: Haramsfjellet 8 x V136, spesific sunprobability, SO1

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/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.31	0.33	0.33	0.35	0.39	0.33	0.29	0.30	0.28	0.29	0.32	0.30

Operational hours are calculated from WTGs in calculation and wind distribution:
Haramsfjellet secbin 82 m 2013-2014

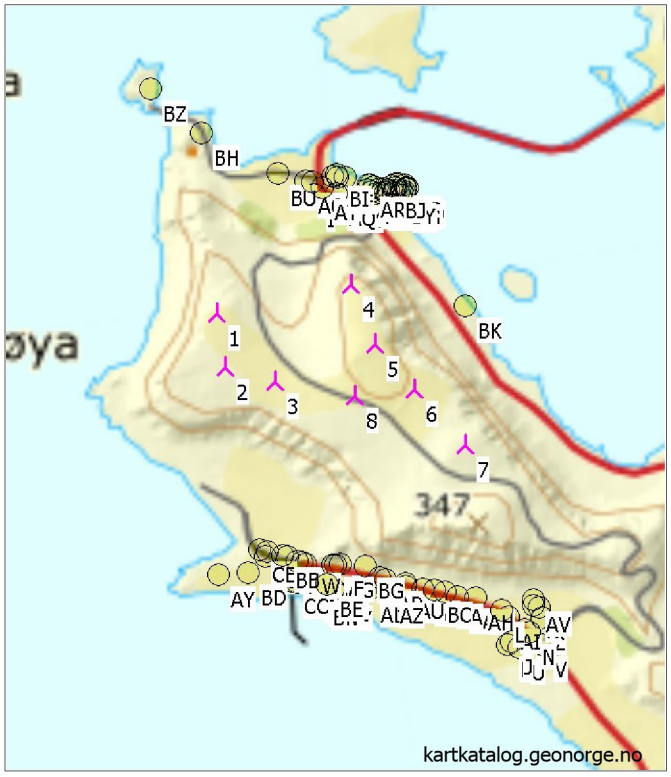
Operational time

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	Sum
349	819	689	425	498	381	854	1,699	1,253	450	273	235	7,926

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: Haram_Height.map (2)
Obstacles used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m
Topographic shadow included in calculation

All coordinates are in
UTM WGS84 Zone: 32



Scale 1:50,000
New WTG
Shadow receptor

WTGs

	X(East)	Y(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	355,408	6,952,169	270.0	T01	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	1,804	10.4
2	355,452	6,951,811	251.1	T02	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	1,804	10.4
3	355,787	6,951,697	245.0	T03	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	1,804	10.4
4	356,322	6,952,324	323.1	T04	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	1,804	10.4
5	356,463	6,951,917	330.0	T05	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	1,804	10.4
6	356,717	6,951,604	292.3	T06	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	1,804	10.4
7	357,038	6,951,221	310.0	T07	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	1,804	10.4
8	356,315	6,951,580	289.7	T08	Yes	VESTAS	V136-4.0-4,000	4,000	136.0	82.0	1,804	10.4

Shadow receptor-Input

No.	X(East)	Y(North)	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
A	357,490	6,950,111	17.4	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
B	357,263	6,949,868	5.7	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
C	355,912	6,950,483	11.7	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
D	356,455	6,952,956	7.7	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
E	356,503	6,952,972	6.4	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
F	356,167	6,950,459	16.7	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
G	356,540	6,952,961	10.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
H	356,488	6,952,946	10.5	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
I	356,104	6,952,943	9.8	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
J	357,295	6,949,890	6.8	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
K	356,599	6,950,309	16.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
L	357,235	6,950,105	12.7	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
M	355,937	6,950,470	11.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
N	357,418	6,949,949	11.5	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0

To be continued on next page...

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Calculated:
2018-12-19 13:45/3.2.723

SHADOW - Main Result

Calculation: Haramsfjellet 8 x V136, spesific sunprobability, SO1

...continued from previous page

No.	X(East)	Y(North)	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
O	356,007	6,950,290	2.4	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
P	355,974	6,950,315	2.8	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
Q	355,685	6,950,564	15.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
R	357,452	6,950,125	17.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
S	356,598	6,952,952	10.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
T	357,384	6,949,967	11.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
U	357,343	6,949,843	9.6	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
V	357,500	6,949,860	10.9	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
W	356,687	6,952,944	10.4	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
X	356,317	6,953,050	1.9	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
Y	356,214	6,950,257	5.8	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
Z	357,507	6,950,041	16.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AA	356,944	6,950,208	14.8	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AB	356,431	6,950,353	15.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AC	355,814	6,950,526	12.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AD	356,348	6,950,278	10.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AE	356,648	6,952,960	13.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AF	356,516	6,952,929	15.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AG	356,135	6,950,453	15.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AH	357,070	6,950,192	15.2	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AI	357,282	6,950,054	12.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AJ	356,114	6,950,453	14.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AK	356,715	6,950,269	15.8	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AL	356,115	6,950,290	5.7	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AM	356,289	6,952,926	9.6	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AN	355,668	6,950,529	13.4	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AO	356,051	6,953,030	5.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AP	356,465	6,950,343	15.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AQ	356,253	6,952,942	8.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AR	356,469	6,952,988	3.5	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AS	356,478	6,952,987	3.7	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AT	356,159	6,952,982	6.6	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AU	356,602	6,950,288	15.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AV	357,454	6,950,166	18.8	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AW	355,877	6,950,490	11.6	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AX	356,095	6,953,023	5.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AY	355,345	6,950,425	8.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
AZ	356,476	6,950,266	11.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BA	356,863	6,950,240	15.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BB	355,782	6,950,531	10.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BC	356,794	6,950,258	15.6	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BD	355,547	6,950,425	8.6	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BE	356,073	6,950,329	6.2	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BF	356,264	6,953,051	3.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BG	356,337	6,950,438	20.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BH	355,363	6,953,382	13.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BI	356,256	6,953,071	2.4	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BJ	356,626	6,952,977	8.4	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BK	357,083	6,952,151	9.2	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BL	356,730	6,952,960	5.2	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BM	356,709	6,952,932	6.5	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BN	356,024	6,950,273	1.9	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BO	356,713	6,952,953	8.5	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BP	356,717	6,952,961	8.4	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BQ	356,632	6,952,931	10.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BR	356,646	6,952,988	5.5	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BS	356,551	6,952,929	15.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BT	355,874	6,950,349	4.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BU	355,863	6,953,093	9.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BV	356,580	6,952,934	12.2	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BW	356,567	6,952,961	10.9	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BX	356,642	6,952,940	11.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BY	356,671	6,952,938	12.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
BZ	355,030	6,953,694	3.6	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
CA	356,228	6,953,055	3.8	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0

To be continued on next page...

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SHADOW - Main Result

Calculation: Haramsfjellet 8 x V136, spesific sunprobability, SO1

...continued from previous page

No.	X(East)	Y(North)	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
CB	356,711	6,952,980	7.8	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
CC	355,834	6,950,356	4.6	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
CD	356,670	6,952,989	10.1	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
CE	355,629	6,950,575	10.6	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
CF	356,679	6,952,912	6.0	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0
CG	356,687	6,952,928	8.3	2.0	2.0	2.0	0.0	90.0	"Green house mode"	4.0

Calculation Results

Shadow receptor

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
A	0:00	0	0:00	0:00
B	0:00	0	0:00	0:00
C	0:00	0	0:00	0:00
D	25:50	69	0:41	5:23
E	26:44	80	0:39	5:34
F	0:00	0	0:00	0:00
G	28:47	85	0:40	6:01
H	27:00	71	0:40	5:38
I	25:12	73	0:39	4:56
J	0:00	0	0:00	0:00
K	0:00	0	0:00	0:00
L	0:00	0	0:00	0:00
M	0:00	0	0:00	0:00
N	0:00	0	0:00	0:00
O	0:00	0	0:00	0:00
P	0:00	0	0:00	0:00
Q	0:42	16	0:04	0:08
R	0:00	0	0:00	0:00
S	34:41	95	0:40	7:17
T	0:00	0	0:00	0:00
U	0:00	0	0:00	0:00
V	0:00	0	0:00	0:00
W	42:27	109	0:39	8:52
X	25:01	76	0:38	5:09
Y	0:00	0	0:00	0:00
Z	0:00	0	0:00	0:00
AA	0:00	0	0:00	0:00
AB	0:00	0	0:00	0:00
AC	0:00	0	0:00	0:00
AD	0:00	0	0:00	0:00
AE	37:40	97	0:39	7:54
AF	29:04	82	0:41	6:06
AG	0:00	0	0:00	0:00
AH	0:00	0	0:00	0:00
AI	0:00	0	0:00	0:00
AJ	0:00	0	0:00	0:00
AK	0:00	0	0:00	0:00
AL	0:00	0	0:00	0:00
AM	20:59	66	0:40	4:19
AN	0:16	11	0:02	0:03
AO	27:01	79	0:37	5:16
AP	0:00	0	0:00	0:00
AQ	21:18	63	0:39	4:21
AR	25:01	70	0:39	5:13
AS	25:07	67	0:39	5:14
AT	24:49	76	0:39	4:57
AU	0:00	0	0:00	0:00
AV	0:00	0	0:00	0:00
AW	0:00	0	0:00	0:00
AX	26:36	82	0:38	5:14

To be continued on next page...

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SHADOW - Main Result

Calculation: Haramsfjellet 8 x V136, spesific sunprobability, SO1

...continued from previous page

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
AY	0:00	0	0:00	0:00
AZ	0:00	0	0:00	0:00
BA	0:00	0	0:00	0:00
BB	0:00	0	0:00	0:00
BC	0:00	0	0:00	0:00
BD	2:54	25	0:09	0:35
BE	0:00	0	0:00	0:00
BF	25:10	75	0:38	5:09
BG	0:00	0	0:00	0:00
BH	8:53	37	0:21	1:23
BI	25:25	74	0:38	5:12
BJ	35:32	95	0:39	7:27
BK	56:01	138	0:40	11:30
BL	35:54	97	0:37	7:33
BM	40:09	109	0:39	8:25
BN	0:00	0	0:00	0:00
BO	42:12	109	0:38	8:49
BP	36:58	99	0:38	7:46
BQ	41:20	105	0:40	8:37
BR	35:44	96	0:38	7:29
BS	30:43	90	0:41	6:28
BT	0:00	0	0:00	0:00
BU	25:30	78	0:33	4:40
BV	33:56	94	0:41	7:08
BW	32:06	92	0:40	6:43
BX	42:20	107	0:40	8:49
BY	42:31	111	0:39	8:52
BZ	6:57	29	0:21	1:19
CA	25:52	77	0:38	5:16
CB	32:09	94	0:37	6:48
CC	0:00	0	0:00	0:00
CD	37:10	98	0:38	7:47
CE	5:16	35	0:13	1:01
CF	39:24	106	0:40	8:18
CG	40:59	109	0:39	8:35

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	T01	75:04	15:28
2	T02	9:38	2:05
3	T03	2:26	0:30
4	T04	178:54	35:37
5	T05	52:27	10:36
6	T06	36:12	7:34
7	T07	26:25	5:18
8	T08	1:23	0:15

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.

Appendix F: WindPRO printouts energy

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Calculated:
13.03.2019 12:07/3.2.743

PARK - Main Result

Calculation: Haramsfjellet 8 x V136 4p2 MW HH 82 m TI 6-12 %

Wake Model N.O. Jensen (RISØ/EMD)

Calculation performed in UTM ED50 Zone: 32
At the site centre the difference between grid north and true north is: -2.5°

Power curve correction method
New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>
Air density calculation method
Height dependent, temperature from climate station
Station: ONA II V3 2014
Base temperature: 7.0 °C at 15.0 m
Base pressure: 1011.4 hPa at 15.0 m
Air density for Site center in key hub height: 236.2 m + 82.0 m = 1.220 kg/m³ -> 99.6 % of Std
Relative humidity: 0.0 %

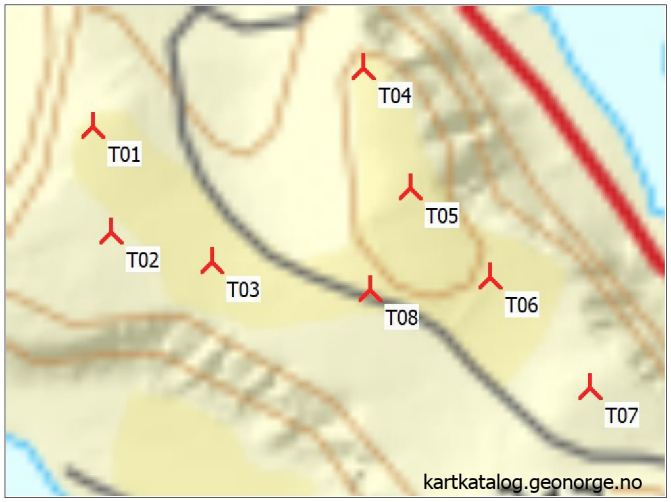
Wake Model Parameters

Terrain type	Wake decay constant
User defined	0.057

Omnidirectional displacement height from objects

Wake calculation settings

Angle [°]			Wind speed [m/s]		
start	end	step	start	end	step
0.5	360.0	1.0	0.5	32.0	1.0



Scale 1:25,000

New WTG

Resource file(s)

L:\KUNDER\123_Haram_Kraft\001_Haramsfjellet_Vindpark\2018_09_EYA\05_WindSim\02_Wind_maps\wind_resources_clim_Haram_82m_2013_2014_0082_int.wrg

Calculated Annual Energy for Wind Farm

				Specific results¤)			
WTG combination	Result PARK [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Wake loss [%]	Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	128,098.1	134,293.5	4.6	43.5	16,012.3	3,812	8.3

¤) Based on wake reduced results, but no other losses included

Calculated Annual Energy for each of 8 new WTGs with total 33.6 MW rated power

	WTG type						Power curve		Annual Energy		
Links	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Creator	Name	Result [MWh/y]	Wake loss [%]	Free mean wind speed [m/s]
1 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	16,553.7	4.8	8.58
2 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	15,824.1	3.7	8.19
3 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	15,203.5	3.9	8.01
4 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	16,897.6	5.7	8.76
5 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	16,667.1	7.7	8.84
6 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	16,631.0	3.0	8.51
7 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	15,209.3	1.2	7.80
8 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	15,112.0	6.4	8.05

Annual Energy results do not include any losses apart from wake losses. Additional losses and uncertainty must be considered for an investment decision.

WTG siting

	UTM WGS84 Zone: 32			
	X(East)	Y(North)	Z [m]	Row data/Description
1 New	355,408	6,952,169	270.0	T01
2 New	355,452	6,951,811	251.1	T02
3 New	355,787	6,951,697	245.0	T03
4 New	356,322	6,952,324	323.1	T04
5 New	356,463	6,951,917	330.0	T05
6 New	356,717	6,951,604	292.3	T06
7 New	357,038	6,951,221	310.0	T07
8 New	356,315	6,951,580	289.7	T08

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PARK - Power Curve Analysis

Calculation: Haramsfjellet 8 x V136 4p2 MW HH 82 m TI 6-12 %**WTG:** 1 - VESTAS V136-4.2 4200 136.0 !O!, Hub height: 82.0 m

Name: Haramsfjellet TI 6-12% 2019-03
Source: Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m²
10.08.2018	USER	04.09.2018	13.03.2019	32.0	Pitch	User defined	Variable	0.29

Received for Haramsfjellet from Client. Document HKAS_B_05-1_Power Curve Warranty_Final Draft.
No CT curve has been received

Power curve

Original data, Air density: 1.200 kg/m³

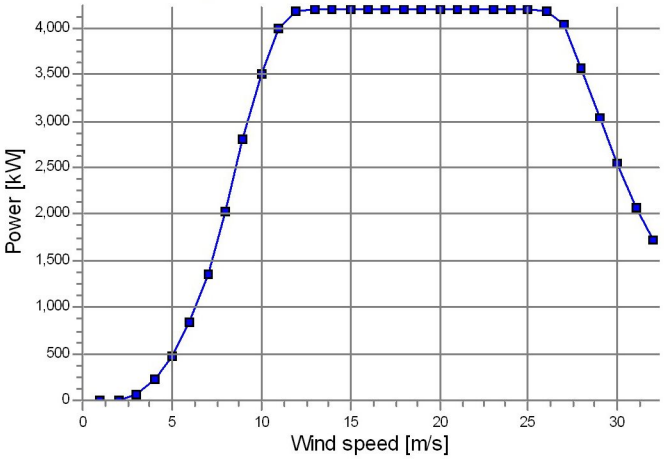
Wind speed [m/s]	Power [kW]	Cp	Wind speed [m/s]	Ct curve
0.0	0.0	0.00	3.0	0.87
0.5	0.0	0.00	3.5	0.85
1.0	0.0	0.00	4.0	0.85
1.5	0.0	0.00	4.5	0.85
2.0	0.0	0.00	5.0	0.84
2.5	0.0	0.00	5.5	0.84
3.0	53.0	0.23	6.0	0.83
3.5	126.0	0.34	6.5	0.83
4.0	215.0	0.39	7.0	0.82
4.5	324.0	0.41	7.5	0.81
5.0	459.0	0.42	8.0	0.82
5.5	624.0	0.43	8.5	0.80
6.0	822.0	0.44	9.0	0.75
6.5	1,056.0	0.44	9.5	0.68
7.0	1,331.0	0.45	10.0	0.61
7.5	1,643.0	0.45	10.5	0.55
8.0	1,997.0	0.45	11.0	0.49
8.5	2,389.0	0.45	11.5	0.43
9.0	2,785.0	0.44	12.0	0.38
9.5	3,149.0	0.42	12.5	0.33
10.0	3,482.0	0.40	13.0	0.29
10.5	3,774.0	0.37	13.5	0.25
11.0	3,982.0	0.34	14.0	0.23
11.5	4,117.0	0.31	14.5	0.20
12.0	4,176.0	0.28	15.0	0.18
12.5	4,194.0	0.25	15.5	0.16
13.0	4,198.0	0.22	16.0	0.15
13.5	4,199.0	0.20	16.5	0.14
14.0	4,200.0	0.18	17.0	0.12
14.5	4,200.0	0.16	17.5	0.11
15.0	4,200.0	0.14	18.0	0.10
15.5	4,200.0	0.13	18.5	0.10
16.0	4,200.0	0.12	19.0	0.09
16.5	4,200.0	0.11	19.5	0.08
17.0	4,200.0	0.10	20.0	0.08
17.5	4,200.0	0.09	20.5	0.07
18.0	4,200.0	0.08	21.0	0.07
18.5	4,200.0	0.08	21.5	0.06
19.0	4,200.0	0.07	22.0	0.06
19.5	4,200.0	0.06	22.5	0.06
20.0	4,200.0	0.06	23.0	0.05
20.5	4,200.0	0.06	23.5	0.05
21.0	4,200.0	0.05	24.0	0.05
21.5	4,200.0	0.05	24.5	0.05
22.0	4,200.0	0.05	25.0	0.04
22.5	4,200.0	0.04	25.5	0.04
23.0	4,200.0	0.04	26.0	0.04
23.5	4,200.0	0.04	26.5	0.04
24.0	4,200.0	0.03	27.0	0.03
24.5	4,200.0	0.03	27.5	0.03
25.0	4,200.0	0.03	28.0	0.03
25.5	4,198.0	0.03	28.5	0.03
26.0	4,182.0	0.03	29.0	0.02
26.5	4,124.0	0.03	29.5	0.02
27.0	4,034.0	0.02	30.0	0.02
27.5	3,835.0	0.02	30.5	0.01
28.0	3,565.0	0.02	31.0	0.01
28.5	3,292.0	0.02	31.5	0.01
29.0	3,039.0	0.01	32.0	0.01
29.5	2,791.0	0.01		
30.0	2,549.0	0.01		
30.5	2,309.0	0.01		
31.0	2,074.0	0.01		
31.5	1,869.0	0.01		
32.0	1,722.0	0.01		

Power, Efficiency and energy vs. wind speed

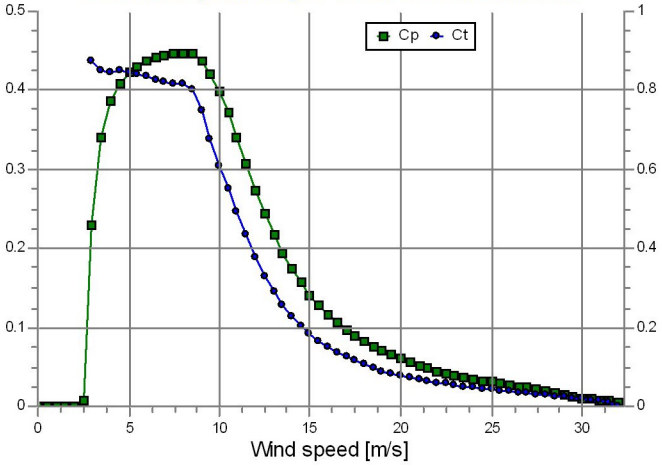
Data used in calculation, Air density: 1.216 kg/m³ New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Cp	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1.0	0.0	0.00	0.50- 1.50	0.0	0.0	0.0
2.0	0.0	0.00	1.50- 2.50	0.3	0.3	0.0
3.0	54.9	0.23	2.50- 3.50	44.4	44.7	0.3
4.0	218.8	0.39	3.50- 4.50	164.6	209.3	1.3
5.0	466.2	0.42	4.50- 5.50	349.9	559.2	3.4
6.0	834.3	0.44	5.50- 6.50	594.4	1,153.6	7.0
7.0	1,350.1	0.45	6.50- 7.50	881.2	2,034.8	12.3
8.0	2,024.7	0.45	7.50- 8.50	1,185.2	3,220.0	19.5
9.0	2,816.1	0.44	8.50- 9.50	1,444.8	4,664.9	28.2
10.0	3,513.3	0.40	9.50-10.50	1,586.9	6,251.7	37.8
11.0	4,000.3	0.34	10.50-11.50	1,576.3	7,828.1	47.3
12.0	4,178.9	0.27	11.50-12.50	1,436.8	9,264.9	56.0
13.0	4,198.2	0.22	12.50-13.50	1,247.5	10,512.4	63.5
14.0	4,200.0	0.17	13.50-14.50	1,066.6	11,579.0	69.9
15.0	4,200.0	0.14	14.50-15.50	905.7	12,484.7	75.4
16.0	4,200.0	0.12	15.50-16.50	764.4	13,249.1	80.0
17.0	4,200.0	0.10	16.50-17.50	641.4	13,890.5	83.9
18.0	4,200.0	0.08	17.50-18.50	535.1	14,425.6	87.1
19.0	4,200.0	0.07	18.50-19.50	443.7	14,869.3	89.8
20.0	4,200.0	0.06	19.50-20.50	365.7	15,235.0	92.0
21.0	4,200.0	0.05	20.50-21.50	299.4	15,534.5	93.8
22.0	4,200.0	0.04	21.50-22.50	243.5	15,778.0	95.3
23.0	4,200.0	0.04	22.50-23.50	196.5	15,974.5	96.5
24.0	4,200.0	0.03	23.50-24.50	157.4	16,131.9	97.5
25.0	4,199.3	0.03	24.50-25.50	125.0	16,256.9	98.2
26.0	4,186.6	0.03	25.50-26.50	97.8	16,354.7	98.8
27.0	4,034.0	0.02	26.50-27.50	73.5	16,428.1	99.2
28.0	3,565.0	0.02	27.50-28.50	51.3	16,479.5	99.6
29.0	3,039.0	0.01	28.50-29.50	33.8	16,513.3	99.8
30.0	2,549.0	0.01	29.50-30.50	21.7	16,535.0	99.9
31.0	2,074.0	0.01	30.50-31.50	13.6	16,548.6	100.0
32.0	1,722.0	0.01	31.50-32.50	5.2	16,553.7	100.0

Power curve
For air density: 1.216 kg/m³ and reference climate data



Cp and Ct curve
For air density: 1.216 kg/m³ and reference climate data



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Calculated:
13.03.2019 12:07/3.2.743

PARK - Main Result

Calculation: Haramsfjellet 8 x V136 4p2 MW HH 82 m Mode SO1 (HWO) Low HH

Wake Model N.O. Jensen (RISØ/EMD)

Calculation performed in UTM ED50 Zone: 32
At the site centre the difference between grid north and true north is: -2.5°

Power curve correction method
New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>
Air density calculation method
Height dependent, temperature from climate station
Station: ONA II V3 2014
Base temperature: 7.0 °C at 15.0 m
Base pressure: 1011.4 hPa at 15.0 m
Air density for Site center in key hub height: 236.2 m + 82.0 m = 1.220 kg/m³ -> 99.6 % of Std
Relative humidity: 0.0 %

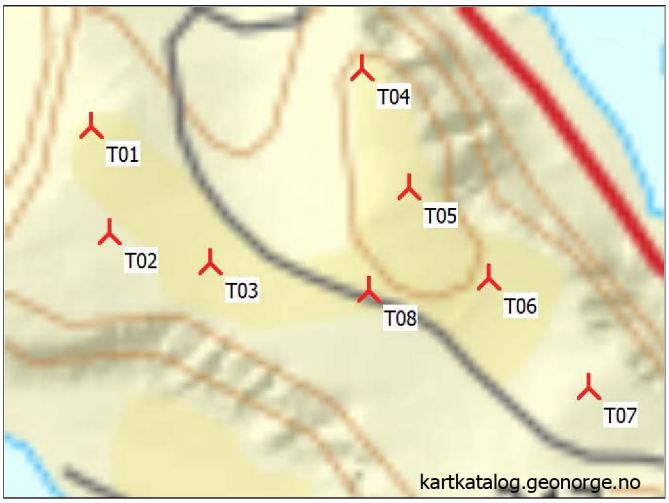
Wake Model Parameters

Terrain type	Wake decay constant
User defined	0.057

Omnidirectional displacement height from objects

Wake calculation settings

Angle [°]			Wind speed [m/s]		
start	end	step	start	end	step
0.5	360.0	1.0	0.5	32.0	1.0



Scale 1:25,000
New WTG

Resource file(s)

L:\KUNDER\123_Haram_Kraft\001_Haramsfjellet_Vindpark\2018_09_EYA\05_WindSim\02_Wind_maps\wind_resources_clim_Haram_82m_2013_2014_0082_int.wrg

Calculated Annual Energy for Wind Farm

							Specific results¤)
WTG combination	Result PARK [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Wake loss [%]	Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	122,282.3	128,097.9	4.5	41.5	15,285.3	3,639	8.3

¤) Based on wake reduced results, but no other losses included

Calculated Annual Energy for each of 8 new WTGs with total 33.6 MW rated power

		WTG type						Power curve		Annual Energy		
	Links	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Creator	Name	Result [MWh/y]	Wake loss [%]	Free mean wind speed [m/s]
1	A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Mode SO1 (HWO) Low HH Haramsfjellet	15,792.3	4.8	8.58
2	A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Mode SO1 (HWO) Low HH Haramsfjellet	15,094.0	3.7	8.19
3	A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Mode SO1 (HWO) Low HH Haramsfjellet	14,501.1	3.9	8.01
4	A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Mode SO1 (HWO) Low HH Haramsfjellet	16,137.5	5.6	8.76
5	A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Mode SO1 (HWO) Low HH Haramsfjellet	15,934.8	7.5	8.84
6	A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Mode SO1 (HWO) Low HH Haramsfjellet	15,867.3	2.9	8.51
7	A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Mode SO1 (HWO) Low HH Haramsfjellet	14,515.6	1.2	7.80
8	A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Mode SO1 (HWO) Low HH Haramsfjellet	14,439.6	6.3	8.05

Annual Energy results do not include any losses apart from wake losses. Additional losses and uncertainty must be considered for an investment decision.

WTG siting

		UTM WGS84 Zone: 32			
		X(East)	Y(North)	Z [m]	Row data/Description
1	New	355,408	6,952,169	270.0	T01
2	New	355,452	6,951,811	251.1	T02
3	New	355,787	6,951,697	245.0	T03
4	New	356,322	6,952,324	323.1	T04
5	New	356,463	6,951,917	330.0	T05
6	New	356,717	6,951,604	292.3	T06
7	New	357,038	6,951,221	310.0	T07
8	New	356,315	6,951,580	289.7	T08

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Calculated:
13.03.2019 12:07/3.2.743

PARK - Power Curve Analysis

Calculation: Haramsfjellet 8 x V136 4p2 MW HH 82 m Mode SO1 (HWO) Low HH **WTG:** 1 - VESTAS V136-4.2 4200 136.0 !O!, Hub height: 82.0 m

Name: Mode SO1 (HWO) Low HH Haramsfjellet
Source: Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type	Generator type	Specific power kW/m²
10.08.2018	USER	04.09.2018	13.03.2019	32.0	Pitch	User defined	Variable	0.29

Document no.: 0067-7066 V05
The power curves and Ct values are valid for hub heights 112m and 132 m.

Power curve

Original data, Air density: 1.200 kg/m³

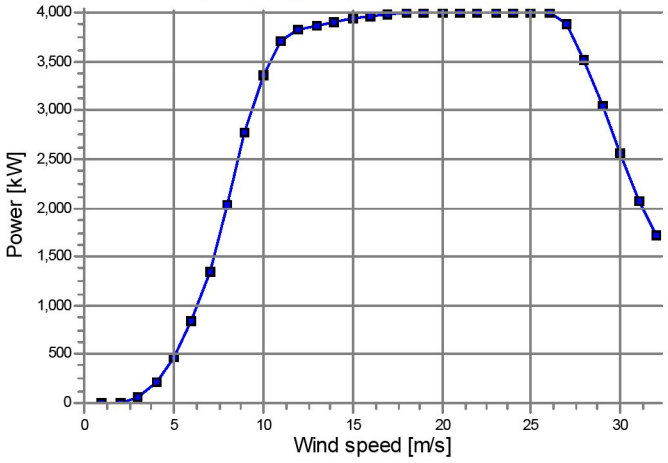
Wind speed [m/s]	Power [kW]	Cp	Wind speed [m/s]	Ct curve
3.0	53.0	0.23	3.0	0.87
3.5	126.0	0.34	3.5	0.85
4.0	215.0	0.39	4.0	0.85
4.5	324.0	0.41	4.5	0.85
5.0	459.0	0.42	5.0	0.84
5.5	624.0	0.43	5.5	0.84
6.0	822.0	0.44	6.0	0.83
6.5	1,056.0	0.44	6.5	0.83
7.0	1,332.0	0.45	7.0	0.83
7.5	1,646.0	0.45	7.5	0.84
8.0	1,997.0	0.45	8.0	0.83
8.5	2,372.0	0.44	8.5	0.79
9.0	2,739.0	0.43	9.0	0.72
9.5	3,064.0	0.41	9.5	0.65
10.0	3,338.0	0.38	10.0	0.58
10.5	3,553.0	0.35	10.5	0.51
11.0	3,697.0	0.32	11.0	0.45
11.5	3,777.0	0.28	11.5	0.39
12.0	3,817.0	0.25	12.0	0.34
12.5	3,839.0	0.23	12.5	0.30
13.0	3,859.0	0.20	13.0	0.26
13.5	3,881.0	0.18	13.5	0.23
14.0	3,900.0	0.16	14.0	0.21
14.5	3,918.0	0.15	14.5	0.19
15.0	3,932.0	0.13	15.0	0.17
15.5	3,945.0	0.12	15.5	0.15
16.0	3,957.0	0.11	16.0	0.14
16.5	3,969.0	0.10	16.5	0.13
17.0	3,981.0	0.09	17.0	0.12
17.5	3,992.0	0.09	17.5	0.11
18.0	3,997.0	0.08	18.0	0.10
18.5	3,999.0	0.07	18.5	0.09
19.0	4,000.0	0.07	19.0	0.09
19.5	4,000.0	0.06	19.5	0.08
20.0	4,000.0	0.06	20.0	0.07
20.5	4,000.0	0.05	20.5	0.07
21.0	4,000.0	0.05	21.0	0.06
21.5	4,000.0	0.05	21.5	0.06
22.0	4,000.0	0.04	22.0	0.06
22.5	4,000.0	0.04	22.5	0.05
23.0	4,000.0	0.04	23.0	0.05
23.5	4,000.0	0.04	23.5	0.05
24.0	4,000.0	0.03	24.0	0.05
24.5	4,000.0	0.03	24.5	0.04
25.0	4,000.0	0.03	25.0	0.04
25.5	3,999.0	0.03	25.5	0.04
26.0	3,987.0	0.03	26.0	0.04
26.5	3,946.0	0.02	26.5	0.04
27.0	3,882.0	0.02	27.0	0.03
27.5	3,731.0	0.02	27.5	0.03
28.0	3,516.0	0.02	28.0	0.03
28.5	3,279.0	0.02	28.5	0.02
29.0	3,037.0	0.01	29.0	0.02
29.5	2,791.0	0.01	29.5	0.02
30.0	2,549.0	0.01	30.0	0.02
30.5	2,309.0	0.01	30.5	0.01
31.0	2,074.0	0.01	31.0	0.01
31.5	1,869.0	0.01	31.5	0.01
32.0	1,722.0	0.01	32.0	0.01

Power, Efficiency and energy vs. wind speed

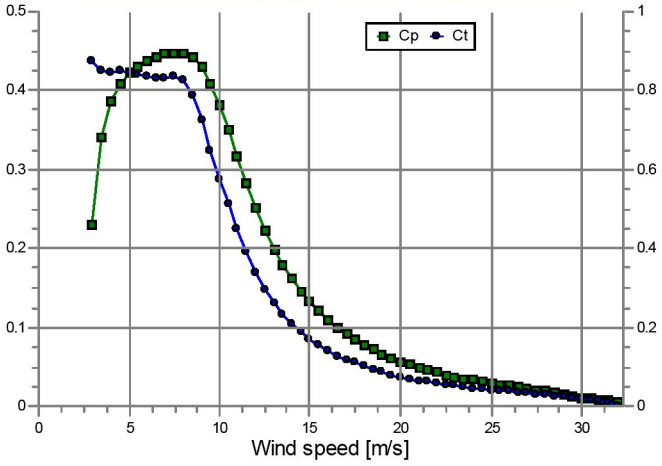
Data used in calculation, Air density: 1.216 kg/m³ New windPRO method (adjusted IEC method, improved to match turbine control) <RECOMMENDED>

Wind speed [m/s]	Power [kW]	Cp	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1.0	0.0	0.00	0.50- 1.50	0.0	0.0	0.0
2.0	0.0	0.00	1.50- 2.50	0.0	0.0	0.0
3.0	54.9	0.23	2.50- 3.50	44.1	44.1	0.3
4.0	218.8	0.39	3.50- 4.50	164.6	208.7	1.3
5.0	466.2	0.42	4.50- 5.50	350.1	558.8	3.5
6.0	834.3	0.44	5.50- 6.50	594.6	1,153.4	7.3
7.0	1,351.2	0.45	6.50- 7.50	882.3	2,035.7	12.9
8.0	2,023.5	0.45	7.50- 8.50	1,181.2	3,216.9	20.4
9.0	2,766.8	0.43	8.50- 9.50	1,417.9	4,634.7	29.3
10.0	3,361.1	0.38	9.50-10.50	1,516.4	6,151.2	39.0
11.0	3,707.8	0.32	10.50-11.50	1,464.4	7,615.6	48.2
12.0	3,820.5	0.25	11.50-12.50	1,317.2	8,932.8	56.6
13.0	3,862.9	0.20	12.50-13.50	1,148.3	10,081.1	63.8
14.0	3,903.4	0.16	13.50-14.50	991.2	11,072.3	70.1
15.0	3,934.6	0.13	14.50-15.50	848.4	11,920.7	75.5
16.0	3,959.6	0.11	15.50-16.50	720.7	12,641.4	80.0
17.0	3,983.5	0.09	16.50-17.50	608.2	13,249.6	83.9
18.0	3,997.5	0.08	17.50-18.50	509.2	13,758.9	87.1
19.0	4,000.0	0.07	18.50-19.50	422.7	14,181.6	89.8
20.0	4,000.0	0.06	19.50-20.50	348.4	14,530.0	92.0
21.0	4,000.0	0.05	20.50-21.50	285.3	14,815.3	93.8
22.0	4,000.0	0.04	21.50-22.50	232.0	15,047.2	95.3
23.0	4,000.0	0.04	22.50-23.50	187.2	15,234.5	96.5
24.0	4,000.0	0.03	23.50-24.50	150.0	15,384.4	97.4
25.0	3,999.7	0.03	24.50-25.50	119.1	15,503.5	98.2
26.0	3,990.3	0.03	25.50-26.50	93.4	15,596.9	98.8
27.0	3,882.0	0.02	26.50-27.50	70.8	15,667.7	99.2
28.0	3,516.0	0.02	27.50-28.50	50.4	15,718.1	99.5
29.0	3,037.0	0.01	28.50-29.50	33.7	15,751.9	99.7
30.0	2,549.0	0.01	29.50-30.50	21.7	15,773.6	99.9
31.0	2,074.0	0.01	30.50-31.50	13.6	15,787.2	100.0
32.0	1,722.0	0.01	31.50-32.50	5.2	15,792.3	100.0

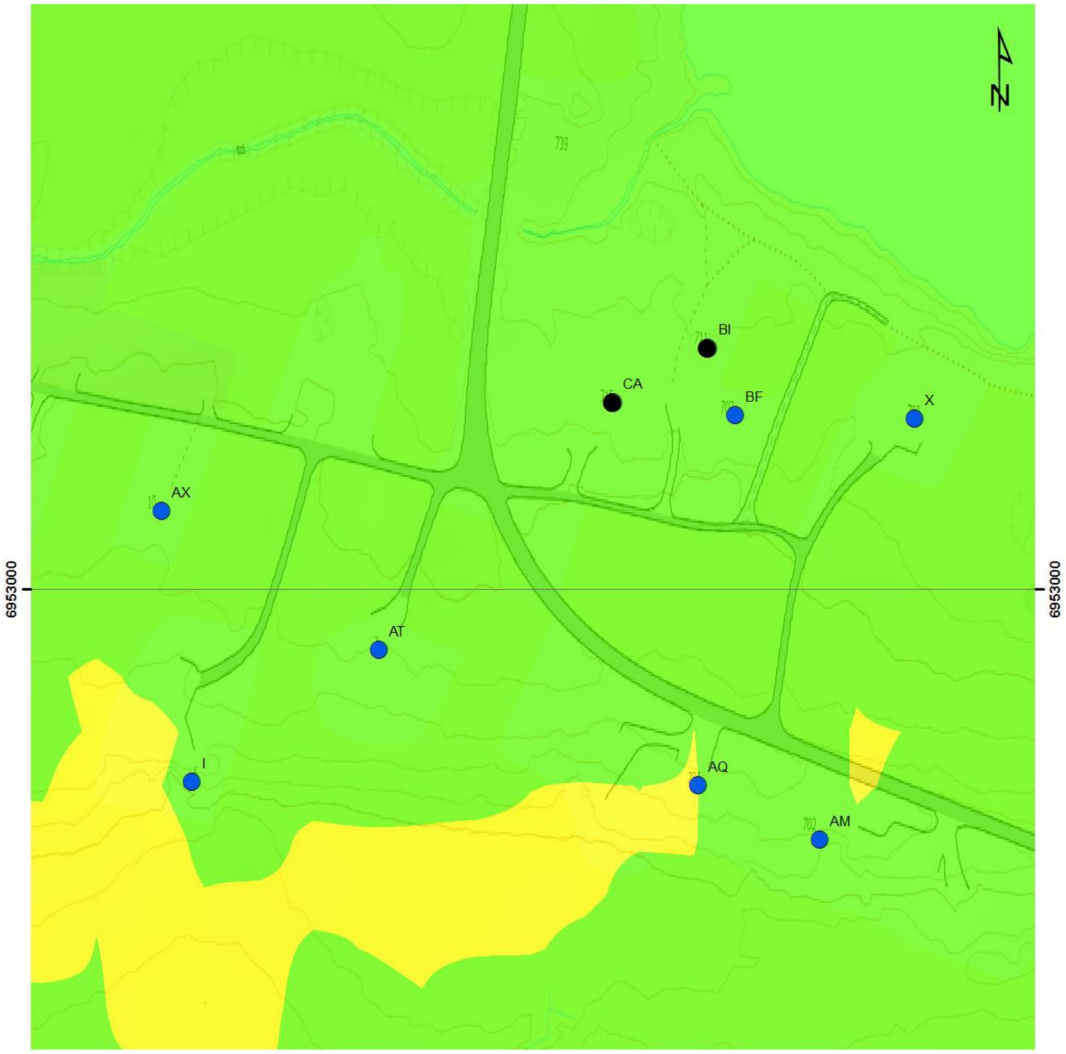
Power curve
For air density: 1.216 kg/m³ and reference climate data



Cp and Ct curve
For air density: 1.216 kg/m³ and reference climate data



Appendix G: Detailed Noise maps, worst case, mode PO1



Noise Vestas layout

- < 40
- 40 - 45
- 45- 55
- > 55
- House
- Holiday house

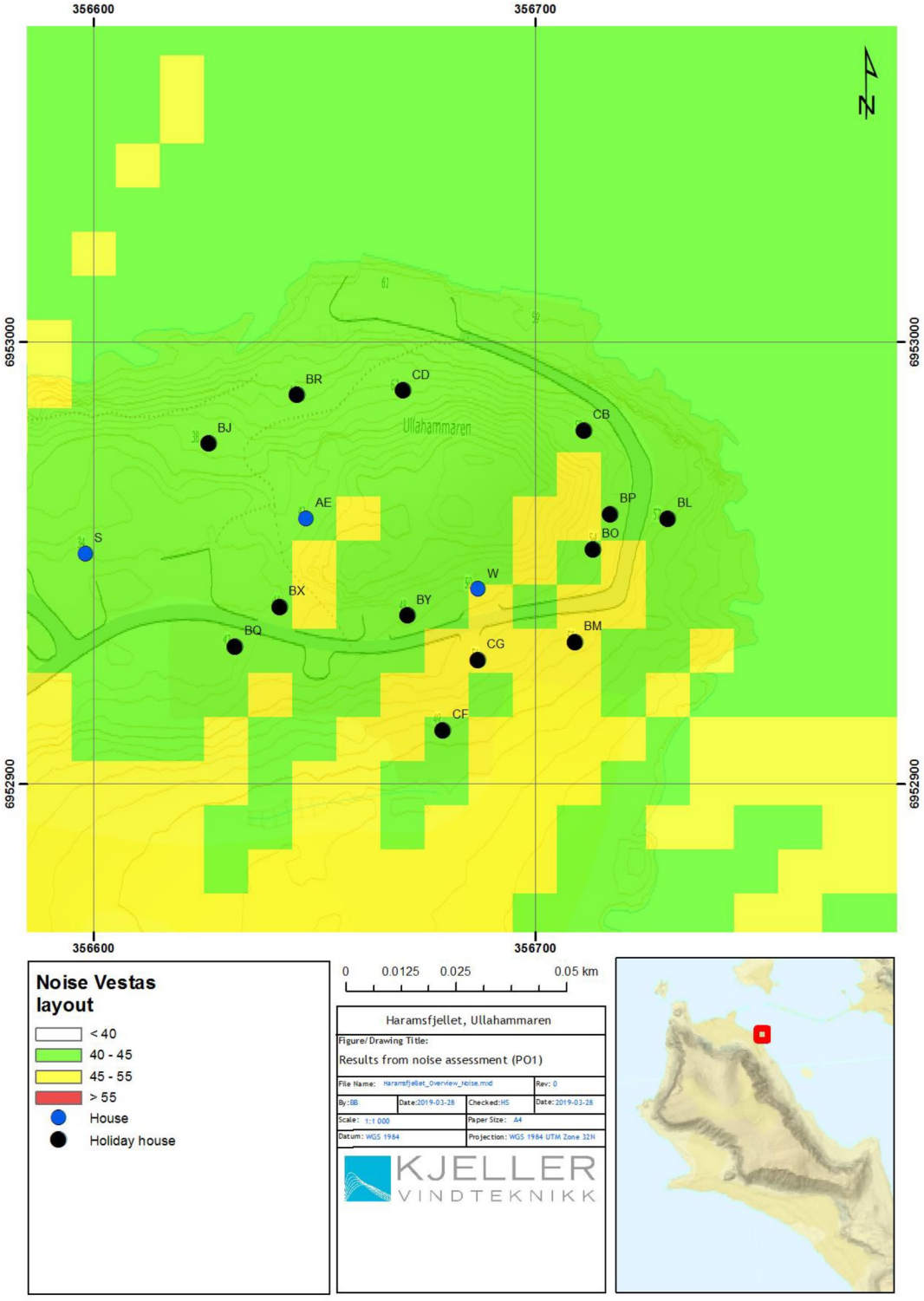
0 0.0175 0.035 0.07 km

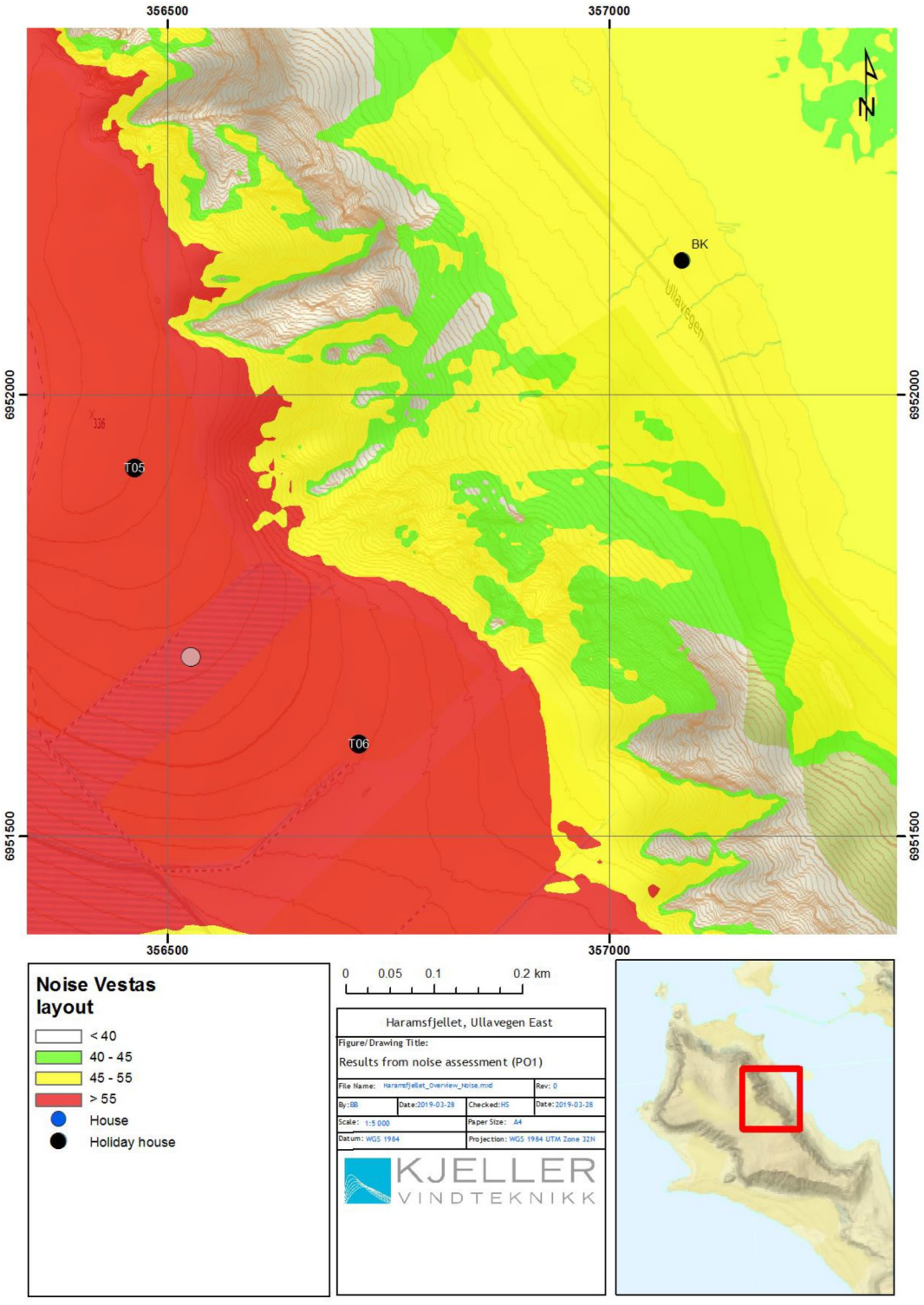
Haramsfjellet, Ullavegen

Figure/ Drawing Title:
Results from noise assessment (PO1)

File Name: Haramsfjellet_Overview_Noise.mod			Rev: 0
By: BB	Date: 2019-03-28	Checked: HS	Date: 2019-03-28
Scale: 1:1 500		Paper Size: A4	
Datum: WGS 1984		Projection: WGS 1984 UTM Zone 32N	

KJELLER VINDTEKNIKK


356600
356700
6953000
6952900
N
BR
CD
BJ
CB
Ullahammaren
AE
BP
BL
S
BO
W
BX
BY
BM
BQ
CG
CF
Noise Vestas layout
< 40
40 - 45
45 - 55
> 55
House
Holiday house
0
0.0125
0.025
0.05 km
Haramsfjellet, Ullahammaren
Figure/Drawing Title:
Results from noise assessment (PO1)
File Name: Haramsfjellet_Overview_Noise.mxd
Rev: 0
By: BB
Date: 2019-03-28
Checked: HS
Date: 2019-03-28
Scale: 1:1 000
Paper Size: A4
Datum: WGS 1984
Projection: WGS 1984 UTM Zone 32N
KJELLER VINDTEKNIKK


356500
357000
6952000
6951500
N
BK
Ullavegen
T05
T06
Noise Vestas layout
< 40
40 - 45
45 - 55
> 55
House
Holiday house
0 0.05 0.1 0.2 km
Haramsfjellet, Ullavegen East
Figure/Drawing Title:
Results from noise assessment (PO1)
File Name: Haramsfjellet_Overview_Noise.mxd
Rev: 0
By: BB
Date: 2019-03-28
Checked: HS
Date: 2019-03-28
Scale: 1:5 000
Paper Size: A4
Datum: WGS 1984
Projection: WGS 1984 UTM Zone 32N
KJELLER VINDTEKNIKK

Appendix H: Detailed Noise maps, worst case, mode SO1