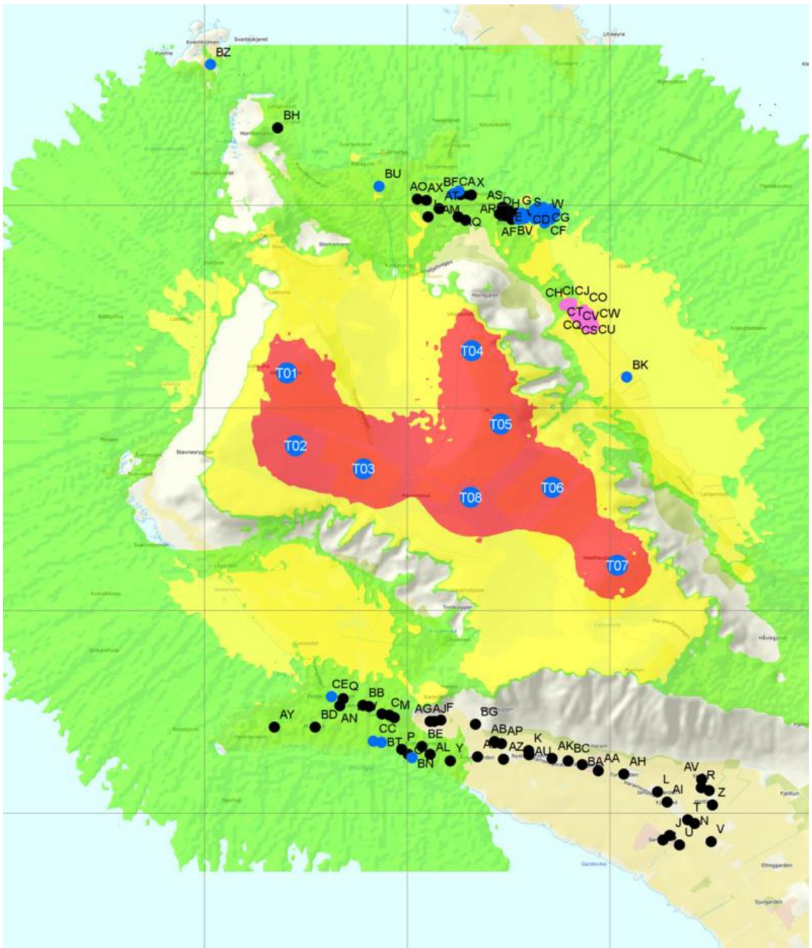
Haramsfjellet, Haram Municipality, Møre og Romsdal, Norway

Noise calculation

Report number: KVT/MEH/2019/R063



KJELLER VINDTEKNIKK

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Objectives

The main objective of this study is to calculate the noise level 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 noise maps for the surrounding area and tables covering the noise sensitive locations including existing houses and planned holiday houses at property 10/72 and 10/73.

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

Revision history

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Contents

1 Summary and conclusions

The noise 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. Three different power modes have been used for the calculations; one is optimized for power production (PO1) and the others are optimized with respect to noise restrictions (SO1 and SO2). The turbines run in High Wind Operation (HWO). The nominal power is 4.2 MW for the power optimized mode (PO1, HWO) and 4.0 MW for the sound optimized mode (SO1/SO2, 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 source noise level of 103.9 dB(A) in mode PO1 (HWO), 102.0 dB(A) in mode SO1 (HWO), and 99.5 dB(A) in mode SO2 at 8 m/s at 10 m height. The wind farm layouts and the noise sensitive locations, both existing buildings and planned holiday houses, are presented in Figure 1-1.

The noise calculations are carried out using the Nord2000 noise propagation model implemented in WindPRO with a map of terrain types and a roughness map. With this input, the noise level generated by the turbines exceeds the L_{DEN} 45 dB(A) limit for 2 houses and 13 planned holiday houses in mode PO1, and for 1 planned holiday house for an alternative case with a mix of SO1 and SO2 power modes, for worst case calculations. When real case calculations are carried out, the noise level is not exceeding L_{DEN} 45 dB(A) at any existing house or planned holiday houses.

The estimated energy loss when using the alternative case with a mix of SO1 (HWO) and SO2 (HWO) power mode instead of PO1 (HWO) to fulfil noise restrictions is 2.2 % when using wind direction curtailment.

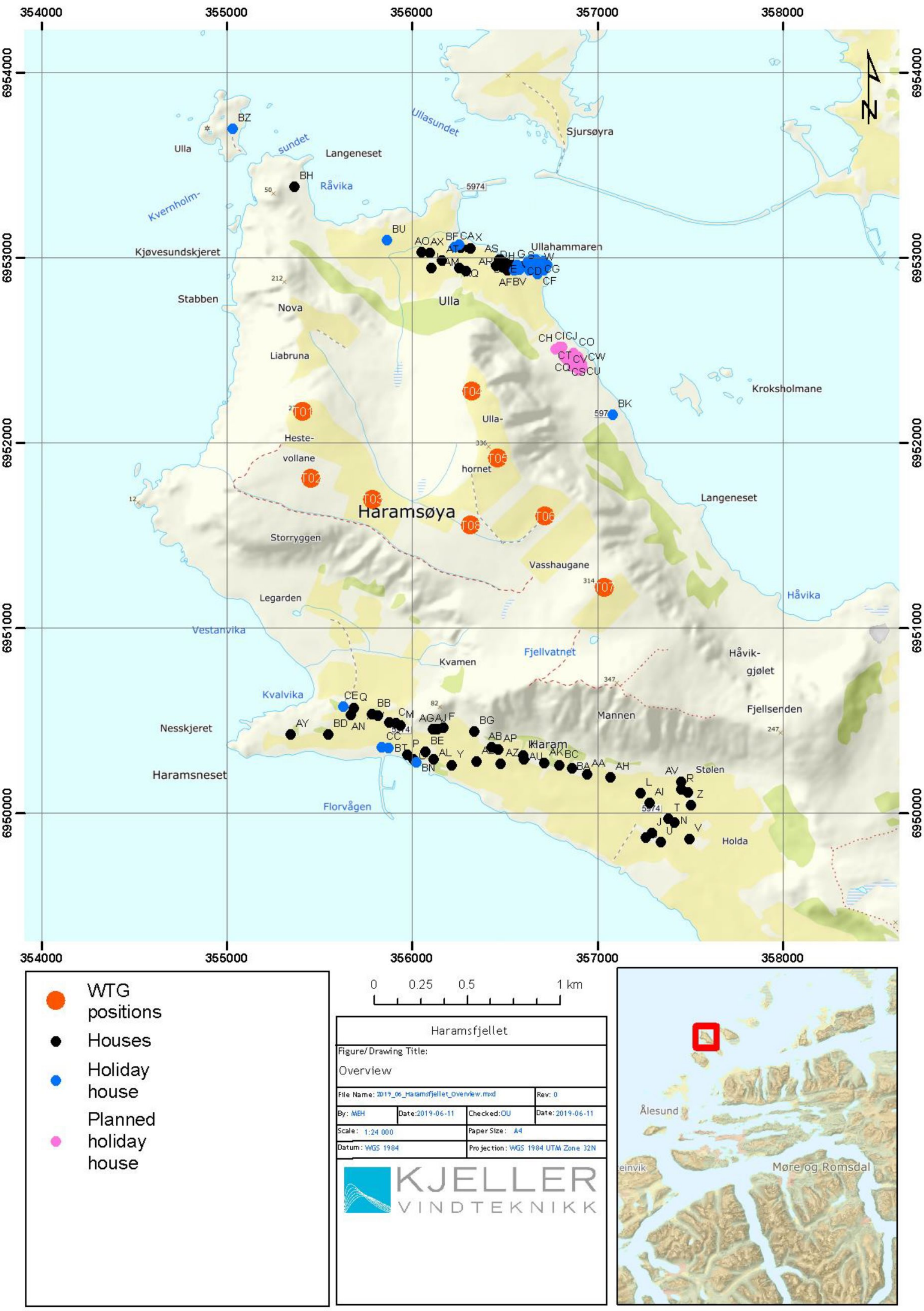

Figure 1-1 Vestas developed layout consisting of 8 Vestas V136 wind turbines. The surrounding noise sensitive locations of existing houses and holiday houses are also shown together with the planned holiday houses at property 10/72 and 10/73.

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.

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. If other wind speeds will cause higher noise levels than the 8 m/s in 10 m height the other wind speeds should be considered used for the calculations.

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, Alternative case

An alternative to running all turbines in PO1 mode is to have different modes for different turbines in order to obtain lower noise emissions. Here, the alternative case has turbine T04 running in SO1 mode, turbine T05 and T06 running in SO2 mode, while the rest of the turbines are running in PO1 mode. Otherwise, the calculations in NORD2000 are the same for the main case and the alternative case where both are calculated following worst case settings as described above. The turbines have the highest noise emissions to a noise receptor when the receptor is located downwind of the turbines, and the turbines that are closest to the noise receptors have the greater effect on the noise levels. Thus, the alternative case may run with changing the power modes only for certain critical wind directions, and run in PO1 mode for the rest of the wind directions. For the alternative case the critical wind directions are from 215° to 240°, see Figure 2-1.

Figure 2-1: Sketch of alternative case. For wind directions inside the yellow triangle T05 and T06 are running in SO2 mode (light blue), and T04 is running in SO1 (red), while the rest of the turbines are always running in PO1 mode (dark blue).

2.3 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). No noise-map is presented for the real case calculations.

2.4 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 for all turbines. Secondly, noise calculations are made using two sound optimized (SO1 and SO2) power curves in HWO and sound emission data in the alternative case. The turbines are running as 4.0MW turbines instead of 4.2MW for the sound optimized modes. 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, SO2)	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, sound optimized mode SO1 (HWO) in Table 2-3, and sound optimized mode SO2 (HWO) in Table 2-4. 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

Table 2-4: Octave data for different wind speed levels at hub height for sound optimized mode (SO2, 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	71.6	79.4	84.2	86.1	85.0	80.8	73.8	63.7	90.9
4	71.7	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	76.5	84.4	89.2	91.1	89.9	85.7	78.5	68.2	95.9
7	79.9	87.6	92.3	94.1	93.0	88.9	81.9	71.9	99.0
8	80.2	87.9	92.8	94.6	93.4	89.3	89.3	82.1	99.4
9	80.3	88.0	92.7	94.5	93.4	89.3	82.4	72.4	99.4
10	80.6	88.2	92.8	94.6	93.5	89.5	82.6	72.8	99.5
11	80.7	88.2	92.8	94.6	93.5	89.5	82.8	73.1	99.5
12	80.8	88.2	92.8	94.5	93.5	89.6	82.9	73.3	99.5
13	80.9	88.2	92.8	94.5	93.5	89.6	83.0	73.5	99.5
14	80.9	88.1	92.7	94.4	93.4	89.6	83.1	73.7	99.4
15	81.0	88.2	92.7	94.4	93.4	89.6	83.1	73.9	99.4
16	81.1	88.3	92.8	94.5	93.5	89.7	83.3	74.1	99.5
17	81.2	88.4	92.8	94.5	93.5	89.8	83.4	74.3	99.5
18	81.3	88.4	92.7	94.4	93.5	89.8	83.6	74.5	99.5
19	81.4	88.4	92.7	94.4	93.5	89.9	83.6	74.6	99.5
20	81.5	88.4	92.7	94.4	93.5	89.9	83.8	74.9	99.5

The most important noise model data are summarized in Table 2-5. Height contours with 5 m equidistance is used and considered appropriate for the noise calculations. After 2012 all houses must be considered to be in wind shadow in the calculations, which is making the noise calculations more conservative than if not. The calculations are done for all 8 turbines at the same time to get the collective noise levels at the noise receptors. This is done to avoid missing out on multi-source effects.

The calculations include both roughness map and different terrain types for the area. The water surrounding Haramsfjellet is included with a hardness of 20 000, the parts of the island with bare rock is included with hardness 2000, and the main ground cover is included with hardness 200. From satellite photos of Haramsfjellet the area is estimated to be mainly covered by grass, both in the areas with houses and at the top of the mountain. The hillsides on the mountain have partly bare rock and are therefore included in the terrain map with its own hardness. The terrain map is thus constructed as a mix of terrain type G for the water, terrain type F for the bare rocks, and terrain type D for the grass in NORD2000, see Figure 2-3. The locations in between the turbines and the buildings will generally have greater influence on noise levels closer to the noise sensitive locations. This is due to that the noise reflection point will generally be close to the houses. The areas with the exposed rock (higher hardness) are mainly in shadow zones in the direction of the noise propagation and are thus having a minimal influence on the noise levels at the houses and holiday houses.

The meteorological parameters are selected in accordance to WindPRO recommendations of standard parameters, together with an example on calculations in typical Norwegian topography (Meventus AS, Sinus AS, 2017). 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.

A roughness map is included to account for the terrain effects on the wind profile. The roughness lengths used in the calculations and presented in the roughness map is estimated from a study on roughness lengths for corine land (Silva, Ribeiro, Guendes, Rua, & Ulrich, 2007). A roughness length of 0.03 m is used for the land (mainly grass). For the areas with bare rock a roughness length of 0.01 m is used (rock partly covered and surrounded by vegetation). The roughness in the areas with relatively dense housing at Haramsfjellet is set between 0.15 m and 0.2 m depending on how close the houses are to each other. The roughness length for water is set to 0.0002 m. See Figure 2-2.

The location of noise sensitive receptors has been set according to coordinates 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 existing noise receptors. In addition a set of planned holiday houses are included, see Appendix B: Coordinates of planned . The location of all the receptors is presented in Figure 1-1 above.

Some more parameters are given in Appendix C: WindPRO printouts noise, PO1, worst caseAppendix D: WindPRO printouts noise, Alternative case.

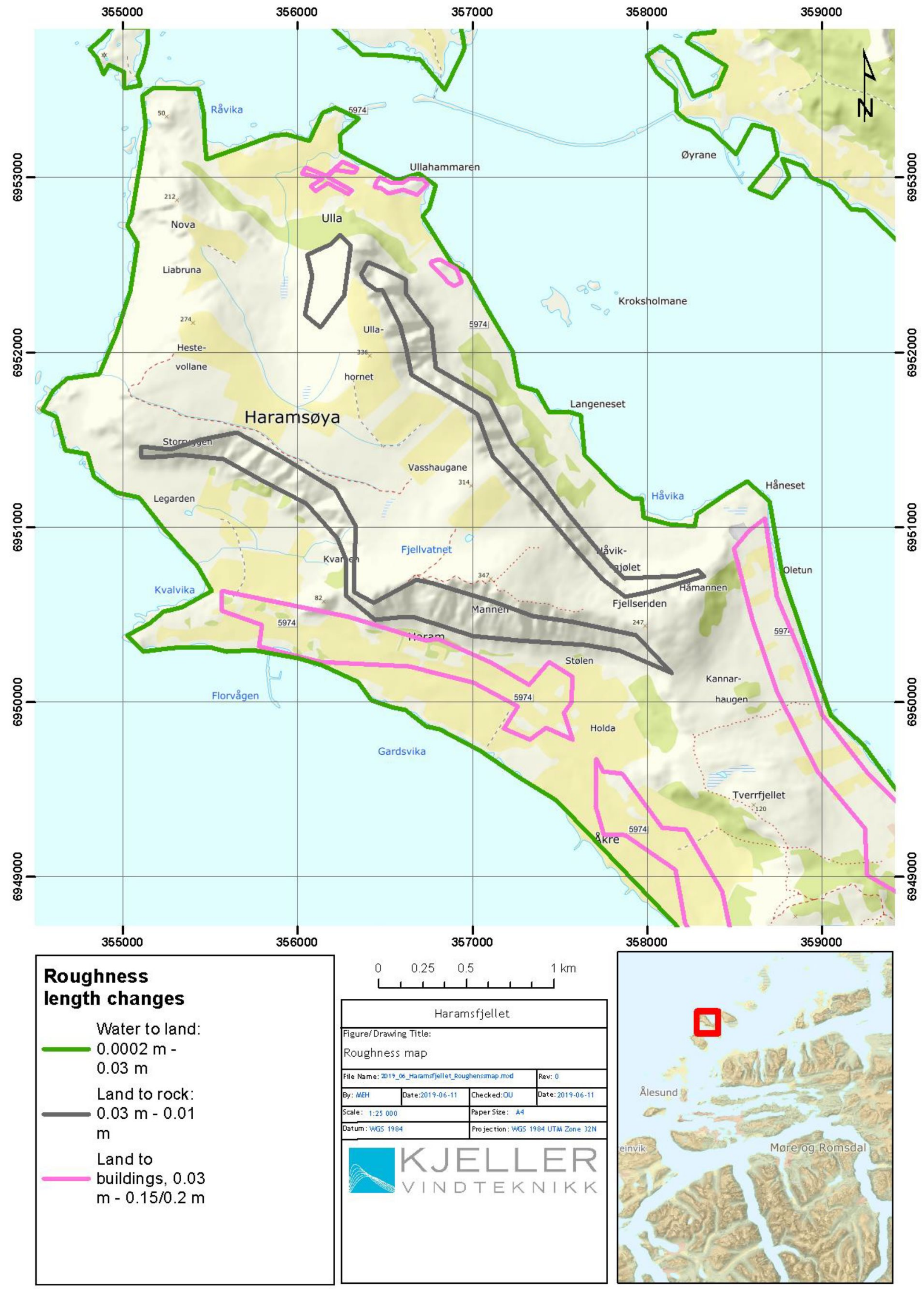

Figure 2-2: Roughness map for Haramsfjellet.

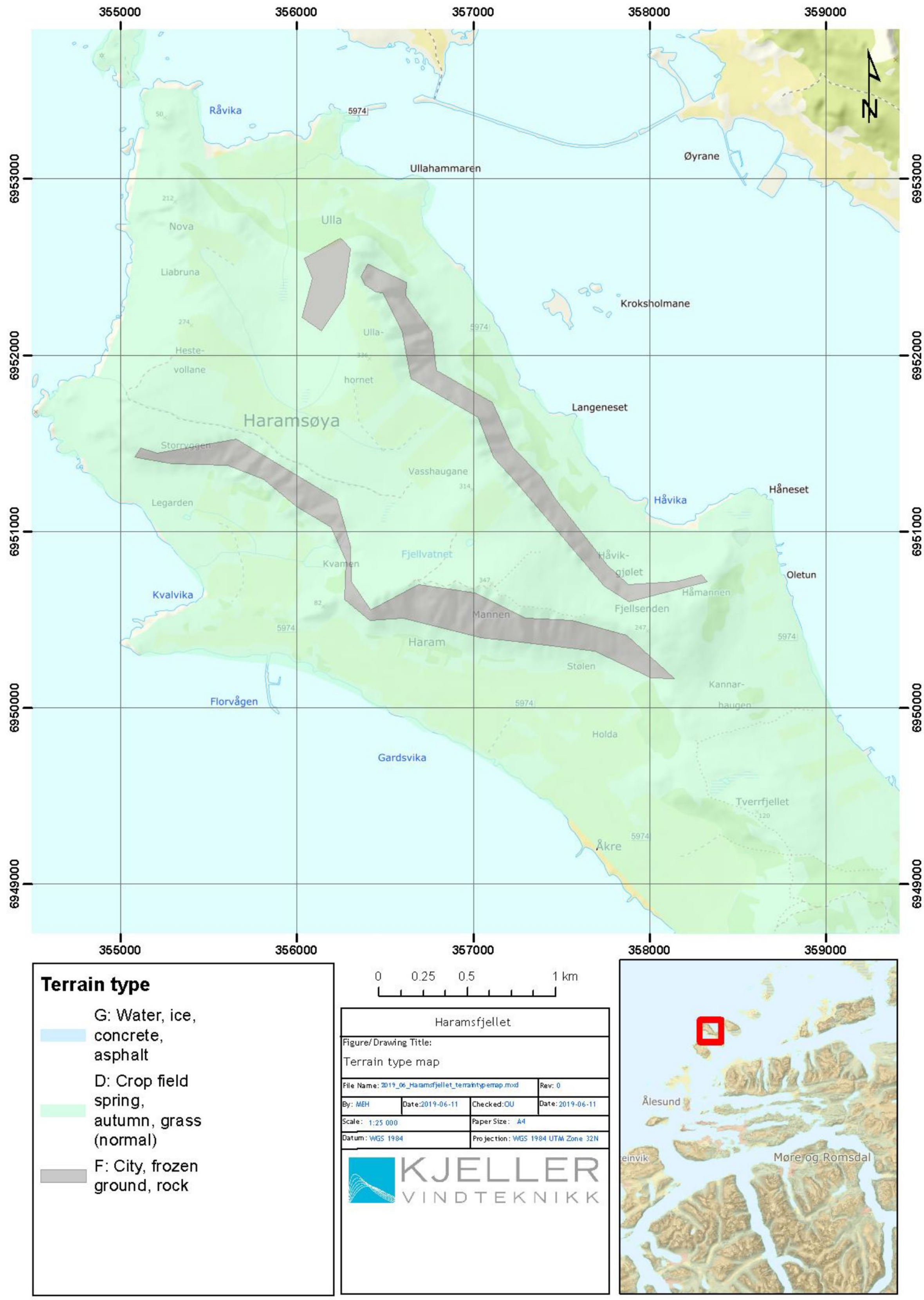

Figure 2-3: Map showing terrain type at Haramsfjellet.

Table 2-5: 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) / 99.5 dB(A)
Noise mode	PO1 / SO1 / SO2, 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, F and G
Relative humidity	70 %
Air temperature 2 m	10 °C
Stability parameters	Night; Clear sky

2.5 Results

The obtained results from the two worst case calculations; PO1 and Alternative, and a real case calculation are presented in the tables and figures below (no noise map for real case). The calculation results are also attached in Appendix C: WindPRO printouts noise, PO1, worst case, Appendix D: WindPRO printouts noise, Alternative case and Appendix E: WindPRO printouts noise, real case. 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 2 existing houses and 13 planned holiday houses that are above the noise limit of 45.0 dB(A) L_{DEN}. When using the turbines with 4.0 MW in mixed modes as in the alternative case there are no existing houses above the noise limit, but there are 1 planned holiday house that is over the 45.0 dB(A) L_{DEN} limit. When calculating the real case using wind statistics for Haramsfjellet as input there are no buildings reaching the 45.0 dB(A) L_{DEN} limit (average level). See Table 2-6 for details.

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) have 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. In these results a temperature of 10˚C and a relative humidity of 70 % are used, which are taken as values representing “typical Norwegian” weather conditions (Meventus AS, Sinus AS, 2017).

Table 2-6: Estimated L_{DEN} noise levels in dB(A) at the location of each existing building for worst case in mode PO1 and for the alternative case with mix of modes.

Existing houses							
#	PO1 (L_{DEN}), worst case	Alternative (L_{DEN}), worst case	PO1 (L_{DEN}), Real case	#	PO1 (L_{DEN}), worst case	Alternative (L_{DEN}), worst case	PO1 (L_{DEN}), Real case
A	17.0	16.6	11.8	AR	42.8	41.6	37.5
B	19.9	19.1	14.2	AS	42.9	41.8	36.7
C	44.0	43.3	38.5	AT	40.3	40.0	33.3
D	42.9	41.6	37.8	AU	20.6	19.6	15.7
E	42.5	41.2	38.1	AV	17.5	17.2	12.0
F	24.3	23.5	17.7	AW	43.8	43.0	38.8
G	43.4	41.9	38.3	AX	44.0	43.0	33.5
H	43.0	41.6	37.8	AY	42.0	41.4	37.8
I	42.5	41.5	33.7	AZ	35.0	35.0	29.8
J	19.0	18.1	13.6	BA	19.3	18.8	14.3
K	19.4	18.4	14.4	BB	44.3	43.6	39.5
L	18.7	17.8	13.8	BC	19.4	18.6	14.2
M	43.6	42.8	38.4	BD	42.9	42.2	38.4
N	18.3	17.5	13.5	BE	41.8	40.9	36.1
O	41.8	40.8	37.3	BF	40.0	39.6	32.1
P	42.3	41.4	37.5	BG	37.1	37.1	32.8
Q	44.1	43.4	39.5	BH	40.8	39.8	32.9
R	17.9	17.3	12.7	BI	41.7	41.0	32.0
S	43.8	42.0	38.1	BJ	44.2	42.3	38.6
T	18.5	17.6	13.7	BK	46.9	44.2	38.2
U	19.0	18.3	13.5	BL	43.9	41.8	38.5
V	17.8	16.9	12.3	BM	44.6	42.5	38.7
W	44.9	42.9	39.2	BN	41.7	40.7	37.3
X	40.2	39.9	31.9	BO	44.4	42.3	38.9
Y	40.7	40.1	35.7	BP	44.3	42.2	38.8
Z	18.2	17.6	13.1	BQ	44.3	42.4	38.6
AA	19.5	18.4	14.5	BR	43.9	41.8	38.3
AB	32.8	32.8	28.3	BS	43.7	42.2	38.5
AC	44.2	43.5	39.4	BT	43.1	42.4	38.3
AD	37.2	37.2	32.5	BU	42.9	42.2	35.9
AE	43.9	41.7	38.6	BV	43.3	41.6	38.2
AF	43.3	42.1	38.7	BW	43.4	41.9	38.3
AG	21.8	21.1	16.6	BX	44.3	42.4	38.7
AH	19.7	18.7	14.7	BY	45.2	43.3	39.8
AI	18.2	17.3	13.4	BZ	39.5	38.6	32.2
AJ	22.4	21.9	17.1	CA	41.7	41.1	32.3
AK	20.9	19.9	16.0	CB	44.2	41.9	38.8
AL	40.8	40.2	35.7	CC	42.9	42.2	38.7
AM	40.2	40.2	34.0	CD	43.8	41.7	38.3
AN	43.6	42.9	39.2	CE	43.9	43.2	39.2
AO	43.3	42.5	33.4	CF	44.5	42.4	38.2
AP	31.1	31.1	23.7	CG	44.5	42.5	38.6
AQ	40.1	40.1	33.9				

Planned holiday houses							
#	PO1 (L_{DEN}), worst case	Alternative (L_{DEN}), worst case	PO1 (L_{DEN}), Real case	#	PO1 (L_{DEN}), worst case	Alternative (L_{DEN}), worst case	PO1 (L_{DEN}), Real case
CH	42.7	39.7	36.0	CP	46.6	44.5	41.7
CI	41.2	38.7	36.5	CQ	46.6	44.0	39.9
CJ	41.0	38.4	34.9	CR	46.4	43.7	40.8
CK	45.3	43.1	35.6	CS	46.2	43.5	39.7
CL	46.4	44.0	37.0	CT	47.3	44.8	40.1
CM	45.7	43.5	39.6	CU	47.2	44.7	40.1
CN	45.5	43.3	36.4	CV	47.9	45.2	41.2
CO	46.0	43.7	35.5	CW	47.1	44.6	40.8

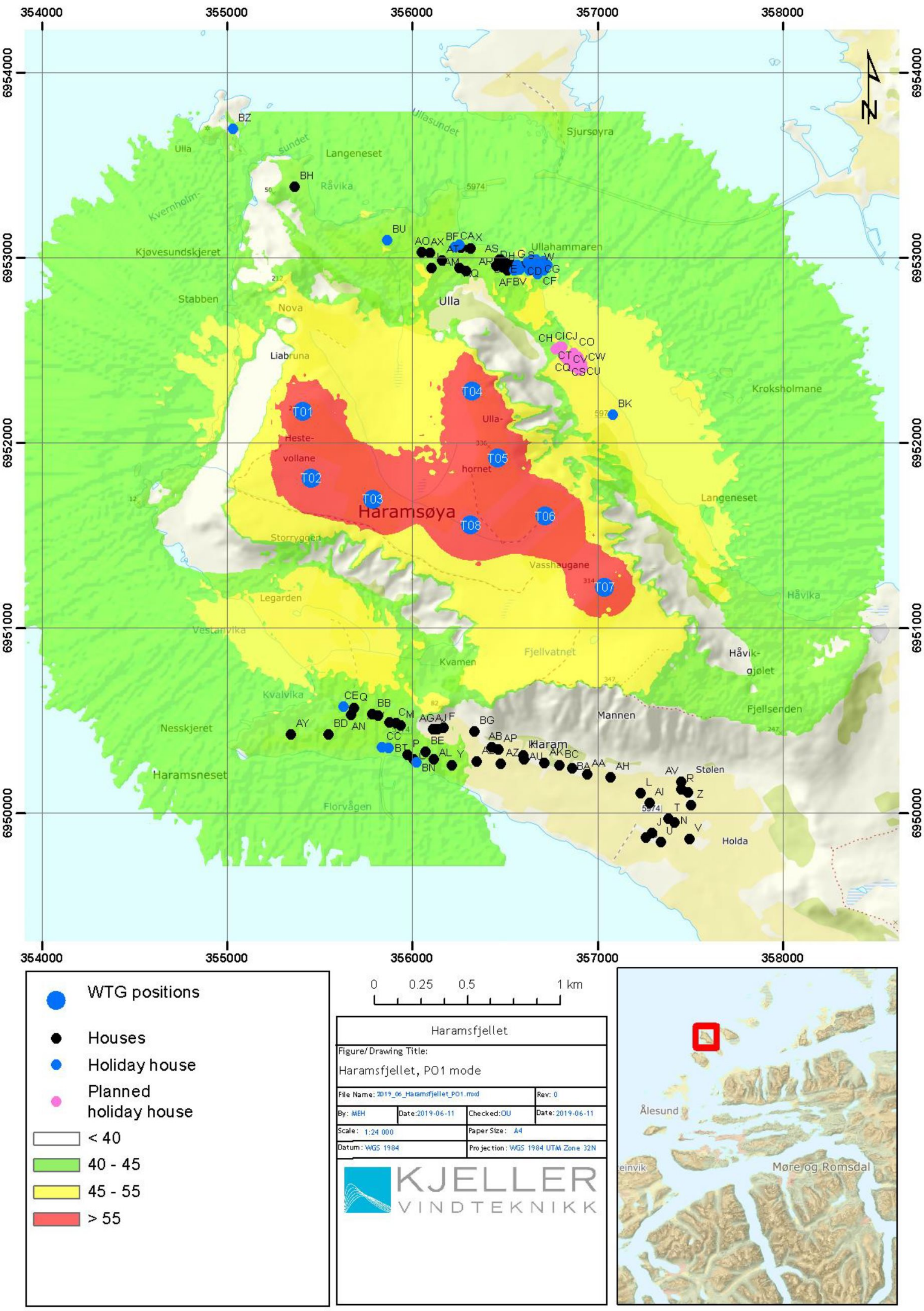

Figure 2-4 Map showing the noise level in worst case weighted to L_{DEN} generated by the Vestas V136-4.2MW (PO1,HWO) turbines in the Vestas layout. The location of the wind turbines is also shown together with the location of the noise sensitive receptors.

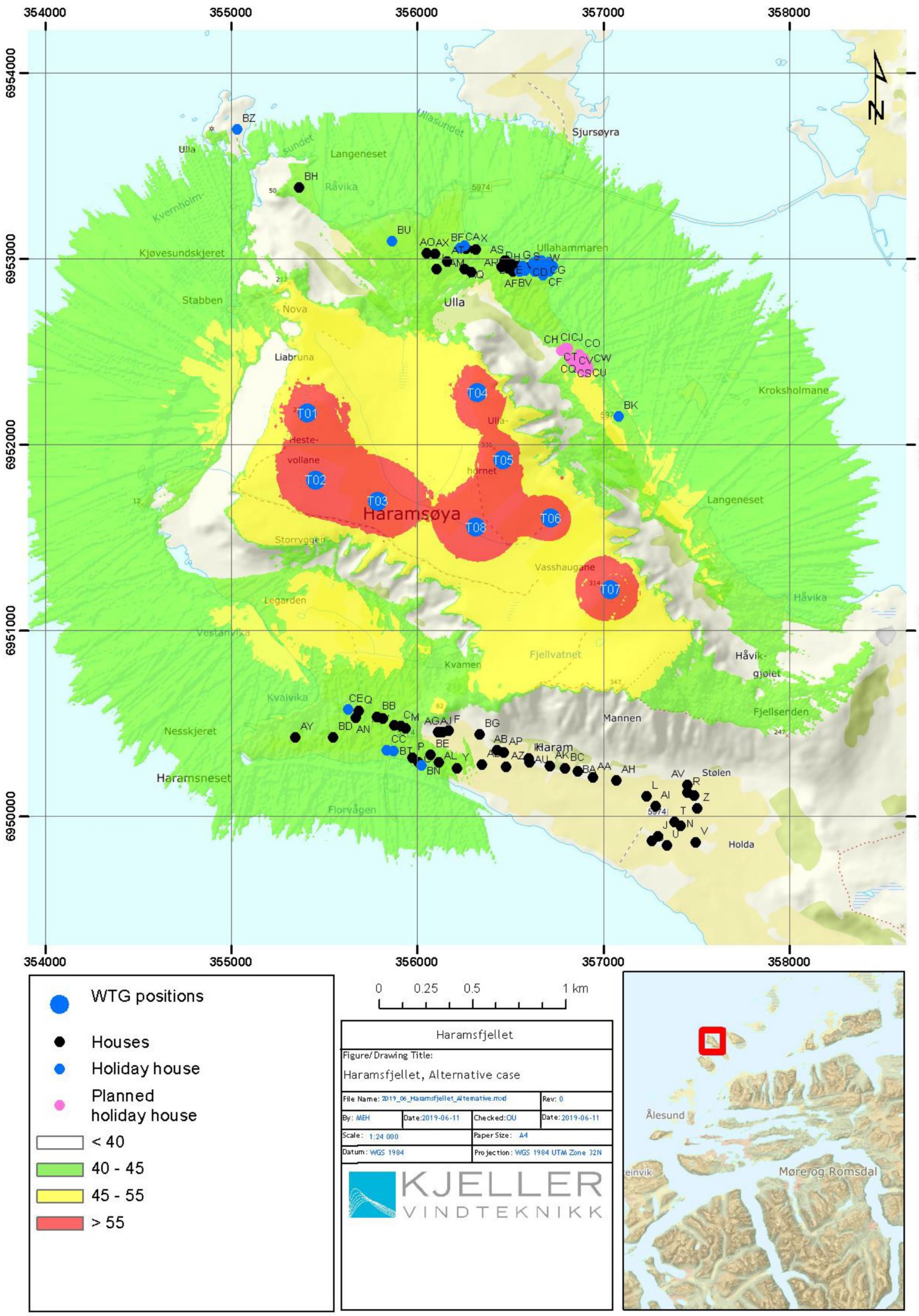

Figure 2-5 Map showing the noise level in worst case weighted to L_{DEN} generated by the Vestas V136-4.2MW (Alternative; SO1, SO2 and PO1, HWO) turbines in the Vestas layout. The location of the wind turbines is also shown together with the location of the noise sensitive receptors.

3 Energy losses due to noise considerations

Calculation of loss in energy due to change of power mode from PO1 to the mix of modes presented in the alternative case is made. Most of the time all the turbines run in PO1 mode and the mode only change when the wind direction is from the critical wind direction for the alternative case. The energy calculation for the alternative case gives the sector wise AEP results, which is then summed for each turbine for the critical wind directions. Then the AEP with only PO1 for all turbines at all times is added to each turbine for the remaining directions. Here, both the results of changing the power modes in the alternative case for all wind directions and the results of only changing the power modes for the critical wind directions are given.

Table 3-1: 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:	8 x Vestas V136-4.2MW. Coordinates in WindPRO printout in Appendix F: WindPRO printouts energy
Power curve:	Specific power curves have been used in the calculations. Power optimized mode is found in Table 2-2 and sound optimized modes are found in Table 2-3 and Table 2-4.

The difference between the modes PO1 (HWO) and SO1 (HWO) / SO2 (HWO) is the nominal power of PO1 (HWO) is 4.2 MW and for SO1 (HWO) / SO2 (HWO) it is 4.0 MW. This will lead to less energy production when the turbines are operated in mode SO1 (HWO) or SO2 (HWO).

The buildings that exceed the noise restrictions when turbines are in PO1 (HWO) mode are according to Table 2-6 existing building BK and BY, and 13 planned holiday houses. For all existing houses and planned holiday houses where noise limits are exceeded the turbines are located upwind within the wind directions 215˚ to 240˚. This means that turbine T04 is assumed to operate in the sound optimized mode SO1 (HWO), turbine T05 and T06 are assumed to operate in the sound optimized mode SO2, and the rest of the turbines are operating in power optimized mode PO1 when the wind is blowing from direction 215˚ to 240˚. In all other directions all the turbines can operate in mode PO1 (HWO).

Table 3-2: Calculated energy losses due to noise reduced modes for Haramsfjellet with 8 x V136 turbines. The losses caused by the change from power mode to noise mode have been estimated both for all wind directions and for critical wind directions.

Turbine	Energy loss due to change of power modes in the alternative case for all directions [%]	Energy loss due to change of power modes in the alternative case for some directions [%]
T01	-6.8	0.0
T02	0.1	0.0
T03	0.1	0.0
T04	6.7	1.8
T05	31.3	7.1
T06	31.3	7.8
T07	-0.1	0.0
T08	-0.7	0.0
Park	8.2	2.2

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Appendix A: Coordinates of existing noise receptors

Coordinates are given in WGS84 UTM32.

#	E	N	Comment	#	E	N	Comment
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: Coordinates of planned holiday houses

Coordinates are given in WGS84 UTM32.

#	E	N	Property
CH	356 776	6 952 506	10/73
CI	356 793	6 952 516	10/73
CJ	356 813	6 952 516	10/73
CK	356 821	6 952 464	10/72
CL	356 836	6 952 449	10/72
CM	356 856	6 952 444	10/72
CN	356 864	6 952 464	10/72
CO	356 872	6 952 482	10/72
CP	356 868	6 952 409	10/72
CQ	356 887	6 952 429	10/72
CR	356 898	6 952 463	10/72
CS	356 905	6 952 444	10/72
CT	356 893	6 952 412	10/72
CU	356 915	6 952 425	10/72
CV	356 901	6 952 391	10/72
CW	356 921	6 952 404	10/72

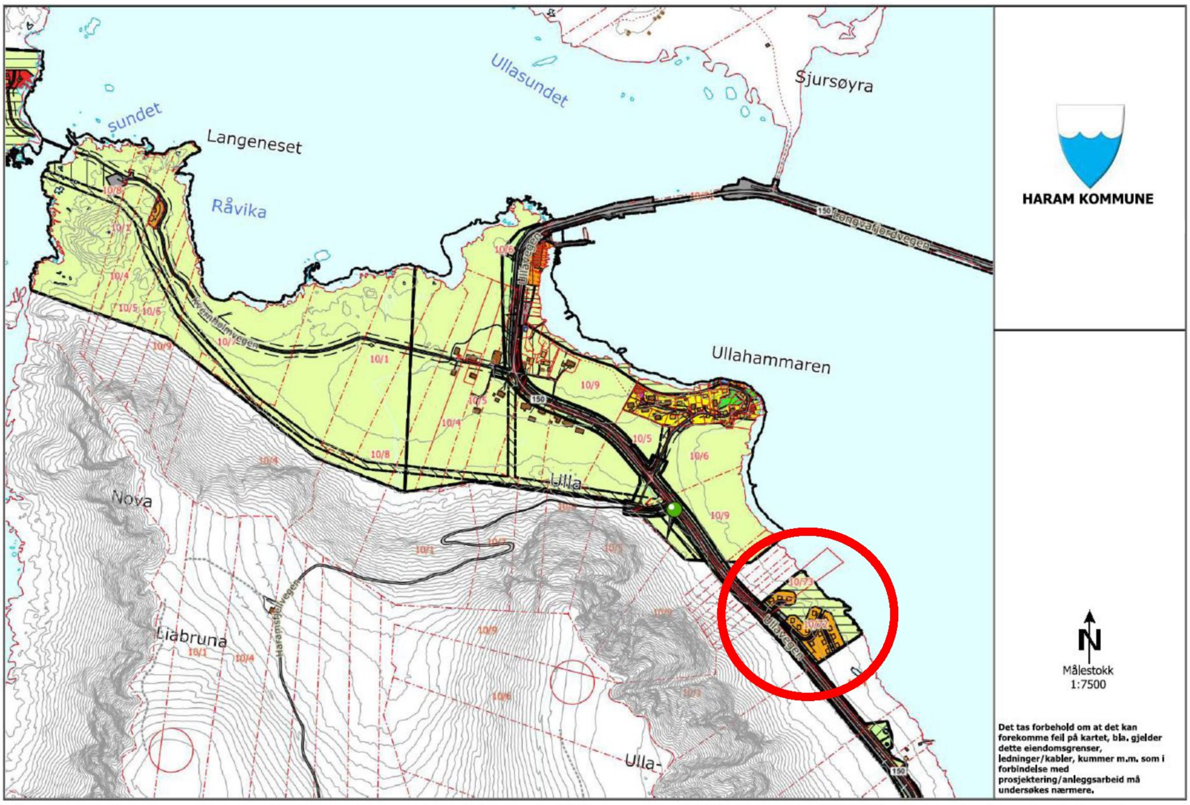

Figure B-1: Overview of the planned cabins at Ullavegen (10/72 and 10/73) are shown inside the red circle. Overview map provided by the client.

Appendix C: WindPRO printouts noise, PO1, worst case

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Calculated:
2019-06-12 09:49/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, GENERAL, 8m/s in 10 m

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)	
Roughness based on line object	
Roughness Lines: HaramRoughness(3).map (7)	
Terrain type based on area object	
Area object (): REGIONS_2019_05_HaramFjellet_1.w2r (2)	
Month for calculation	January
Wind speed criteria	
Uniform wind speed at 10 m agl.	
Wind speed	8.0 m/s
Wind direction	All receptors downwind
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]	Setting	Noise data Creator	Name	Wind speed [m/s]	LwA,ref [dB(A)]
1	355,408	6,952,169	270.0	VESTAS V136-4.2 4200 ...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
2	355,452	6,951,811	251.1	VESTAS V136-4.2 4200 ...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
3	355,787	6,951,697	245.0	VESTAS V136-4.2 4200 ...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
4	356,322	6,952,279	324.5	VESTAS V136-4.2 4200 ...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
5	356,463	6,951,917	330.0	VESTAS V136-4.2 4200 ...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
6	356,717	6,951,604	292.3	VESTAS V136-4.2 4200 ...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
7	357,038	6,951,221	310.0	VESTAS V136-4.2 4200 ...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
8	356,315	6,951,556	285.7	VESTAS V136-4.2 4200 ...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9

Calculation Results

Sound level

Noise sensitive area No.	Name	X(East)	Y(North)	Z [m]	Imission height [m]	Wind speed [m/s]	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	8.0	45.0	17.0	Yes
A	Day							10.6	
A	Evening							10.6	
A	Night							10.6	
B	Noise sensitive point: Demands defined in calculation setup. (734)	357,263	6,949,868	5.7	4.0	8.0	45.0	19.9	Yes
B	Day							13.5	
B	Evening							13.5	
B	Night							13.5	
C	Noise sensitive point: Demands defined in calculation setup. (735)	355,912	6,950,483	11.7	4.0	8.0	45.0	44.0	Yes

To be continued on next page...

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Calculated:
2019-06-12 09:49/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, GENERAL, 8m/s in 10 m

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Noise sensitive area							Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
				[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
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	8.0	45.0	42.9	Yes
D	Day							36.5	
D	Evening							36.5	
D	Night							36.5	
E	Noise sensitive point: Demands defined in calculation setup. (737)	356,503	6,952,972	6.4	4.0	8.0	45.0	42.5	Yes
E	Day							36.1	
E	Evening							36.1	
E	Night							36.1	
F	Noise sensitive point: Demands defined in calculation setup. (738)	356,167	6,950,459	16.7	4.0	8.0	45.0	24.3	Yes
F	Day							17.9	
F	Evening							17.9	
F	Night							17.9	
G	Noise sensitive point: Demands defined in calculation setup. (739)	356,540	6,952,961	10.0	4.0	8.0	45.0	43.4	Yes
G	Day							37.0	
G	Evening							37.0	
G	Night							37.0	
H	Noise sensitive point: Demands defined in calculation setup. (740)	356,488	6,952,946	10.5	4.0	8.0	45.0	43.0	Yes
H	Day							36.6	
H	Evening							36.6	
H	Night							36.6	
I	Noise sensitive point: Demands defined in calculation setup. (741)	356,104	6,952,943	9.8	4.0	8.0	45.0	42.5	Yes
I	Day							36.1	
I	Evening							36.1	
I	Night							36.1	
J	Noise sensitive point: Demands defined in calculation setup. (742)	357,295	6,949,890	6.8	4.0	8.0	45.0	19.0	Yes
J	Day							12.6	
J	Evening							12.6	
J	Night							12.6	
K	Noise sensitive point: Demands defined in calculation setup. (743)	356,599	6,950,309	16.3	4.0	8.0	45.0	19.4	Yes
K	Day							13.0	
K	Evening							13.0	
K	Night							13.0	
L	Noise sensitive point: Demands defined in calculation setup. (744)	357,235	6,950,105	12.7	4.0	8.0	45.0	18.7	Yes
L	Day							12.3	
L	Evening							12.3	
L	Night							12.3	
M	Noise sensitive point: Demands defined in calculation setup. (745)	355,937	6,950,470	11.1	4.0	8.0	45.0	43.6	Yes
M	Day							37.2	
M	Evening							37.2	
M	Night							37.2	
N	Noise sensitive point: Demands defined in calculation setup. (746)	357,418	6,949,949	11.5	4.0	8.0	45.0	18.3	Yes
N	Day							11.9	
N	Evening							11.9	
N	Night							11.9	
O	Noise sensitive point: Demands defined in calculation setup. (747)	356,007	6,950,290	2.4	4.0	8.0	45.0	41.8	Yes
O	Day							35.4	
O	Evening							35.4	
O	Night							35.4	
P	Noise sensitive point: Demands defined in calculation setup. (748)	355,974	6,950,315	2.8	4.0	8.0	45.0	42.3	Yes
P	Day							35.9	
P	Evening							35.9	
P	Night							35.9	
Q	Noise sensitive point: Demands defined in calculation setup. (749)	355,685	6,950,564	15.0	4.0	8.0	45.0	44.1	Yes
Q	Day							37.7	
Q	Evening							37.7	
Q	Night							37.7	
R	Noise sensitive point: Demands defined in calculation setup. (750)	357,452	6,950,125	17.0	4.0	8.0	45.0	17.9	Yes
R	Day							11.5	
R	Evening							11.5	
R	Night							11.5	
S	Noise sensitive point: Demands defined in calculation setup. (751)	356,598	6,952,952	10.0	4.0	8.0	45.0	43.8	Yes
S	Day							37.4	
S	Evening							37.4	
S	Night							37.4	
T	Noise sensitive point: Demands defined in calculation setup. (752)	357,384	6,949,967	11.1	4.0	8.0	45.0	18.5	Yes
T	Day							12.1	
T	Evening							12.1	

To be continued on next page...

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Calculated:
2019-06-12 09:49/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, GENERAL, 8m/s in 10 m

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Noise sensitive area							**Demands**	**Sound level**	**Demands fulfilled?**
No.	Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
				[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
T	Night							12.1	
U	Noise sensitive point: Demands defined in calculation setup. (753)	357,343	6,949,843	9.6	4.0	8.0	45.0	19.0	Yes
U	Day							12.6	
U	Evening							12.6	
U	Night							12.6	
V	Noise sensitive point: Demands defined in calculation setup. (754)	357,500	6,949,860	10.9	4.0	8.0	45.0	17.8	Yes
V	Day							11.4	
V	Evening							11.4	
V	Night							11.4	
W	Noise sensitive point: Demands defined in calculation setup. (755)	356,687	6,952,944	10.4	4.0	8.0	45.0	44.9	Yes
W	Day							38.5	
W	Evening							38.5	
W	Night							38.5	
X	Noise sensitive point: Demands defined in calculation setup. (756)	356,317	6,953,050	1.9	4.0	8.0	45.0	40.2	Yes
X	Day							33.8	
X	Evening							33.8	
X	Night							33.8	
Y	Noise sensitive point: Demands defined in calculation setup. (757)	356,214	6,950,257	5.8	4.0	8.0	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	8.0	45.0	18.2	Yes
Z	Day							11.8	
Z	Evening							11.8	
Z	Night							11.8	
AA	Noise sensitive point: Demands defined in calculation setup. (759)	356,944	6,950,208	14.8	4.0	8.0	45.0	19.5	Yes
AA	Day							13.1	
AA	Evening							13.1	
AA	Night							13.1	
AB	Noise sensitive point: Demands defined in calculation setup. (760)	356,431	6,950,353	15.0	4.0	8.0	45.0	32.8	Yes
AB	Day							26.4	
AB	Evening							26.4	
AB	Night							26.4	
AC	Noise sensitive point: Demands defined in calculation setup. (761)	355,814	6,950,526	12.0	4.0	8.0	45.0	44.2	Yes
AC	Day							37.8	
AC	Evening							37.8	
AC	Night							37.8	
AD	Noise sensitive point: Demands defined in calculation setup. (762)	356,348	6,950,278	10.0	4.0	8.0	45.0	37.2	Yes
AD	Day							30.8	
AD	Evening							30.8	
AD	Night							30.8	
AE	Noise sensitive point: Demands defined in calculation setup. (763)	356,648	6,952,960	13.1	4.0	8.0	45.0	43.9	Yes
AE	Day							37.5	
AE	Evening							37.5	
AE	Night							37.5	
AF	Noise sensitive point: Demands defined in calculation setup. (764)	356,516	6,952,929	15.0	4.0	8.0	45.0	43.3	Yes
AF	Day							36.9	
AF	Evening							36.9	
AF	Night							36.9	
AG	Noise sensitive point: Demands defined in calculation setup. (765)	356,135	6,950,453	15.0	4.0	8.0	45.0	21.8	Yes
AG	Day							15.4	
AG	Evening							15.4	
AG	Night							15.4	
AH	Noise sensitive point: Demands defined in calculation setup. (766)	357,070	6,950,192	15.2	4.0	8.0	45.0	19.7	Yes
AH	Day							13.3	
AH	Evening							13.3	
AH	Night							13.3	
AI	Noise sensitive point: Demands defined in calculation setup. (767)	357,282	6,950,054	12.0	4.0	8.0	45.0	18.2	Yes
AI	Day							11.8	
AI	Evening							11.8	
AI	Night							11.8	
AJ	Noise sensitive point: Demands defined in calculation setup. (768)	356,114	6,950,453	14.3	4.0	8.0	45.0	22.4	Yes
AJ	Day							16.0	
AJ	Evening							16.0	
AJ	Night							16.0	
AK	Noise sensitive point: Demands defined in calculation setup. (769)	356,715	6,950,269	15.8	4.0	8.0	45.0	20.9	Yes
AK	Day							14.5	
AK	Evening							14.5	
AK	Night							14.5	
AL	Noise sensitive point: Demands defined in calculation setup. (770)	356,115	6,950,290	5.7	4.0	8.0	45.0	40.8	Yes

To be continued on next page...

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, GENERAL, 8m/s in 10 m

...continued from previous page

Noise sensitive area							**Demands**	**Sound level**	**Demands fulfilled?**
No.	Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
				[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
AL	Day							34.4	
AL	Evening							34.4	
AL	Night							34.4	
AM	Noise sensitive point: Demands defined in calculation setup. (771)	356,289	6,952,926	9.6	4.0	8.0	45.0	40.2	Yes
AM	Day							33.8	
AM	Evening							33.8	
AM	Night							33.8	
AN	Noise sensitive point: Demands defined in calculation setup. (772)	355,668	6,950,529	13.4	4.0	8.0	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	8.0	45.0	43.3	Yes
AO	Day							36.9	
AO	Evening							36.9	
AO	Night							36.9	
AP	Noise sensitive point: Demands defined in calculation setup. (774)	356,465	6,950,343	15.0	4.0	8.0	45.0	31.1	Yes
AP	Day							24.7	
AP	Evening							24.7	
AP	Night							24.7	
AQ	Noise sensitive point: Demands defined in calculation setup. (775)	356,253	6,952,942	8.3	4.0	8.0	45.0	40.1	Yes
AQ	Day							33.7	
AQ	Evening							33.7	
AQ	Night							33.7	
AR	Noise sensitive point: Demands defined in calculation setup. (776)	356,469	6,952,988	3.5	4.0	8.0	45.0	42.8	Yes
AR	Day							36.4	
AR	Evening							36.4	
AR	Night							36.4	
AS	Noise sensitive point: Demands defined in calculation setup. (777)	356,478	6,952,987	3.7	4.0	8.0	45.0	42.9	Yes
AS	Day							36.5	
AS	Evening							36.5	
AS	Night							36.5	
AT	Noise sensitive point: Demands defined in calculation setup. (778)	356,159	6,952,982	6.6	4.0	8.0	45.0	40.3	Yes
AT	Day							34.0	
AT	Evening							34.0	
AT	Night							34.0	
AU	Noise sensitive point: Demands defined in calculation setup. (779)	356,602	6,950,288	15.0	4.0	8.0	45.0	20.6	Yes
AU	Day							14.2	
AU	Evening							14.2	
AU	Night							14.2	
AV	Noise sensitive point: Demands defined in calculation setup. (780)	357,454	6,950,166	18.8	4.0	8.0	45.0	17.5	Yes
AV	Day							11.1	
AV	Evening							11.1	
AV	Night							11.1	
AW	Noise sensitive point: Demands defined in calculation setup. (781)	355,877	6,950,490	11.6	4.0	8.0	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	8.0	45.0	44.0	Yes
AX	Day							37.6	
AX	Evening							37.6	
AX	Night							37.6	
AY	Noise sensitive point: Demands defined in calculation setup. (783)	355,345	6,950,425	8.3	4.0	8.0	45.0	42.0	Yes
AY	Day							35.6	
AY	Evening							35.6	
AY	Night							35.6	
AZ	Noise sensitive point: Demands defined in calculation setup. (784)	356,476	6,950,266	11.3	4.0	8.0	45.0	35.0	Yes
AZ	Day							28.6	
AZ	Evening							28.6	
AZ	Night							28.6	
BA	Noise sensitive point: Demands defined in calculation setup. (785)	356,863	6,950,240	15.1	4.0	8.0	45.0	19.3	Yes
BA	Day							12.9	
BA	Evening							12.9	
BA	Night							12.9	
BB	Noise sensitive point: Demands defined in calculation setup. (786)	355,782	6,950,531	10.1	4.0	8.0	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	8.0	45.0	19.4	Yes
BC	Day							13.0	
BC	Evening							13.0	

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Calculated:
2019-06-12 09:49/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, GENERAL, 8m/s in 10 m

...continued from previous page

Noise sensitive area						**Demands**	**Sound level**	**Demands fulfilled?**
No. Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
			[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
BC Night							13.0	
BD Noise sensitive point: Demands defined in calculation setup. (788)	355,547	6,950,425	8.6	4.0	8.0	45.0	42.9	Yes
BD Day							36.5	
BD Evening							36.5	
BD Night							36.5	
BE Noise sensitive point: Demands defined in calculation setup. (789)	356,073	6,950,329	6.2	4.0	8.0	45.0	41.8	Yes
BE Day							35.4	
BE Evening							35.4	
BE Night							35.4	
BF Noise sensitive point: Demands defined in calculation setup. (846)	356,264	6,953,051	3.1	4.0	8.0	45.0	40.0	Yes
BF Day							33.6	
BF Evening							33.6	
BF Night							33.6	
BG Noise sensitive point: Demands defined in calculation setup. (847)	356,337	6,950,438	20.0	4.0	8.0	45.0	37.1	Yes
BG Day							30.7	
BG Evening							30.7	
BG Night							30.7	
BH Noise sensitive point: Demands defined in calculation setup. (848)	355,363	6,953,382	13.3	4.0	8.0	45.0	40.8	Yes
BH Day							34.4	
BH Evening							34.4	
BH Night							34.4	
BI Noise sensitive point: Demands defined in calculation setup. (849)	356,256	6,953,071	2.4	4.0	8.0	45.0	41.7	Yes
BI Day							35.3	
BI Evening							35.3	
BI Night							35.3	
BJ Noise sensitive point: Demands defined in calculation setup. (850)	356,626	6,952,977	8.4	4.0	8.0	45.0	44.2	Yes
BJ Day							37.8	
BJ Evening							37.8	
BJ Night							37.8	
BK Noise sensitive point: Demands defined in calculation setup. (851)	357,083	6,952,151	9.2	4.0	8.0	45.0	46.9	No
BK Day							40.5	
BK Evening							40.5	
BK Night							40.5	
BL Noise sensitive point: Demands defined in calculation setup. (852)	356,730	6,952,960	5.2	4.0	8.0	45.0	43.9	Yes
BL Day							37.5	
BL Evening							37.5	
BL Night							37.5	
BM Noise sensitive point: Demands defined in calculation setup. (853)	356,709	6,952,932	6.5	4.0	8.0	45.0	44.6	Yes
BM Day							38.2	
BM Evening							38.2	
BM Night							38.2	
BN Noise sensitive point: Demands defined in calculation setup. (854)	356,024	6,950,273	1.9	4.0	8.0	45.0	41.7	Yes
BN Day							35.3	
BN Evening							35.3	
BN Night							35.3	
BO Noise sensitive point: Demands defined in calculation setup. (855)	356,713	6,952,953	8.5	4.0	8.0	45.0	44.4	Yes
BO Day							38.0	
BO Evening							38.0	
BO Night							38.0	
BP Noise sensitive point: Demands defined in calculation setup. (856)	356,717	6,952,961	8.4	4.0	8.0	45.0	44.3	Yes
BP Day							37.9	
BP Evening							37.9	
BP Night							37.9	
BQ Noise sensitive point: Demands defined in calculation setup. (857)	356,632	6,952,931	10.0	4.0	8.0	45.0	44.3	Yes
BQ Day							37.9	
BQ Evening							37.9	
BQ Night							37.9	
BR Noise sensitive point: Demands defined in calculation setup. (858)	356,646	6,952,988	5.5	4.0	8.0	45.0	43.9	Yes
BR Day							37.5	
BR Evening							37.5	
BR Night							37.5	
BS Noise sensitive point: Demands defined in calculation setup. (859)	356,551	6,952,929	15.0	4.0	8.0	45.0	43.7	Yes
BS Day							37.3	
BS Evening							37.3	
BS Night							37.3	
BT Noise sensitive point: Demands defined in calculation setup. (860)	355,874	6,950,349	4.3	4.0	8.0	45.0	43.1	Yes
BT Day							36.7	
BT Evening							36.7	
BT Night							36.7	
BU Noise sensitive point: Demands defined in calculation setup. (861)	355,863	6,953,093	9.1	4.0	8.0	45.0	42.9	Yes

To be continued on next page...

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, GENERAL, 8m/s in 10 m

...continued from previous page

Noise sensitive area						Demands	Sound level	Demands fulfilled?
No. Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
			[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
BU Day							36.5	
BU Evening							36.5	
BU Night							36.5	
BV Noise sensitive point: Demands defined in calculation setup. (862)	356,580	6,952,934	12.2	4.0	8.0	45.0	43.3	Yes
BV Day							36.9	
BV Evening							36.9	
BV Night							36.9	
BW Noise sensitive point: Demands defined in calculation setup. (863)	356,567	6,952,961	10.9	4.0	8.0	45.0	43.4	Yes
BW Day							37.0	
BW Evening							37.0	
BW Night							37.0	
BX Noise sensitive point: Demands defined in calculation setup. (864)	356,642	6,952,940	11.3	4.0	8.0	45.0	44.3	Yes
BX Day							38.0	
BX Evening							38.0	
BX Night							38.0	
BY Noise sensitive point: Demands defined in calculation setup. (865)	356,671	6,952,938	12.1	4.0	8.0	45.0	45.2	No
BY Day							38.8	
BY Evening							38.8	
BY Night							38.8	
BZ Noise sensitive point: Demands defined in calculation setup. (866)	355,030	6,953,694	3.6	4.0	8.0	45.0	39.5	Yes
BZ Day							33.1	
BZ Evening							33.1	
BZ Night							33.1	
CA Noise sensitive point: Demands defined in calculation setup. (867)	356,228	6,953,055	3.8	4.0	8.0	45.0	41.7	Yes
CA Day							35.3	
CA Evening							35.3	
CA Night							35.3	
CB Noise sensitive point: Demands defined in calculation setup. (868)	356,711	6,952,980	7.8	4.0	8.0	45.0	44.2	Yes
CB Day							37.8	
CB Evening							37.8	
CB Night							37.8	
CC Noise sensitive point: Demands defined in calculation setup. (869)	355,834	6,950,356	4.6	4.0	8.0	45.0	42.9	Yes
CC Day							36.5	
CC Evening							36.5	
CC Night							36.5	
CD Noise sensitive point: Demands defined in calculation setup. (870)	356,670	6,952,989	10.1	4.0	8.0	45.0	43.8	Yes
CD Day							37.4	
CD Evening							37.4	
CD Night							37.4	
CE Noise sensitive point: Demands defined in calculation setup. (871)	355,629	6,950,575	10.6	4.0	8.0	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	8.0	45.0	44.5	Yes
CF Day							38.1	
CF Evening							38.1	
CF Night							38.1	
CG Noise sensitive point: Demands defined in calculation setup. (873)	356,687	6,952,928	8.3	4.0	8.0	45.0	44.5	Yes
CG Day							38.1	
CG Evening							38.1	
CG Night							38.1	
CH Noise sensitive point: Norwegian - Yellow zone (908)	356,776	6,952,506	13.6	4.0	8.0	45.0	42.7	Yes
CH Day							36.3	
CH Evening							36.3	
CH Night							36.3	
CI Noise sensitive point: Norwegian - Yellow zone (909)	356,793	6,952,513	12.6	4.0	8.0	45.0	41.2	Yes
CI Day							34.8	
CI Evening							34.8	
CI Night							34.8	
CJ Noise sensitive point: Norwegian - Yellow zone (910)	356,813	6,952,516	11.6	4.0	8.0	45.0	41.0	Yes
CJ Day							34.6	
CJ Evening							34.6	
CJ Night							34.6	
CK Noise sensitive point: Norwegian - Yellow zone (911)	356,821	6,952,464	15.9	4.0	8.0	45.0	45.3	No
CK Day							38.9	
CK Evening							38.9	
CK Night							38.9	
CL Noise sensitive point: Norwegian - Yellow zone (912)	356,836	6,952,449	13.7	4.0	8.0	45.0	46.4	No
CL Day							40.0	
CL Evening							40.0	

To be continued on next page...

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, GENERAL, 8m/s in 10 m

...continued from previous page

Noise sensitive area						**Demands**	**Sound level**	**Demands fulfilled?**
No. Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
			[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
CL Night							40.0	
CM Noise sensitive point: Norwegian - Yellow zone (913)	356,856	6,952,444	11.6	4.0	8.0	45.0	45.7	No
CM Day							39.3	
CM Evening							39.3	
CM Night							39.3	
CN Noise sensitive point: Norwegian - Yellow zone (914)	356,864	6,952,464	10.0	4.0	8.0	45.0	45.5	No
CN Day							39.1	
CN Evening							39.1	
CN Night							39.1	
CO Noise sensitive point: Norwegian - Yellow zone (915)	356,872	6,952,482	9.8	4.0	8.0	45.0	46.0	No
CO Day							39.6	
CO Evening							39.6	
CO Night							39.6	
CP Noise sensitive point: Norwegian - Yellow zone (916)	356,868	6,952,409	11.6	4.0	8.0	45.0	46.6	No
CP Day							40.2	
CP Evening							40.2	
CP Night							40.2	
CQ Noise sensitive point: Norwegian - Yellow zone (917)	356,887	6,952,429	9.2	4.0	8.0	45.0	46.6	No
CQ Day							40.2	
CQ Evening							40.2	
CQ Night							40.2	
CR Noise sensitive point: Norwegian - Yellow zone (918)	356,898	6,952,463	6.8	4.0	8.0	45.0	46.4	No
CR Day							40.0	
CR Evening							40.0	
CR Night							40.0	
CS Noise sensitive point: Norwegian - Yellow zone (919)	356,905	6,952,444	6.8	4.0	8.0	45.0	46.2	No
CS Day							39.8	
CS Evening							39.8	
CS Night							39.8	
CT Noise sensitive point: Norwegian - Yellow zone (920)	356,893	6,952,412	9.4	4.0	8.0	45.0	47.3	No
CT Day							40.9	
CT Evening							40.9	
CT Night							40.9	
CU Noise sensitive point: Norwegian - Yellow zone (921)	356,915	6,952,425	6.5	4.0	8.0	45.0	47.2	No
CU Day							40.8	
CU Evening							40.8	
CU Night							40.8	
CV Noise sensitive point: Norwegian - Yellow zone (922)	356,901	6,952,391	9.6	4.0	8.0	45.0	47.9	No
CV Day							41.5	
CV Evening							41.5	
CV Night							41.5	
CW Noise sensitive point: Norwegian - Yellow zone (923)	356,921	6,952,404	7.1	4.0	8.0	45.0	47.1	No
CW Day							40.7	
CW Evening							40.7	
CW Night							40.7	

Appendix D: WindPRO printouts noise, Alternative case

Project:

2019_05_HaramFjellet

Licensed user:
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kvt73 / ove.undheim@vindteknikk.no

Calculated:
2019-06-12 10:41/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, Alternative, GENERAL, 8 m/s

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)	
Roughness based on line object	
Roughness Lines: HaramRoughness(3).map (7)	
Terrain type based on area object	
Area object (): REGIONS_2019_05_HaramFjellet_1.w2r (2)	
Month for calculation	January
Wind speed criteria	
Uniform wind speed at 10 m agl.	
Wind speed	8.0 m/s
Wind direction	All receptors downwind
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	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Setting	Noise data Creator	Name	Wind speed	LwA,ref
			[m]					[kW]	[m]	[m]				[m/s]	[dB(A)]
1	355,408	6,952,169	270.0	VESTAS V136-4.2 4200 1...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
2	355,452	6,951,811	251.1	VESTAS V136-4.2 4200 1...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
3	355,787	6,951,697	245.0	VESTAS V136-4.2 4200 1...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
4	356,322	6,952,279	324.5	VESTAS V136-4.2 4200 1...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Sound Optimized Mode SO1	11.2	102.0
											Evening	USER	Sound Optimized Mode SO1	11.2	102.0
											Night	USER	Sound Optimized Mode SO1	11.2	102.0
5	356,463	6,951,917	330.0	VESTAS V136-4.2 4200 1...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Sound Opitmized Mode SO2	11.2	99.5
											Evening	USER	Sound Opitmized Mode SO2	11.2	99.5
											Night	USER	Sound Opitmized Mode SO2	11.2	99.5
6	356,717	6,951,604	292.3	VESTAS V136-4.2 4200 1...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Sound Opitmized Mode SO2	11.2	99.5
											Evening	USER	Sound Opitmized Mode SO2	11.2	99.5
											Night	USER	Sound Opitmized Mode SO2	11.2	99.5
7	357,038	6,951,221	310.0	VESTAS V136-4.2 4200 1...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9
8	356,315	6,951,556	285.7	VESTAS V136-4.2 4200 1...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	Day	USER	Haramsfjellet_2019_03	11.2	103.9
											Evening	USER	Haramsfjellet_2019_03	11.2	103.9
											Night	USER	Haramsfjellet_2019_03	11.2	103.9

Calculation Results

Sound level

Noise sensitive area No.	Name	X(East)	Y(North)	Z	Imission height	Wind speed	Demands Noise	Sound level From WTGs	Demands fulfilled? Noise
				[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
A	Noise sensitive point: Demands defined in calculation setup. (733)	357,490	6,950,111	17.4	4.0	8.0	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	8.0	45.0	19.1	Yes
B	Day							12.7	
B	Evening							12.7	
B	Night							12.7	
C	Noise sensitive point: Demands defined in calculation setup. (735)	355,912	6,950,483	11.7	4.0	8.0	45.0	43.3	Yes

To be continued on next page...

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Calculated:
2019-06-12 10:41/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, Alternative, GENERAL, 8 m/s

...continued from previous page

Noise sensitive area							**Demands**	**Sound level**	**Demands fulfilled?**
No.	Name	X(East)	Y(North)	Z [m]	Imission height [m]	Wind speed [m/s]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
C	Day							36.9	
C	Evening							36.9	
C	Night							36.9	
D	Noise sensitive point: Demands defined in calculation setup. (736)	356,455	6,952,956	7.7	4.0	8.0	45.0	41.6	Yes
D	Day							35.3	
D	Evening							35.3	
D	Night							35.3	
E	Noise sensitive point: Demands defined in calculation setup. (737)	356,503	6,952,972	6.4	4.0	8.0	45.0	41.2	Yes
E	Day							34.8	
E	Evening							34.8	
E	Night							34.8	
F	Noise sensitive point: Demands defined in calculation setup. (738)	356,167	6,950,459	16.7	4.0	8.0	45.0	23.5	Yes
F	Day							17.1	
F	Evening							17.1	
F	Night							17.1	
G	Noise sensitive point: Demands defined in calculation setup. (739)	356,540	6,952,961	10.0	4.0	8.0	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	8.0	45.0	41.6	Yes
H	Day							35.2	
H	Evening							35.2	
H	Night							35.2	
I	Noise sensitive point: Demands defined in calculation setup. (741)	356,104	6,952,943	9.8	4.0	8.0	45.0	41.5	Yes
I	Day							35.1	
I	Evening							35.1	
I	Night							35.1	
J	Noise sensitive point: Demands defined in calculation setup. (742)	357,295	6,949,890	6.8	4.0	8.0	45.0	18.1	Yes
J	Day							11.7	
J	Evening							11.7	
J	Night							11.7	
K	Noise sensitive point: Demands defined in calculation setup. (743)	356,599	6,950,309	16.3	4.0	8.0	45.0	18.4	Yes
K	Day							12.0	
K	Evening							12.0	
K	Night							12.0	
L	Noise sensitive point: Demands defined in calculation setup. (744)	357,235	6,950,105	12.7	4.0	8.0	45.0	17.8	Yes
L	Day							11.4	
L	Evening							11.4	
L	Night							11.4	
M	Noise sensitive point: Demands defined in calculation setup. (745)	355,937	6,950,470	11.1	4.0	8.0	45.0	42.8	Yes
M	Day							36.4	
M	Evening							36.4	
M	Night							36.4	
N	Noise sensitive point: Demands defined in calculation setup. (746)	357,418	6,949,949	11.5	4.0	8.0	45.0	17.5	Yes
N	Day							11.1	
N	Evening							11.1	
N	Night							11.1	
O	Noise sensitive point: Demands defined in calculation setup. (747)	356,007	6,950,290	2.4	4.0	8.0	45.0	40.8	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	8.0	45.0	41.4	Yes
P	Day							35.0	
P	Evening							35.0	
P	Night							35.0	
Q	Noise sensitive point: Demands defined in calculation setup. (749)	355,685	6,950,564	15.0	4.0	8.0	45.0	43.4	Yes
Q	Day							37.0	
Q	Evening							37.0	
Q	Night							37.0	
R	Noise sensitive point: Demands defined in calculation setup. (750)	357,452	6,950,125	17.0	4.0	8.0	45.0	17.3	Yes
R	Day							10.9	
R	Evening							10.9	
R	Night							10.9	
S	Noise sensitive point: Demands defined in calculation setup. (751)	356,598	6,952,952	10.0	4.0	8.0	45.0	42.0	Yes
S	Day							35.6	
S	Evening							35.6	
S	Night							35.6	
T	Noise sensitive point: Demands defined in calculation setup. (752)	357,384	6,949,967	11.1	4.0	8.0	45.0	17.6	Yes
T	Day							11.3	
T	Evening							11.3	

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2019-06-12 10:41/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, Alternative, GENERAL, 8 m/s

...continued from previous page

Noise sensitive area							**Demands**	**Sound level**	**Demands fulfilled?**
No.	Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
				[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
T	Night							11.3	
U	Noise sensitive point: Demands defined in calculation setup. (753)	357,343	6,949,843	9.6	4.0	8.0	45.0	18.3	Yes
U	Day							11.9	
U	Evening							11.9	
U	Night							11.9	
V	Noise sensitive point: Demands defined in calculation setup. (754)	357,500	6,949,860	10.9	4.0	8.0	45.0	16.9	Yes
V	Day							10.5	
V	Evening							10.5	
V	Night							10.5	
W	Noise sensitive point: Demands defined in calculation setup. (755)	356,687	6,952,944	10.4	4.0	8.0	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	8.0	45.0	39.9	Yes
X	Day							33.5	
X	Evening							33.5	
X	Night							33.5	
Y	Noise sensitive point: Demands defined in calculation setup. (757)	356,214	6,950,257	5.8	4.0	8.0	45.0	40.1	Yes
Y	Day							33.7	
Y	Evening							33.7	
Y	Night							33.7	
Z	Noise sensitive point: Demands defined in calculation setup. (758)	357,507	6,950,041	16.1	4.0	8.0	45.0	17.6	Yes
Z	Day							11.2	
Z	Evening							11.2	
Z	Night							11.2	
AA	Noise sensitive point: Demands defined in calculation setup. (759)	356,944	6,950,208	14.8	4.0	8.0	45.0	18.4	Yes
AA	Day							12.0	
AA	Evening							12.0	
AA	Night							12.0	
AB	Noise sensitive point: Demands defined in calculation setup. (760)	356,431	6,950,353	15.0	4.0	8.0	45.0	32.8	Yes
AB	Day							26.4	
AB	Evening							26.4	
AB	Night							26.4	
AC	Noise sensitive point: Demands defined in calculation setup. (761)	355,814	6,950,526	12.0	4.0	8.0	45.0	43.5	Yes
AC	Day							37.1	
AC	Evening							37.1	
AC	Night							37.1	
AD	Noise sensitive point: Demands defined in calculation setup. (762)	356,348	6,950,278	10.0	4.0	8.0	45.0	37.2	Yes
AD	Day							30.8	
AD	Evening							30.8	
AD	Night							30.8	
AE	Noise sensitive point: Demands defined in calculation setup. (763)	356,648	6,952,960	13.1	4.0	8.0	45.0	41.7	Yes
AE	Day							35.3	
AE	Evening							35.3	
AE	Night							35.3	
AF	Noise sensitive point: Demands defined in calculation setup. (764)	356,516	6,952,929	15.0	4.0	8.0	45.0	42.1	Yes
AF	Day							35.7	
AF	Evening							35.7	
AF	Night							35.7	
AG	Noise sensitive point: Demands defined in calculation setup. (765)	356,135	6,950,453	15.0	4.0	8.0	45.0	21.1	Yes
AG	Day							14.7	
AG	Evening							14.7	
AG	Night							14.7	
AH	Noise sensitive point: Demands defined in calculation setup. (766)	357,070	6,950,192	15.2	4.0	8.0	45.0	18.7	Yes
AH	Day							12.3	
AH	Evening							12.3	
AH	Night							12.3	
AI	Noise sensitive point: Demands defined in calculation setup. (767)	357,282	6,950,054	12.0	4.0	8.0	45.0	17.3	Yes
AI	Day							10.9	
AI	Evening							10.9	
AI	Night							10.9	
AJ	Noise sensitive point: Demands defined in calculation setup. (768)	356,114	6,950,453	14.3	4.0	8.0	45.0	21.9	Yes
AJ	Day							15.5	
AJ	Evening							15.5	
AJ	Night							15.5	
AK	Noise sensitive point: Demands defined in calculation setup. (769)	356,715	6,950,269	15.8	4.0	8.0	45.0	19.9	Yes
AK	Day							13.5	
AK	Evening							13.5	
AK	Night							13.5	
AL	Noise sensitive point: Demands defined in calculation setup. (770)	356,115	6,950,290	5.7	4.0	8.0	45.0	40.2	Yes

To be continued on next page...

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, Alternative, GENERAL, 8 m/s

...continued from previous page

Noise sensitive area							Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
				[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
AL	Day							33.8	
AL	Evening							33.8	
AL	Night							33.8	
AM	Noise sensitive point: Demands defined in calculation setup. (771)	356,289	6,952,926	9.6	4.0	8.0	45.0	40.2	Yes
AM	Day							33.8	
AM	Evening							33.8	
AM	Night							33.8	
AN	Noise sensitive point: Demands defined in calculation setup. (772)	355,668	6,950,529	13.4	4.0	8.0	45.0	42.9	Yes
AN	Day							36.5	
AN	Evening							36.5	
AN	Night							36.5	
AO	Noise sensitive point: Demands defined in calculation setup. (773)	356,051	6,953,030	5.0	4.0	8.0	45.0	42.5	Yes
AO	Day							36.1	
AO	Evening							36.1	
AO	Night							36.1	
AP	Noise sensitive point: Demands defined in calculation setup. (774)	356,465	6,950,343	15.0	4.0	8.0	45.0	31.1	Yes
AP	Day							24.7	
AP	Evening							24.7	
AP	Night							24.7	
AQ	Noise sensitive point: Demands defined in calculation setup. (775)	356,253	6,952,942	8.3	4.0	8.0	45.0	40.1	Yes
AQ	Day							33.7	
AQ	Evening							33.7	
AQ	Night							33.7	
AR	Noise sensitive point: Demands defined in calculation setup. (776)	356,469	6,952,988	3.5	4.0	8.0	45.0	41.6	Yes
AR	Day							35.2	
AR	Evening							35.2	
AR	Night							35.2	
AS	Noise sensitive point: Demands defined in calculation setup. (777)	356,478	6,952,987	3.7	4.0	8.0	45.0	41.8	Yes
AS	Day							35.4	
AS	Evening							35.4	
AS	Night							35.4	
AT	Noise sensitive point: Demands defined in calculation setup. (778)	356,159	6,952,982	6.6	4.0	8.0	45.0	40.0	Yes
AT	Day							33.6	
AT	Evening							33.6	
AT	Night							33.6	
AU	Noise sensitive point: Demands defined in calculation setup. (779)	356,602	6,950,288	15.0	4.0	8.0	45.0	19.6	Yes
AU	Day							13.2	
AU	Evening							13.2	
AU	Night							13.2	
AV	Noise sensitive point: Demands defined in calculation setup. (780)	357,454	6,950,166	18.8	4.0	8.0	45.0	17.2	Yes
AV	Day							10.8	
AV	Evening							10.8	
AV	Night							10.8	
AW	Noise sensitive point: Demands defined in calculation setup. (781)	355,877	6,950,490	11.6	4.0	8.0	45.0	43.0	Yes
AW	Day							36.6	
AW	Evening							36.6	
AW	Night							36.6	
AX	Noise sensitive point: Demands defined in calculation setup. (782)	356,095	6,953,023	5.3	4.0	8.0	45.0	43.0	Yes
AX	Day							36.6	
AX	Evening							36.6	
AX	Night							36.6	
AY	Noise sensitive point: Demands defined in calculation setup. (783)	355,345	6,950,425	8.3	4.0	8.0	45.0	41.4	Yes
AY	Day							35.0	
AY	Evening							35.0	
AY	Night							35.0	
AZ	Noise sensitive point: Demands defined in calculation setup. (784)	356,476	6,950,266	11.3	4.0	8.0	45.0	35.0	Yes
AZ	Day							28.6	
AZ	Evening							28.6	
AZ	Night							28.6	
BA	Noise sensitive point: Demands defined in calculation setup. (785)	356,863	6,950,240	15.1	4.0	8.0	45.0	18.8	Yes
BA	Day							12.4	
BA	Evening							12.4	
BA	Night							12.4	
BB	Noise sensitive point: Demands defined in calculation setup. (786)	355,782	6,950,531	10.1	4.0	8.0	45.0	43.6	Yes
BB	Day							37.2	
BB	Evening							37.2	
BB	Night							37.2	
BC	Noise sensitive point: Demands defined in calculation setup. (787)	356,794	6,950,258	15.6	4.0	8.0	45.0	18.6	Yes
BC	Day							12.2	
BC	Evening							12.2	

To be continued on next page...

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, Alternative, GENERAL, 8 m/s

...continued from previous page

Noise sensitive area							**Demands**	**Sound level**	**Demands fulfilled?**
No.	Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
				[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
BC	Night							12.2	
BD	Noise sensitive point: Demands defined in calculation setup. (788)	355,547	6,950,425	8.6	4.0	8.0	45.0	42.2	Yes
BD	Day							35.8	
BD	Evening							35.8	
BD	Night							35.8	
BE	Noise sensitive point: Demands defined in calculation setup. (789)	356,073	6,950,329	6.2	4.0	8.0	45.0	40.9	Yes
BE	Day							34.5	
BE	Evening							34.5	
BE	Night							34.5	
BF	Noise sensitive point: Demands defined in calculation setup. (846)	356,264	6,953,051	3.1	4.0	8.0	45.0	39.6	Yes
BF	Day							33.2	
BF	Evening							33.2	
BF	Night							33.2	
BG	Noise sensitive point: Demands defined in calculation setup. (847)	356,337	6,950,438	20.0	4.0	8.0	45.0	37.1	Yes
BG	Day							30.7	
BG	Evening							30.7	
BG	Night							30.7	
BH	Noise sensitive point: Demands defined in calculation setup. (848)	355,363	6,953,382	13.3	4.0	8.0	45.0	39.8	Yes
BH	Day							33.4	
BH	Evening							33.4	
BH	Night							33.4	
BI	Noise sensitive point: Demands defined in calculation setup. (849)	356,256	6,953,071	2.4	4.0	8.0	45.0	41.0	Yes
BI	Day							34.6	
BI	Evening							34.6	
BI	Night							34.6	
BJ	Noise sensitive point: Demands defined in calculation setup. (850)	356,626	6,952,977	8.4	4.0	8.0	45.0	42.3	Yes
BJ	Day							35.9	
BJ	Evening							35.9	
BJ	Night							35.9	
BK	Noise sensitive point: Demands defined in calculation setup. (851)	357,083	6,952,151	9.2	4.0	8.0	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	8.0	45.0	41.8	Yes
BL	Day							35.4	
BL	Evening							35.4	
BL	Night							35.4	
BM	Noise sensitive point: Demands defined in calculation setup. (853)	356,709	6,952,932	6.5	4.0	8.0	45.0	42.5	Yes
BM	Day							36.1	
BM	Evening							36.1	
BM	Night							36.1	
BN	Noise sensitive point: Demands defined in calculation setup. (854)	356,024	6,950,273	1.9	4.0	8.0	45.0	40.7	Yes
BN	Day							34.3	
BN	Evening							34.3	
BN	Night							34.3	
BO	Noise sensitive point: Demands defined in calculation setup. (855)	356,713	6,952,953	8.5	4.0	8.0	45.0	42.3	Yes
BO	Day							35.9	
BO	Evening							35.9	
BO	Night							35.9	
BP	Noise sensitive point: Demands defined in calculation setup. (856)	356,717	6,952,961	8.4	4.0	8.0	45.0	42.2	Yes
BP	Day							35.8	
BP	Evening							35.8	
BP	Night							35.8	
BQ	Noise sensitive point: Demands defined in calculation setup. (857)	356,632	6,952,931	10.0	4.0	8.0	45.0	42.4	Yes
BQ	Day							36.0	
BQ	Evening							36.0	
BQ	Night							36.0	
BR	Noise sensitive point: Demands defined in calculation setup. (858)	356,646	6,952,988	5.5	4.0	8.0	45.0	41.8	Yes
BR	Day							35.4	
BR	Evening							35.4	
BR	Night							35.4	
BS	Noise sensitive point: Demands defined in calculation setup. (859)	356,551	6,952,929	15.0	4.0	8.0	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	8.0	45.0	42.4	Yes
BT	Day							36.0	
BT	Evening							36.0	
BT	Night							36.0	
BU	Noise sensitive point: Demands defined in calculation setup. (861)	355,863	6,953,093	9.1	4.0	8.0	45.0	42.2	Yes

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NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, Alternative, GENERAL, 8 m/s

...continued from previous page

Noise sensitive area							Demands	Sound level	Demands fulfilled?
No.	Name	X(East)	Y(North)	Z [m]	Imission height [m]	Wind speed [m/s]	Noise [dB(A)]	From WTGs [dB(A)]	Noise [dB(A)]
BU	Day							35.8	
BU	Evening							35.8	
BU	Night							35.8	
BV	Noise sensitive point: Demands defined in calculation setup. (862)	356,580	6,952,934	12.2	4.0	8.0	45.0	41.6	Yes
BV	Day							35.2	
BV	Evening							35.2	
BV	Night							35.2	
BW	Noise sensitive point: Demands defined in calculation setup. (863)	356,567	6,952,961	10.9	4.0	8.0	45.0	41.9	Yes
BW	Day							35.5	
BW	Evening							35.5	
BW	Night							35.5	
BX	Noise sensitive point: Demands defined in calculation setup. (864)	356,642	6,952,940	11.3	4.0	8.0	45.0	42.4	Yes
BX	Day							36.0	
BX	Evening							36.0	
BX	Night							36.0	
BY	Noise sensitive point: Demands defined in calculation setup. (865)	356,671	6,952,938	12.1	4.0	8.0	45.0	43.3	Yes
BY	Day							36.9	
BY	Evening							36.9	
BY	Night							36.9	
BZ	Noise sensitive point: Demands defined in calculation setup. (866)	355,030	6,953,694	3.6	4.0	8.0	45.0	38.6	Yes
BZ	Day							32.2	
BZ	Evening							32.2	
BZ	Night							32.2	
CA	Noise sensitive point: Demands defined in calculation setup. (867)	356,228	6,953,055	3.8	4.0	8.0	45.0	41.1	Yes
CA	Day							34.7	
CA	Evening							34.7	
CA	Night							34.7	
CB	Noise sensitive point: Demands defined in calculation setup. (868)	356,711	6,952,980	7.8	4.0	8.0	45.0	41.9	Yes
CB	Day							35.5	
CB	Evening							35.5	
CB	Night							35.5	
CC	Noise sensitive point: Demands defined in calculation setup. (869)	355,834	6,950,356	4.6	4.0	8.0	45.0	42.2	Yes
CC	Day							35.8	
CC	Evening							35.8	
CC	Night							35.8	
CD	Noise sensitive point: Demands defined in calculation setup. (870)	356,670	6,952,989	10.1	4.0	8.0	45.0	41.7	Yes
CD	Day							35.3	
CD	Evening							35.3	
CD	Night							35.3	
CE	Noise sensitive point: Demands defined in calculation setup. (871)	355,629	6,950,575	10.6	4.0	8.0	45.0	43.2	Yes
CE	Day							36.8	
CE	Evening							36.8	
CE	Night							36.8	
CF	Noise sensitive point: Demands defined in calculation setup. (872)	356,679	6,952,912	6.0	4.0	8.0	45.0	42.4	Yes
CF	Day							36.0	
CF	Evening							36.0	
CF	Night							36.0	
CG	Noise sensitive point: Demands defined in calculation setup. (873)	356,687	6,952,928	8.3	4.0	8.0	45.0	42.5	Yes
CG	Day							36.1	
CG	Evening							36.1	
CG	Night							36.1	
CH	Noise sensitive point: Norwegian - Yellow zone (908)	356,776	6,952,506	13.6	4.0	8.0	45.0	39.7	Yes
CH	Day							33.3	
CH	Evening							33.3	
CH	Night							33.3	
CI	Noise sensitive point: Norwegian - Yellow zone (909)	356,793	6,952,513	12.6	4.0	8.0	45.0	38.7	Yes
CI	Day							32.3	
CI	Evening							32.3	
CI	Night							32.3	
CJ	Noise sensitive point: Norwegian - Yellow zone (910)	356,813	6,952,516	11.6	4.0	8.0	45.0	38.4	Yes
CJ	Day							32.0	
CJ	Evening							32.0	
CJ	Night							32.0	
CK	Noise sensitive point: Norwegian - Yellow zone (911)	356,821	6,952,464	15.9	4.0	8.0	45.0	43.1	Yes
CK	Day							36.7	
CK	Evening							36.7	
CK	Night							36.7	
CL	Noise sensitive point: Norwegian - Yellow zone (912)	356,836	6,952,449	13.7	4.0	8.0	45.0	44.0	Yes
CL	Day							37.6	
CL	Evening							37.6	

To be continued on next page...

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, Alternative, GENERAL, 8 m/s

...continued from previous page

Noise sensitive area						**Demands**	**Sound level**	**Demands fulfilled?**
No. Name	X(East)	Y(North)	Z	Imission height	Wind speed	Noise	From WTGs	Noise
			[m]	[m]	[m/s]	[dB(A)]	[dB(A)]	[dB(A)]
CL Night							37.6	
CM Noise sensitive point: Norwegian - Yellow zone (913)	356,856	6,952,444	11.6	4.0	8.0	45.0	43.5	Yes
CM Day							37.1	
CM Evening							37.1	
CM Night							37.1	
CN Noise sensitive point: Norwegian - Yellow zone (914)	356,864	6,952,464	10.0	4.0	8.0	45.0	43.3	Yes
CN Day							36.9	
CN Evening							36.9	
CN Night							36.9	
CO Noise sensitive point: Norwegian - Yellow zone (915)	356,872	6,952,482	9.8	4.0	8.0	45.0	43.7	Yes
CO Day							37.3	
CO Evening							37.3	
CO Night							37.3	
CP Noise sensitive point: Norwegian - Yellow zone (916)	356,868	6,952,409	11.6	4.0	8.0	45.0	44.5	Yes
CP Day							38.1	
CP Evening							38.1	
CP Night							38.1	
CQ Noise sensitive point: Norwegian - Yellow zone (917)	356,887	6,952,429	9.2	4.0	8.0	45.0	44.0	Yes
CQ Day							37.6	
CQ Evening							37.6	
CQ Night							37.6	
CR Noise sensitive point: Norwegian - Yellow zone (918)	356,898	6,952,463	6.8	4.0	8.0	45.0	43.7	Yes
CR Day							37.3	
CR Evening							37.3	
CR Night							37.3	
CS Noise sensitive point: Norwegian - Yellow zone (919)	356,905	6,952,444	6.8	4.0	8.0	45.0	43.5	Yes
CS Day							37.1	
CS Evening							37.1	
CS Night							37.1	
CT Noise sensitive point: Norwegian - Yellow zone (920)	356,893	6,952,412	9.4	4.0	8.0	45.0	44.8	Yes
CT Day							38.4	
CT Evening							38.4	
CT Night							38.4	
CU Noise sensitive point: Norwegian - Yellow zone (921)	356,915	6,952,425	6.5	4.0	8.0	45.0	44.7	Yes
CU Day							38.3	
CU Evening							38.3	
CU Night							38.3	
CV Noise sensitive point: Norwegian - Yellow zone (922)	356,901	6,952,391	9.6	4.0	8.0	45.0	45.2	No
CV Day							38.8	
CV Evening							38.8	
CV Night							38.8	
CW Noise sensitive point: Norwegian - Yellow zone (923)	356,921	6,952,404	7.1	4.0	8.0	45.0	44.6	Yes
CW Day							38.2	
CW Evening							38.2	
CW Night							38.2	

Appendix E: WindPRO printouts noise, real case

Project:
2019_05_HaramFjellet

Licensed user:
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Calculated:
2019-06-11 10:25/3.2.744

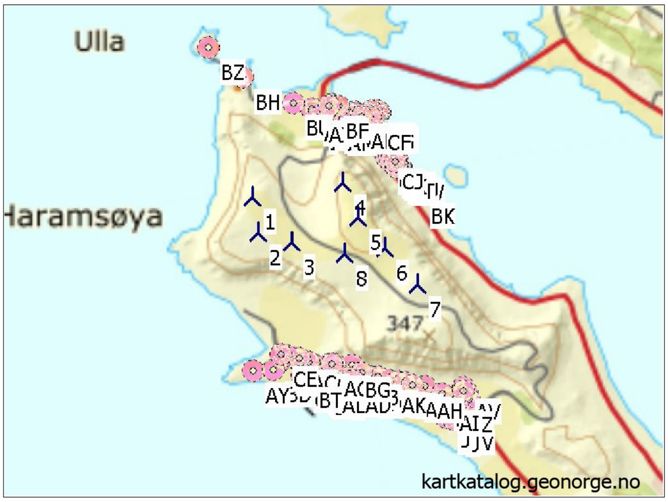
NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, 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)	
Roughness based on line object	
Roughness Lines: HaramRoughness(3).map (7)	
Terrain type based on area object	
Area object (): REGIONS_2019_05_HaramFjellet_1.w2r (2)	
Month for calculation	January
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	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Setting	Noise data Creator	Name
			[m]					[kW]	[m]	[m]			
1	355,408	6,952,169	270.0	VESTAS V136-4.2 420...	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	VESTAS V136-4.2 420...	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	VESTAS V136-4.2 420...	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	6,952,279	324.5	VESTAS V136-4.2 420...	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	VESTAS V136-4.2 420...	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	VESTAS V136-4.2 420...	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	VESTAS V136-4.2 420...	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	6,951,556	285.7	VESTAS V136-4.2 420...	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	Imission height	Demands Noise	Sound level L50	Demands fulfilled? Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]
A	Noise sensitive point: Demands defined in calculation setup. (733)	357,490	6,950,111	17.4	4.0	45.0	11.8	Yes
A	Day						5.4	
A	Evening						5.4	
A	Night						5.4	
B	Noise sensitive point: Demands defined in calculation setup. (734)	357,263	6,949,868	5.7	4.0	45.0	14.2	Yes
B	Day						7.8	
B	Evening						7.8	
B	Night						7.8	

To be continued on next page...

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2019-06-11 10:25/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, 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)]
C	Noise sensitive point: Demands defined in calculation setup. (735)	355,912	6,950,483	11.7	4.0	45.0	38.5	Yes
C	Day						32.1	
C	Evening						32.1	
C	Night						32.1	
D	Noise sensitive point: Demands defined in calculation setup. (736)	356,455	6,952,956	7.7	4.0	45.0	37.8	Yes
D	Day						31.4	
D	Evening						31.4	
D	Night						31.4	
E	Noise sensitive point: Demands defined in calculation setup. (737)	356,503	6,952,972	6.4	4.0	45.0	38.1	Yes
E	Day						31.7	
E	Evening						31.7	
E	Night						31.7	
F	Noise sensitive point: Demands defined in calculation setup. (738)	356,167	6,950,459	16.7	4.0	45.0	17.7	Yes
F	Day						11.3	
F	Evening						11.3	
F	Night						11.3	
G	Noise sensitive point: Demands defined in calculation setup. (739)	356,540	6,952,961	10.0	4.0	45.0	38.3	Yes
G	Day						31.9	
G	Evening						31.9	
G	Night						31.9	
H	Noise sensitive point: Demands defined in calculation setup. (740)	356,488	6,952,946	10.5	4.0	45.0	37.8	Yes
H	Day						31.4	
H	Evening						31.4	
H	Night						31.4	
I	Noise sensitive point: Demands defined in calculation setup. (741)	356,104	6,952,943	9.8	4.0	45.0	33.7	Yes
I	Day						27.3	
I	Evening						27.3	
I	Night						27.3	
J	Noise sensitive point: Demands defined in calculation setup. (742)	357,295	6,949,890	6.8	4.0	45.0	13.6	Yes
J	Day						7.2	
J	Evening						7.2	
J	Night						7.2	
K	Noise sensitive point: Demands defined in calculation setup. (743)	356,599	6,950,309	16.3	4.0	45.0	14.4	Yes
K	Day						8.0	
K	Evening						8.0	
K	Night						8.0	
L	Noise sensitive point: Demands defined in calculation setup. (744)	357,235	6,950,105	12.7	4.0	45.0	13.8	Yes
L	Day						7.4	
L	Evening						7.4	
L	Night						7.4	
M	Noise sensitive point: Demands defined in calculation setup. (745)	355,937	6,950,470	11.1	4.0	45.0	38.4	Yes
M	Day						32.0	
M	Evening						32.0	
M	Night						32.0	
N	Noise sensitive point: Demands defined in calculation setup. (746)	357,418	6,949,949	11.5	4.0	45.0	13.5	Yes
N	Day						7.1	
N	Evening						7.1	
N	Night						7.1	
O	Noise sensitive point: Demands defined in calculation setup. (747)	356,007	6,950,290	2.4	4.0	45.0	37.3	Yes
O	Day						30.9	
O	Evening						30.9	
O	Night						30.9	
P	Noise sensitive point: Demands defined in calculation setup. (748)	355,974	6,950,315	2.8	4.0	45.0	37.5	Yes
P	Day						31.1	
P	Evening						31.1	
P	Night						31.1	
Q	Noise sensitive point: Demands defined in calculation setup. (749)	355,685	6,950,564	15.0	4.0	45.0	39.5	Yes
Q	Day						33.1	
Q	Evening						33.1	
Q	Night						33.1	
R	Noise sensitive point: Demands defined in calculation setup. (750)	357,452	6,950,125	17.0	4.0	45.0	12.7	Yes
R	Day						6.3	
R	Evening						6.3	
R	Night						6.3	
S	Noise sensitive point: Demands defined in calculation setup. (751)	356,598	6,952,952	10.0	4.0	45.0	38.1	Yes
S	Day						31.7	
S	Evening						31.7	

To be continued on next page...

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, Real case

...continued from previous page

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)]
S	Night						31.7	
T	Noise sensitive point: Demands defined in calculation setup. (752)	357,384	6,949,967	11.1	4.0	45.0	13.7	Yes
T	Day						7.3	
T	Evening						7.3	
T	Night						7.3	
U	Noise sensitive point: Demands defined in calculation setup. (753)	357,343	6,949,843	9.6	4.0	45.0	13.5	Yes
U	Day						7.1	
U	Evening						7.1	
U	Night						7.1	
V	Noise sensitive point: Demands defined in calculation setup. (754)	357,500	6,949,860	10.9	4.0	45.0	12.3	Yes
V	Day						5.9	
V	Evening						5.9	
V	Night						5.9	
W	Noise sensitive point: Demands defined in calculation setup. (755)	356,687	6,952,944	10.4	4.0	45.0	39.2	Yes
W	Day						32.8	
W	Evening						32.8	
W	Night						32.8	
X	Noise sensitive point: Demands defined in calculation setup. (756)	356,317	6,953,050	1.9	4.0	45.0	31.9	Yes
X	Day						25.5	
X	Evening						25.5	
X	Night						25.5	
Y	Noise sensitive point: Demands defined in calculation setup. (757)	356,214	6,950,257	5.8	4.0	45.0	35.7	Yes
Y	Day						29.3	
Y	Evening						29.3	
Y	Night						29.3	
Z	Noise sensitive point: Demands defined in calculation setup. (758)	357,507	6,950,041	16.1	4.0	45.0	13.1	Yes
Z	Day						6.7	
Z	Evening						6.7	
Z	Night						6.7	
AA	Noise sensitive point: Demands defined in calculation setup. (759)	356,944	6,950,208	14.8	4.0	45.0	14.5	Yes
AA	Day						8.1	
AA	Evening						8.1	
AA	Night						8.1	
AB	Noise sensitive point: Demands defined in calculation setup. (760)	356,431	6,950,353	15.0	4.0	45.0	28.3	Yes
AB	Day						21.9	
AB	Evening						21.9	
AB	Night						21.9	
AC	Noise sensitive point: Demands defined in calculation setup. (761)	355,814	6,950,526	12.0	4.0	45.0	39.4	Yes
AC	Day						33.0	
AC	Evening						33.0	
AC	Night						33.0	
AD	Noise sensitive point: Demands defined in calculation setup. (762)	356,348	6,950,278	10.0	4.0	45.0	32.5	Yes
AD	Day						26.1	
AD	Evening						26.1	
AD	Night						26.1	
AE	Noise sensitive point: Demands defined in calculation setup. (763)	356,648	6,952,960	13.1	4.0	45.0	38.6	Yes
AE	Day						32.2	
AE	Evening						32.2	
AE	Night						32.2	
AF	Noise sensitive point: Demands defined in calculation setup. (764)	356,516	6,952,929	15.0	4.0	45.0	38.7	Yes
AF	Day						32.3	
AF	Evening						32.3	
AF	Night						32.3	
AG	Noise sensitive point: Demands defined in calculation setup. (765)	356,135	6,950,453	15.0	4.0	45.0	16.6	Yes
AG	Day						10.2	
AG	Evening						10.2	
AG	Night						10.2	
AH	Noise sensitive point: Demands defined in calculation setup. (766)	357,070	6,950,192	15.2	4.0	45.0	14.7	Yes
AH	Day						8.3	
AH	Evening						8.3	
AH	Night						8.3	
AI	Noise sensitive point: Demands defined in calculation setup. (767)	357,282	6,950,054	12.0	4.0	45.0	13.4	Yes
AI	Day						7.0	
AI	Evening						7.0	
AI	Night						7.0	
AJ	Noise sensitive point: Demands defined in calculation setup. (768)	356,114	6,950,453	14.3	4.0	45.0	17.1	Yes
AJ	Day						10.7	

To be continued on next page...

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Calculated:
2019-06-11 10:25/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, 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	Evening						10.7	
AJ	Night						10.7	
AK	Noise sensitive point: Demands defined in calculation setup. (769)	356,715	6,950,269	15.8	4.0	45.0	16.0	Yes
AK	Day						9.6	
AK	Evening						9.6	
AK	Night						9.6	
AL	Noise sensitive point: Demands defined in calculation setup. (770)	356,115	6,950,290	5.7	4.0	45.0	35.7	Yes
AL	Day						29.3	
AL	Evening						29.3	
AL	Night						29.3	
AM	Noise sensitive point: Demands defined in calculation setup. (771)	356,289	6,952,926	9.6	4.0	45.0	34.0	Yes
AM	Day						27.6	
AM	Evening						27.6	
AM	Night						27.6	
AN	Noise sensitive point: Demands defined in calculation setup. (772)	355,668	6,950,529	13.4	4.0	45.0	39.2	Yes
AN	Day						32.8	
AN	Evening						32.8	
AN	Night						32.8	
AO	Noise sensitive point: Demands defined in calculation setup. (773)	356,051	6,953,030	5.0	4.0	45.0	33.4	Yes
AO	Day						27.0	
AO	Evening						27.0	
AO	Night						27.0	
AP	Noise sensitive point: Demands defined in calculation setup. (774)	356,465	6,950,343	15.0	4.0	45.0	23.7	Yes
AP	Day						17.4	
AP	Evening						17.4	
AP	Night						17.4	
AQ	Noise sensitive point: Demands defined in calculation setup. (775)	356,253	6,952,942	8.3	4.0	45.0	33.9	Yes
AQ	Day						27.5	
AQ	Evening						27.5	
AQ	Night						27.5	
AR	Noise sensitive point: Demands defined in calculation setup. (776)	356,469	6,952,988	3.5	4.0	45.0	37.5	Yes
AR	Day						31.1	
AR	Evening						31.1	
AR	Night						31.1	
AS	Noise sensitive point: Demands defined in calculation setup. (777)	356,478	6,952,987	3.7	4.0	45.0	36.7	Yes
AS	Day						30.3	
AS	Evening						30.3	
AS	Night						30.3	
AT	Noise sensitive point: Demands defined in calculation setup. (778)	356,159	6,952,982	6.6	4.0	45.0	33.3	Yes
AT	Day						26.9	
AT	Evening						26.9	
AT	Night						26.9	
AU	Noise sensitive point: Demands defined in calculation setup. (779)	356,602	6,950,288	15.0	4.0	45.0	15.7	Yes
AU	Day						9.3	
AU	Evening						9.3	
AU	Night						9.3	
AV	Noise sensitive point: Demands defined in calculation setup. (780)	357,454	6,950,166	18.8	4.0	45.0	12.0	Yes
AV	Day						5.6	
AV	Evening						5.6	
AV	Night						5.6	
AW	Noise sensitive point: Demands defined in calculation setup. (781)	355,877	6,950,490	11.6	4.0	45.0	38.8	Yes
AW	Day						32.4	
AW	Evening						32.4	
AW	Night						32.4	
AX	Noise sensitive point: Demands defined in calculation setup. (782)	356,095	6,953,023	5.3	4.0	45.0	33.5	Yes
AX	Day						27.1	
AX	Evening						27.1	
AX	Night						27.1	
AY	Noise sensitive point: Demands defined in calculation setup. (783)	355,345	6,950,425	8.3	4.0	45.0	37.8	Yes
AY	Day						31.4	
AY	Evening						31.4	
AY	Night						31.4	
AZ	Noise sensitive point: Demands defined in calculation setup. (784)	356,476	6,950,266	11.3	4.0	45.0	29.8	Yes
AZ	Day						23.4	
AZ	Evening						23.4	
AZ	Night						23.4	
BA	Noise sensitive point: Demands defined in calculation setup. (785)	356,863	6,950,240	15.1	4.0	45.0	14.3	Yes

To be continued on next page...

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2019-06-11 10:25/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, 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)]
BA Day						7.9	
BA Evening						7.9	
BA Night						7.9	
BB Noise sensitive point: Demands defined in calculation setup. (786)	355,782	6,950,531	10.1	4.0	45.0	39.5	Yes
BB Day						33.1	
BB Evening						33.1	
BB Night						33.1	
BC Noise sensitive point: Demands defined in calculation setup. (787)	356,794	6,950,258	15.6	4.0	45.0	14.2	Yes
BC Day						7.8	
BC Evening						7.8	
BC Night						7.8	
BD Noise sensitive point: Demands defined in calculation setup. (788)	355,547	6,950,425	8.6	4.0	45.0	38.4	Yes
BD Day						32.0	
BD Evening						32.0	
BD Night						32.0	
BE Noise sensitive point: Demands defined in calculation setup. (789)	356,073	6,950,329	6.2	4.0	45.0	36.1	Yes
BE Day						29.7	
BE Evening						29.7	
BE Night						29.7	
BF Noise sensitive point: Demands defined in calculation setup. (846)	356,264	6,953,051	3.1	4.0	45.0	32.1	Yes
BF Day						25.7	
BF Evening						25.7	
BF Night						25.7	
BG Noise sensitive point: Demands defined in calculation setup. (847)	356,337	6,950,438	20.0	4.0	45.0	32.8	Yes
BG Day						26.4	
BG Evening						26.4	
BG Night						26.4	
BH Noise sensitive point: Demands defined in calculation setup. (848)	355,363	6,953,382	13.3	4.0	45.0	32.9	Yes
BH Day						26.5	
BH Evening						26.5	
BH Night						26.5	
BI Noise sensitive point: Demands defined in calculation setup. (849)	356,256	6,953,071	2.4	4.0	45.0	32.0	Yes
BI Day						25.6	
BI Evening						25.6	
BI Night						25.6	
BJ Noise sensitive point: Demands defined in calculation setup. (850)	356,626	6,952,977	8.4	4.0	45.0	38.6	Yes
BJ Day						32.2	
BJ Evening						32.2	
BJ Night						32.2	
BK Noise sensitive point: Demands defined in calculation setup. (851)	357,083	6,952,151	9.2	4.0	45.0	38.2	Yes
BK Day						31.8	
BK Evening						31.8	
BK Night						31.8	
BL Noise sensitive point: Demands defined in calculation setup. (852)	356,730	6,952,960	5.2	4.0	45.0	38.5	Yes
BL Day						32.1	
BL Evening						32.1	
BL Night						32.1	
BM Noise sensitive point: Demands defined in calculation setup. (853)	356,709	6,952,932	6.5	4.0	45.0	38.7	Yes
BM Day						32.3	
BM Evening						32.3	
BM Night						32.3	
BN Noise sensitive point: Demands defined in calculation setup. (854)	356,024	6,950,273	1.9	4.0	45.0	37.3	Yes
BN Day						30.9	
BN Evening						30.9	
BN Night						30.9	
BO Noise sensitive point: Demands defined in calculation setup. (855)	356,713	6,952,953	8.5	4.0	45.0	38.9	Yes
BO Day						32.5	
BO Evening						32.5	
BO Night						32.5	
BP Noise sensitive point: Demands defined in calculation setup. (856)	356,717	6,952,961	8.4	4.0	45.0	38.8	Yes
BP Day						32.4	
BP Evening						32.4	
BP Night						32.4	
BQ Noise sensitive point: Demands defined in calculation setup. (857)	356,632	6,952,931	10.0	4.0	45.0	38.6	Yes
BQ Day						32.3	
BQ Evening						32.3	
BQ Night						32.3	

To be continued on next page...

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Calculated:
2019-06-11 10:25/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, Real case

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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)]
BR	Noise sensitive point: Demands defined in calculation setup. (858)	356,646	6,952,988	5.5	4.0	45.0	38.3	Yes
BR	Day						31.9	
BR	Evening						31.9	
BR	Night						31.9	
BS	Noise sensitive point: Demands defined in calculation setup. (859)	356,551	6,952,929	15.0	4.0	45.0	38.5	Yes
BS	Day						32.1	
BS	Evening						32.1	
BS	Night						32.1	
BT	Noise sensitive point: Demands defined in calculation setup. (860)	355,874	6,950,349	4.3	4.0	45.0	38.3	Yes
BT	Day						31.9	
BT	Evening						31.9	
BT	Night						31.9	
BU	Noise sensitive point: Demands defined in calculation setup. (861)	355,863	6,953,093	9.1	4.0	45.0	35.9	Yes
BU	Day						29.5	
BU	Evening						29.5	
BU	Night						29.5	
BV	Noise sensitive point: Demands defined in calculation setup. (862)	356,580	6,952,934	12.2	4.0	45.0	38.2	Yes
BV	Day						31.8	
BV	Evening						31.8	
BV	Night						31.8	
BW	Noise sensitive point: Demands defined in calculation setup. (863)	356,567	6,952,961	10.9	4.0	45.0	38.3	Yes
BW	Day						31.9	
BW	Evening						31.9	
BW	Night						31.9	
BX	Noise sensitive point: Demands defined in calculation setup. (864)	356,642	6,952,940	11.3	4.0	45.0	38.7	Yes
BX	Day						32.3	
BX	Evening						32.3	
BX	Night						32.3	
BY	Noise sensitive point: Demands defined in calculation setup. (865)	356,671	6,952,938	12.1	4.0	45.0	39.8	Yes
BY	Day						33.4	
BY	Evening						33.4	
BY	Night						33.4	
BZ	Noise sensitive point: Demands defined in calculation setup. (866)	355,030	6,953,694	3.6	4.0	45.0	32.2	Yes
BZ	Day						25.8	
BZ	Evening						25.8	
BZ	Night						25.8	
CA	Noise sensitive point: Demands defined in calculation setup. (867)	356,228	6,953,055	3.8	4.0	45.0	32.3	Yes
CA	Day						25.9	
CA	Evening						25.9	
CA	Night						25.9	
CB	Noise sensitive point: Demands defined in calculation setup. (868)	356,711	6,952,980	7.8	4.0	45.0	38.8	Yes
CB	Day						32.4	
CB	Evening						32.4	
CB	Night						32.4	
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	38.3	Yes
CD	Day						31.9	
CD	Evening						31.9	
CD	Night						31.9	
CE	Noise sensitive point: Demands defined in calculation setup. (871)	355,629	6,950,575	10.6	4.0	45.0	39.2	Yes
CE	Day						32.8	
CE	Evening						32.8	
CE	Night						32.8	
CF	Noise sensitive point: Demands defined in calculation setup. (872)	356,679	6,952,912	6.0	4.0	45.0	38.2	Yes
CF	Day						31.8	
CF	Evening						31.8	
CF	Night						31.8	
CG	Noise sensitive point: Demands defined in calculation setup. (873)	356,687	6,952,928	8.3	4.0	45.0	38.6	Yes
CG	Day						32.2	
CG	Evening						32.2	
CG	Night						32.2	
CH	Noise sensitive point: Norwegian - Yellow zone (908)	356,776	6,952,506	13.6	4.0	45.0	36.0	Yes
CH	Day						29.6	
CH	Evening						29.6	

To be continued on next page...

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2019-06-11 10:25/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, 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)]
CH	Night						29.6	
CI	Noise sensitive point: Norwegian - Yellow zone (909)	356,793	6,952,513	12.6	4.0	45.0	36.5	Yes
CI	Day						30.1	
CI	Evening						30.1	
CI	Night						30.1	
CJ	Noise sensitive point: Norwegian - Yellow zone (910)	356,813	6,952,516	11.6	4.0	45.0	34.9	Yes
CJ	Day						28.5	
CJ	Evening						28.5	
CJ	Night						28.5	
CK	Noise sensitive point: Norwegian - Yellow zone (911)	356,821	6,952,464	15.9	4.0	45.0	35.6	Yes
CK	Day						29.2	
CK	Evening						29.2	
CK	Night						29.2	
CL	Noise sensitive point: Norwegian - Yellow zone (912)	356,836	6,952,449	13.7	4.0	45.0	37.0	Yes
CL	Day						30.6	
CL	Evening						30.6	
CL	Night						30.6	
CM	Noise sensitive point: Norwegian - Yellow zone (913)	356,856	6,952,444	11.6	4.0	45.0	39.6	Yes
CM	Day						33.2	
CM	Evening						33.2	
CM	Night						33.2	
CN	Noise sensitive point: Norwegian - Yellow zone (914)	356,864	6,952,464	10.0	4.0	45.0	36.4	Yes
CN	Day						30.0	
CN	Evening						30.0	
CN	Night						30.0	
CO	Noise sensitive point: Norwegian - Yellow zone (915)	356,872	6,952,482	9.8	4.0	45.0	35.5	Yes
CO	Day						29.1	
CO	Evening						29.1	
CO	Night						29.1	
CP	Noise sensitive point: Norwegian - Yellow zone (916)	356,868	6,952,409	11.6	4.0	45.0	41.7	Yes
CP	Day						35.3	
CP	Evening						35.3	
CP	Night						35.3	
CQ	Noise sensitive point: Norwegian - Yellow zone (917)	356,887	6,952,429	9.2	4.0	45.0	39.9	Yes
CQ	Day						33.5	
CQ	Evening						33.5	
CQ	Night						33.5	
CR	Noise sensitive point: Norwegian - Yellow zone (918)	356,898	6,952,463	6.8	4.0	45.0	40.8	Yes
CR	Day						34.4	
CR	Evening						34.4	
CR	Night						34.4	
CS	Noise sensitive point: Norwegian - Yellow zone (919)	356,905	6,952,444	6.8	4.0	45.0	39.7	Yes
CS	Day						33.3	
CS	Evening						33.3	
CS	Night						33.3	
CT	Noise sensitive point: Norwegian - Yellow zone (920)	356,893	6,952,412	9.4	4.0	45.0	40.1	Yes
CT	Day						33.7	
CT	Evening						33.7	
CT	Night						33.7	
CU	Noise sensitive point: Norwegian - Yellow zone (921)	356,915	6,952,425	6.5	4.0	45.0	40.1	Yes
CU	Day						33.7	
CU	Evening						33.7	
CU	Night						33.7	
CV	Noise sensitive point: Norwegian - Yellow zone (922)	356,901	6,952,391	9.6	4.0	45.0	41.2	Yes
CV	Day						34.8	
CV	Evening						34.8	
CV	Night						34.8	
CW	Noise sensitive point: Norwegian - Yellow zone (923)	356,921	6,952,404	7.1	4.0	45.0	40.8	Yes
CW	Day						34.4	
CW	Evening						34.4	
CW	Night						34.4	

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2019-06-11 10:25/3.2.744

NORD2000 - Main Result

Calculation: 2019_06_Haramsfjellet 8 x V136 HH 82 m, PO1, Real case

Appendix F: WindPRO printouts energy

Project:
2019_03_HaramFjellet

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PARK - Main Result

Calculation: 2019-05-25 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 %

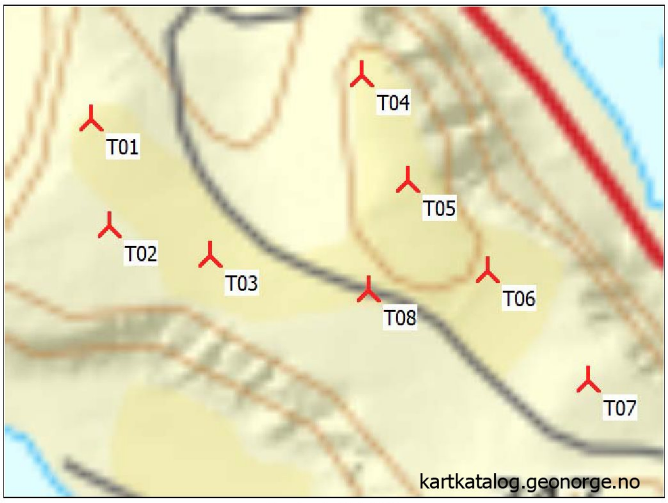
Wake Model Parameters

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

WTG combination	Result PARK [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Wake loss [%]	Specific results¤) Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	128,043.6	134,208.1	4.6	43.5	16,005.5	3,811	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

Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy 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	16,565.5	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	15,817.3	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	15,208.3	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	16,865.6	5.8	8.75
5 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	16,714.7	7.5	8.84
6 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	16,586.0	3.2	8.51
7 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	15,205.8	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	15,080.4	6.2	8.03

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	6,952,279	324.5	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	6,951,556	285.7	T08

PARK - Map

Calculation: 2019-05-25 Haramsfjellet 8 x V136 4p2 MW HH 82 m TI 6-12 %

Map: Topografisk norgeskart , Print scale 1:40,000, Map center UTM WGS84 Zone: 32 East: 356,223 North: 6,951,750

New WTG

Project:
2019_05_HaramFjellet

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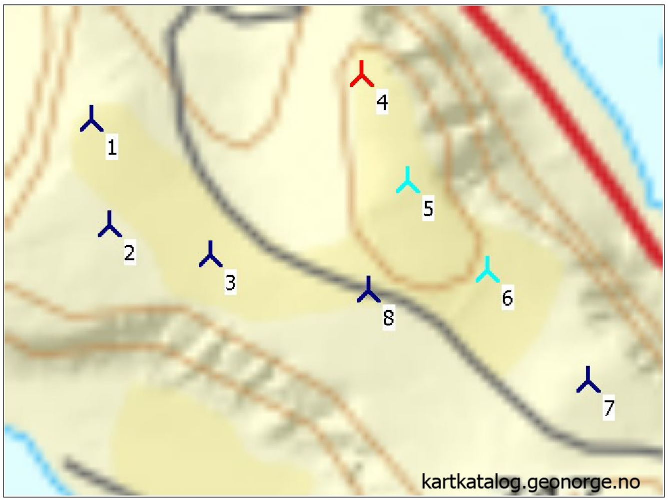
Calculated:
2019-05-24 10:54/3.2.744

PARK - Main Result

Calculation: 2019_05_Haramsfjellet 8 x V136 HH 82 m New Layout, PO1, SO1 for T04, SO2 for T05 and T06

Wake Model N.O. Jensen (RISØ/EMD)



Scale 1:25,000

New WTG

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: 1013.3 hPa at 0.0 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

Resource file(s)

\\kvtsrv03.vindteknikk.local\kvt\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

WTG combination	Result PARK [MWh/y]	GROSS (no loss) Free WTGs [MWh/y]	Wake loss [%]	Specific results¤) Capacity factor [%]	Mean WTG result [MWh/y]	Full load hours [Hours/year]	Mean wind speed @hub height [m/s]
Wind farm	117,011.3	121,913.2	4.0	39.7	14,626.4	3,482	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

Links	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Power curve Creator	Name	Annual Energy 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	16,628.7	4.4	8.58
2 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	15,855.7	3.5	8.19
3 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	15,248.5	3.6	8.01
4 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Power Curve, Sound Optimized Mode SO1 (HWO)	15,815.6	5.3	8.75
5 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Power Curve, Sound Optimized Mode SO2 (HWO)	11,542.9	6.5	8.84
6 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Power Curve, Sound Optimized Mode SO2 (HWO)	11,428.3	2.9	8.51
7 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	15,230.7	1.0	7.80
8 A	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	USER	Haramsfjellet TI 6-12% 2019-03	15,260.9	5.1	8.03

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	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (155)
2 New	355,452	6,951,811	251.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (156)
3 New	355,787	6,951,697	245.0	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (157)
4 New	356,322	6,952,279	324.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (158)
5 New	356,463	6,951,917	330.0	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (159)
6 New	356,717	6,951,604	292.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (160)
7 New	357,038	6,951,221	310.0	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (161)
8 New	356,315	6,951,556	285.7	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (162)