Tysvaer Wind Farm - Noise Assessment (85m HH)

6.19.26.GLA.R.004 B2

Summary:

Wood has been appointed by Green Investment Group (the Client) to provide noise assessment services for Tysvaer Wind Farm (the Project), located in Norway.

A selection of representative noise receptors were identified within 1.5 km of the Project and noise modelling carried out to quantify the noise effects predicted to be experienced.

Based on the operational noise modelling carried out, the uncurtailed layout is predicted to result in noise levels at identified potentially sensitive receptors that is in excess of both current and historical Norwegian standards.

Noise mitigation schemes have been developed to ensure that operational noise meets the appropriate standards.

It is recommended that the client consider modelling other noise curtailment strategies that may result in less severe curtailment.

It is recommended that the client consider approaching residents with a view to agreeing financial compensation for relaxing the noise constraints.

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Report Classification:	Confidential

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Date of issue:	12 April 2019		

1 Introduction

This report provides details on:

- The assessment methodology.
- The likely significant noise effects of operation of the Project.
- The mitigation measures required to prevent, reduce or offset any significant adverse effects.
- The likely residual effects after these measures have been employed.

WTGs produce noise through a number of different mechanisms, which can be roughly grouped into mechanical and aerodynamic sources. The following represents a preliminary assessment of potential operational noise impacts associated with the Project.

2 Applicable Standards

An overview of key guidance with respect to noise is outlined below, and further details of legislation, policy and guidance specifically for operational noise are set out below.

2.1 Noise Modelling Standards

Noise propagation has been modelled in accordance with International Standard ISO 9613-2: 1996 Acoustics – Attenuation of Sound Propagation Outdoors – Part 2: General Method of Calculation[1], and using the NORD2000 model[2].

2.2 Noise Limits

The impact of operational noise has been assessed in accordance with the local planning guideline, M128[3], and also in accordance with the earlier TA-2115/2005[4].

Unlike in other countries, such as France and the UK, which have separate daytime and night-time noise limits, the Norwegian standard imposes a single, long-term average noise limit. The parameter used is the L_{den}, the averaged sound pressure level where evening noise (19:00 to 23:00) is penalised by +5 dB and night-time noise (23:00 to 07:00) by +10 dB. The L_{den} should not exceed 45 dB(A).

The current practice on controlling wind farm noise imposes noise limits at the noise sensitive receptors (NSRs). Noise limits should be applied to external locations and should apply only to those areas frequently used for relaxation or activities for which a quiet environment is highly desirable.

3 Baseline Information

3.1 Baseline Data Collection

No baseline data are required, as the local guidelines are fixed values, irrespective of background noise.

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[1] International Standard ISO 9613-2: 1996, *Acoustics – Attenuation of Sound during Propagation Outdoors*

[2] https://assets.madebydelta.com/assets/docs/share/Akustik/Nord2000_Comprehensive_Outdoor_Sound_Propagation_Model-_-Part_2_Propagation_in_an_Atmosphere_with_Refraction.pdf, last visited 04 April 2019

[3] M128, *Veileder til retningslinje for behandling av støy i arealplanlegging (T-1442/2016),* Miljødirektoratet, 2016

[4] TA-2115/2005, *Veileder til Miljøverndepartementets retningslinje for behandling av støy i arealplanlegging (støyretningslinjen),* 2005

4 Noise Modelling

4.1 Siemens Gamesa SWT-DD-130, Rev. 2 WTG Emission Data

The sound power level is taken from Siemens Gamesa document ID: SGRE ON TE SYSE-DK LACS SA-40-0000-001AB5D-00[5].

The sound power level (SWL), in dB against hub height wind speed is shown in Table 4-1. Octave band data are not available, so generic values have been used. As can be seen, the sound power level reaches a maximum at a hub height wind speed of 9 m/s. If the wind farm can be shown to comply with the noise limits, which are independent of wind speed, at 10 m/s, it will comply at all wind speeds.

Table 4-1: 4.1 Siemens Gamesa SWT-DD-130, Rev. 2 SWL Data

Hub height wind speed (m/s)	Sound Power Level (dB(A))			
	Mode 1	Mode 2	Mode 6	Mode 7
3	92.3	92.3	92.3	92.3
4	92.3	92.3	92.3	92.3
5	95.3	95.3	95.3	95.3
6	98.3	98.3	98.3	97.0
7	102.3	102.3	100.0	97.0
8	105.0	105.0	100.0	97.0
9	106.0	105.0	100.0	97.0
10+	106.0	105.0	100.0	97.0

The sound power level spectra in octave bands are shown in Table 4-2 for 6 m/s and Table 4-3 for 8 m/s.

5 ID: SGRE ON TE SYSE-DK LACS SA-40-0000-001AB5D-00, Siemens Gamesa, 08 November 2018

Table 4-2: Siemens Gamesa SWT-DD-130, Rev. 2 Sound Power Frequency Distribution, 6 m/s

Octave band centre frequency (Hz)	Sound Power Level (dB(A))			
	Mode 1	Mode 2	Mode 6	Mode 7
63	76.8	77.0	80.4	76.3
125	84.7	85.3	84.7	84.6
250	87.3	86.2	87.4	85.6
500	89.6	88.9	88.6	88.1
1000	91.9	91.6	91.6	90.4
2000	93.0	93.7	93.7	92.5
4000	91.0	91.2	90.7	88.7
8000	81.7	79.5	79.4	77.7

Table 4-3: Siemens Gamesa SWT-DD-130, Rev. 2 Sound Power Frequency Distribution, 8 m/s

Octave band centre frequency (Hz)	Sound Power Level (dB(A))			
	Mode 1	Mode 2	Mode 6	Mode 7
63	87.2	87.3	81.9	77.8
125	91.7	92.3	86.5	84.5
250	93.6	92.8	89.1	85.6
500	96.1	95.6	90.5	88.5
1000	98.5	98.3	93.3	90.6
2000	99.9	100.2	95.4	92.6
4000	97.6	97.8	92.2	87.6
8000	88.2	86.0	80.9	76.4

4.2 Wind Farm Operational Noise Propagation Model

The sound propagation was calculated using the WindPRO model DECIBEL, which implements ISO 9613-2. The following assumptions were used to calculate the propagation effects:

- Ground absorption 0.0;
- Receiver height 4 m;
- Air absorption characteristic of 10ºC, 70% relative humidity.

Receptors in this assessment are assumed to be discrete points. They are listed in Table A-2.

Sound pressure level contours were then exported in GIS shapefile format and were used to provide an indication of the potential noise impacts relative to the locations of potentially sensitive receptors.

4.3 Noise Model Results TA-2115/2005

The propagation has been modelled using ISO 9613-2. This is a worst case calculation in that it assumes all receptors are downwind of all WTGs. The results are shown in Table 4-4 and Figure 4-1.

Table 4-4: ISO 9613-2 Uncurtailed Noise Levels

Receptor	L_{den}	Met/Not met
A	48.1	Not met
B	47.2	Not met
C	44.1	Met
D	43.3	Met
E	42.0	Met
F	44.9	Met
G	48.8	Not met
H	48.0	Not met
I	47.8	Not met
J	46.5	Not met
K	44.1	Met
L	46.5	Not met
M	45.4	Not met
N	41.5	Met
O	42.3	Met
P	46.0	Not met
Q	45.3	Not met
R	45.6	Not met
S	46.3	Not met

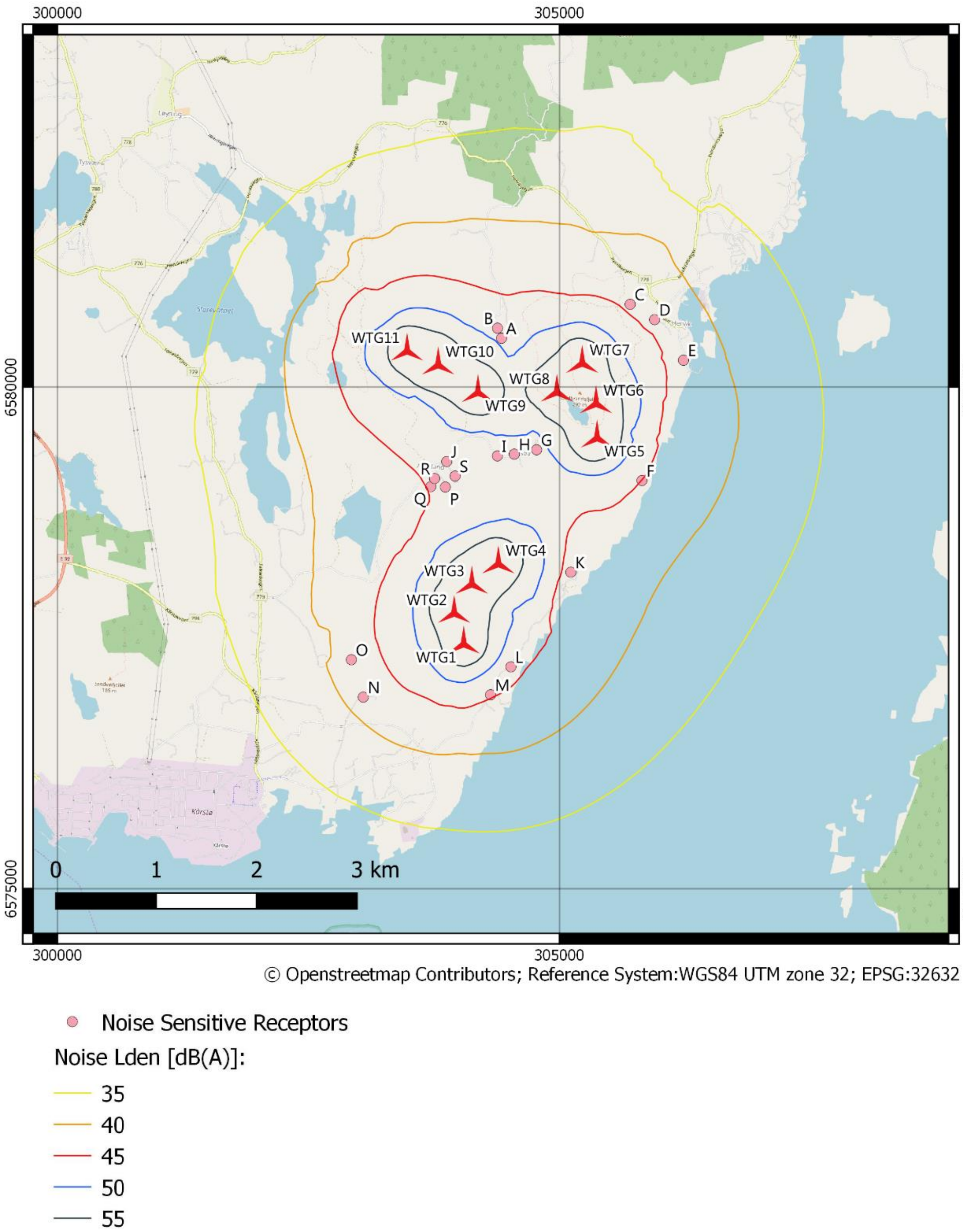

Figure 4-1: ISO 9613-2 Uncurtailed Noise Contours

5 Noise Mitigation

Mitigation has been considered to reduce excessive noise at NSRs. Mitigation in the form of noise-curtailed operational modes has been considered. From assessment, it has been determined that the noise limits can be met.

5.1 Residual Effects: TA-2115/2005

A curtailment scheme to bring the TA-2115/2005 model into compliance is shown in Table 5-1, and the results in Table 5-2 and Figure 5-1.

Table 5-1: ISO 9613-2 Compliant Curtailment Scheme

WTG	Time	Mode
1	Day	2
	Evening	2
	Night	6
2	Day	2
	Evening	2
	Night	2
3	Day	2
	Evening	2
	Night	2
4	Day	2
	Evening	2
	Night	6
5	Day	6
	Evening	6
	Night	6
6	Day	2
	Evening	6
	Night	6
7	Day	2
	Evening	2
	Night	2
8	Day	2
	Evening	6
	Night	6
9	Day	6
	Evening	2
	Night	6
10	Day	2
	Evening	2
	Night	6
11	Day	2
	Evening	2
	Night	2

Table 5-2: ISO 9613-2 Compliant Noise Levels

Receptor	L_{den}	Met/Not met
A	44.6	Met
B	43.8	Met
C	41.6	Met
D	40.6	Met
E	38.5	Met
F	40.3	Met
G	44.5	Met
H	43.9	Met
I	43.9	Met
J	43.0	Met
K	41.0	Met
L	43.5	Met
M	42.3	Met
N	39.0	Met
O	40.0	Met
P	42.9	Met
Q	42.2	Met
R	42.4	Met
S	43.0	Met

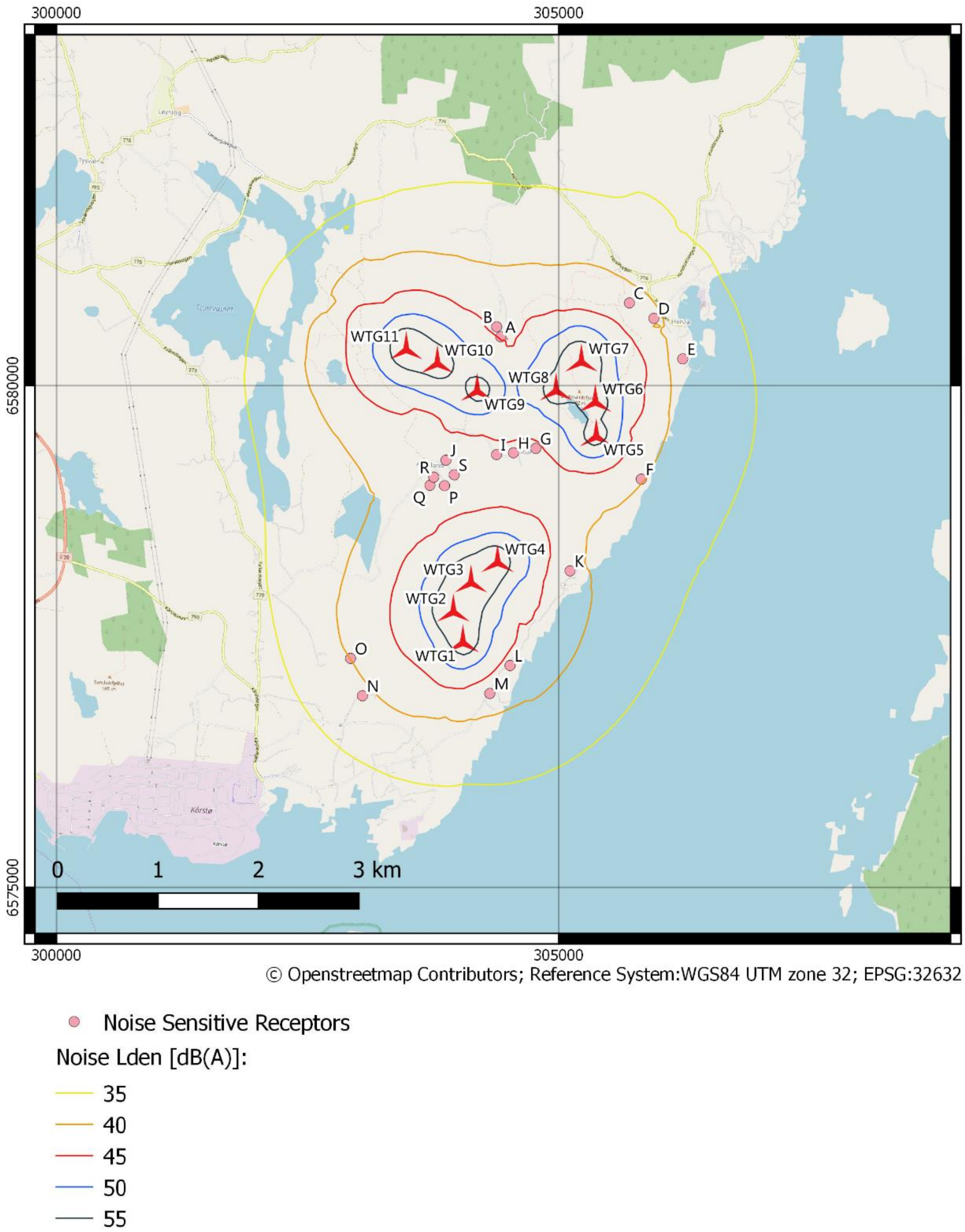

Figure 5-1: ISO 9613-2 Curtailed Noise Contours

6 Conclusions

Based on the operational noise modelling carried out, the uncurtailed layout is predicted to result in noise levels at identified potentially sensitive receptors that is in excess of both current and historical Norwegian standards.

Noise mitigation schemes have been developed to ensure that operational noise meets the appropriate standards.

7 Recommendations

It is recommended that the client consider modelling other noise curtailment strategies that may result in less severe curtailment.

It is recommended that the client consider approaching residents with a view to agreeing financial compensation for relaxing the noise constraints.

Appendix A Modelling Parameters

Table A-1: WTG Location Coordinates (UTM WGS84 Zone 32N)

WTG	Locations	
	Easting	Northing
T1	304046	6577449
T2	303951	6577756
T3	304127	6578046
T4	304391	6578248
T5	305374	6579503
T6	305364	6579845
T7	305226	6580247
T8	304974	6579960
T9	304188	6579956
T10	303792	6580231
T11	303482	6580369

Table A-2: Modelled Receptors (UTM WGS84 Zone 32N)

Receptor	Locations	
	Easting	Northing
A	304423	6580486
B	304383	6580586
C	305704	6580824
D	305947	6580671
E	306235	6580267
F	305822	6579068
G	304772	6579374
H	304550	6579331
I	304382	6579313
J	303877	6579257
K	305113	6578154
L	304516	6577211
M	304314	6576932
N	303046	6576909
O	302927	6577282
P	303863	6579003
Q	303718	6579007
R	303756	6579088
S	303960	6579112

DECIBEL - Assumptions for noise calculation

Calculation: Siemens SWT130 85m hh curtailed_ISO

Noise calculation model:
ISO 9613-2 Norway (Outdated)
Wind speed (in 10 m height):
8.0 m/s
Ground attenuation:
Alternative
Meteorological coefficient, C0:
0.0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Pure tone penalty is subtracted from demand
WTG catalogue
Height above ground level, when no value in NSA object:
4.0 m; Don't allow override of model height with height from NSA object
Uncertainty margin:
0.0 dB; Uncertainty margin in NSA has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0.0 dB(A)

Setup for Lden calculation

Variant	Name	From hour	To hour	Hours	Penalty [dB]	Days per year
1	Day	7	19	12	0	290
2	Evening	19	23	4	5	290
3	Night	23	7	8	10	290

Octave data used if available
Frequency independent air absorption: 1.9 dB/km

Frequency dependent air absorption

63 [db/km]	125 [db/km]	250 [db/km]	500 [db/km]	1,000 [db/km]	2,000 [db/km]	4,000 [db/km]	8,000 [db/km]
0.1	0.4	1.0	1.9	3.7	9.7	32.8	117.0

WTG: Siemens SWT-DD-130 4300 130.0 !O!
Noise: Mode 2 - Rev. 2 - 2018.11.08

Source		Source/Date	Creator	Edited
SGRE ON TE	SYSE-DK LACS SA-40-0000-001AB5D-00, WTG5.9.6.0 / DLL20181107	13/03/2019	USER	13/03/2019 10:48

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones
Interpolated	85.0	8.0	105.0	No

WTG: Siemens SWT-DD-130 4300 130.0 !O!
Noise: Mode 6 - Rev. 2 - 2018.11.08

Source		Source/Date	Creator	Edited
SGRE ON TE	SYSE-DK LACS SA-40-0000-001AB5D-00, WTG5.9.6.0 / DLL20181107	13/03/2019	USER	13/03/2019 10:53

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones
Interpolated	85.0	8.0	100.0	No

NSA: 01-A
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

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DECIBEL - Assumptions for noise calculation

Calculation: Siemens SWT130 85m hh curtailed_ISO

NSA: 02-B
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 03-C
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 04-D
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 05-E
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 06-F
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 07-G
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 08-H
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 09-I
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 10-J
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

DECIBEL - Assumptions for noise calculation

Calculation: Siemens SWT130 85m hh curtailed_ISO
Noise demand: 45.0 dB(A)
No distance demand

NSA: 11-K
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 12-L
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 13-M
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 14-N
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 15-O
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 16-P
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 17-Q
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 18-R
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

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Calculated:
10/04/2019 16:45/3.2.744

DECIBEL - Assumptions for noise calculation

Calculation: Siemens SWT130 85m hh curtailed_ISO
NSA: 19-S
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Assumptions

Calculated L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet
(when calculated with ground attenuation, then Dc = Domega)

LWA,ref:	Sound pressure level at WTG
K:	Pure tone
Dc:	Directivity correction
Adiv:	the attenuation due to geometrical divergence
Aatm:	the attenuation due to atmospheric absorption
Agr:	the attenuation due to ground effect
Abar:	the attenuation due to a barrier
Amisc:	the attenuation due to miscellaneous other effects
Cmet:	Meteorological correction

Calculation Results

Noise sensitive area: A 01

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,060	3,062	58.6	No	**18.86**	15.67	15.67	10.67	16.67	16.67	11.67
2	2,770	2,772	60.7	No	**23.48**	17.09	17.09	17.09	18.09	18.09	18.09
3	2,457	2,461	74.1	No	**25.11**	18.71	18.71	18.71	19.71	19.71	19.71
4	2,238	2,240	58.9	No	**23.13**	19.95	19.95	14.95	20.95	20.95	15.95
5	1,367	1,377	19.5	No	**27.21**	20.81	20.81	20.81	21.81	21.81	21.81
6	1,138	1,152	28.4	Yes	**31.00**	28.64	23.64	23.64	29.64	24.64	24.64
7	838	855	46.5	Yes	**39.23**	32.83	32.83	32.83	33.83	33.83	33.83
8	762	781	44.7	Yes	**36.21**	33.86	28.86	28.86	34.86	29.86	29.86
9	580	593	33.9	No	**37.03**	29.62	34.62	29.62	30.62	35.62	30.62
10	680	689	34.9	No	**36.31**	33.13	33.13	28.13	34.13	34.13	29.13
11	948	953	34.3	No	**36.22**	29.82	29.82	29.82	30.82	30.82	30.82

Sum 44.57

Noise sensitive area: B 02

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,154	3,157	50.9	No	**18.41**	15.23	15.23	10.23	16.23	16.23	11.23
2	2,862	2,865	51.4	No	**23.02**	16.63	16.63	16.63	17.62	17.62	17.62
3	2,552	2,556	66.0	No	**24.60**	18.20	18.20	18.20	19.20	19.20	19.20
4	2,338	2,341	50.5	No	**22.56**	19.38	19.38	14.38	20.37	20.37	15.37
5	1,468	1,479	16.5	No	**26.40**	20.00	20.00	20.00	21.00	21.00	21.00
6	1,229	1,244	26.8	Yes	**30.05**	27.69	22.69	22.69	28.69	23.69	23.69
7	908	928	44.4	Yes	**38.15**	31.76	31.76	31.76	32.76	32.76	32.76
8	861	881	43.2	Yes	**34.69**	32.33	27.33	27.33	33.33	28.33	28.33
9	659	674	28.3	No	**35.75**	28.35	33.35	28.35	29.35	34.35	29.35
10	689	701	33.0	No	**36.15**	32.96	32.96	27.96	33.96	33.96	28.96
11	927	933	33.2	No	**36.43**	30.04	30.04	30.04	31.04	31.04	31.04

Sum 43.79

Noise sensitive area: C 03

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,759	3,767	-25.0	No	**15.72**	12.53	12.53	7.53	13.53	13.53	8.53
2	3,533	3,540	-30.0	No	**19.90**	13.50	13.50	13.50	14.50	14.50	14.50
3	3,194	3,204	-17.5	No	**21.41**	15.01	15.01	15.01	16.01	16.01	16.01
4	2,891	2,900	-26.2	No	**19.64**	16.45	16.45	11.45	17.45	17.45	12.45
5	1,361	1,392	12.1	No	**27.09**	20.69	20.69	20.69	21.69	21.69	21.69
6	1,036	1,079	30.9	Yes	**31.84**	29.48	24.48	24.48	30.48	25.48	25.48
7	749	806	47.3	Yes	**39.98**	33.59	33.59	33.59	34.59	34.59	34.59
8	1,131	1,170	8.4	No	**29.98**	27.62	22.62	22.62	28.62	23.62	23.62

To be continued on next page...

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

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WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
9	1,747	1,764	-9.8	No	**25.33**	17.93	22.93	17.93	18.93	23.93	18.93
10	2,001	2,015	-1.8	No	**24.48**	21.30	21.30	16.30	22.29	22.29	17.29
11	2,268	2,278	-0.1	No	**26.13**	19.73	19.73	19.73	20.73	20.73	20.73

Sum 41.58

Noise sensitive area: D 04

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,740	3,748	-23.7	No	**15.80**	12.61	12.61	7.61	13.61	13.61	8.61
2	3,532	3,540	-29.4	No	**19.90**	13.50	13.50	13.50	14.50	14.50	14.50
3	3,194	3,204	-16.4	No	**21.40**	15.01	15.01	15.01	16.01	16.01	16.01
4	2,879	2,889	-23.9	No	**19.69**	16.51	16.51	11.51	17.51	17.51	12.51
5	1,301	1,334	17.6	No	**27.57**	21.17	21.17	21.17	22.17	22.17	22.17
6	1,011	1,057	38.0	No	**31.08**	28.72	23.72	23.72	29.72	24.72	24.72
7	836	890	49.9	Yes	**38.87**	32.48	32.48	32.48	33.48	33.48	33.48
8	1,205	1,243	9.9	No	**29.31**	26.96	21.96	21.96	27.96	22.96	22.96
9	1,898	1,916	-14.8	No	**24.33**	16.93	21.93	16.93	17.92	22.92	17.92
10	2,199	2,212	-7.9	No	**23.29**	20.11	20.11	15.11	21.11	21.11	16.11
11	2,483	2,493	-9.5	No	**24.93**	18.54	18.54	18.54	19.54	19.54	19.54

Sum 40.64

Noise sensitive area: E 05

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,568	3,577	-7.0	No	**16.53**	13.34	13.34	8.34	14.34	14.34	9.34
2	3,394	3,403	-27.1	No	**20.50**	14.11	14.11	14.11	15.11	15.11	15.11
3	3,061	3,074	-15.2	No	**22.01**	15.62	15.62	15.62	16.62	16.62	16.62
4	2,734	2,745	-20.5	No	**20.41**	17.22	17.22	12.22	18.22	18.22	13.22
5	1,151	1,191	15.4	No	**28.82**	22.43	22.43	22.43	23.42	23.42	23.42
6	968	1,020	30.0	No	**31.46**	29.10	24.10	24.10	30.10	25.10	25.10
7	1,009	1,057	35.0	No	**35.11**	28.72	28.72	28.72	29.72	29.72	29.72
8	1,298	1,336	1.3	No	**28.51**	26.16	21.16	21.16	27.16	22.16	22.16
9	2,070	2,087	-37.5	No	**23.26**	15.85	20.85	15.85	16.85	21.85	16.85
10	2,443	2,456	-31.4	No	**21.92**	18.74	18.74	13.74	19.74	19.74	14.74
11	2,754	2,765	-34.6	No	**23.52**	17.13	17.13	17.13	18.12	18.12	18.12

Sum 38.53

Noise sensitive area: F 06

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	2,403	2,416	43.6	No	**22.14**	18.96	18.96	13.96	19.96	19.96	14.96
2	2,285	2,298	10.1	No	**26.02**	19.62	19.62	19.62	20.62	20.62	20.62
3	1,979	1,997	20.8	No	**27.81**	21.41	21.41	21.41	22.41	22.41	22.41
4	1,649	1,667	20.2	No	**26.79**	23.61	23.61	18.61	24.60	24.60	19.60
5	624	692	33.6	Yes	**36.17**	29.77	29.77	29.77	30.77	30.77	30.77
6	902	955	10.7	No	**32.15**	29.80	24.80	24.80	30.80	25.80	25.80
7	1,321	1,356	-15.6	No	**32.38**	25.99	25.99	25.99	26.99	26.99	26.99
8	1,231	1,269	-14.9	No	**29.09**	26.73	21.73	21.73	27.73	22.73	22.73
9	1,859	1,877	-32.8	No	**24.58**	17.17	22.17	17.17	18.17	23.17	18.17
10	2,339	2,352	-43.0	No	**22.50**	19.31	19.31	14.31	20.31	20.31	15.31
11	2,677	2,687	-47.9	No	**23.92**	17.52	17.52	17.52	18.52	18.52	18.52

Sum 40.28

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Noise sensitive area: G 07

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance	Sound distance	Mean height	Visible	Calculated	Day	Evening	Night	Day	Evening	Night
	[m]	[m]	[m]		[dB]	[dB]	[dB]	[dB]	[dB(A)]	[dB(A)]	[dB(A)]
1	2,057	2,060	52.3	Yes	**25.07**	21.89	21.89	16.89	22.89	22.89	17.89
2	1,814	1,817	49.4	Yes	**29.90**	23.50	23.50	23.50	24.50	24.50	24.50
3	1,476	1,481	66.6	Yes	**32.93**	26.53	26.53	26.53	27.53	27.53	27.53
4	1,188	1,193	68.6	Yes	**32.58**	29.39	29.39	24.39	30.39	30.39	25.39
5	616	636	25.4	Yes	**36.72**	30.33	30.33	30.33	31.33	31.33	31.33
6	756	776	23.7	No	**34.29**	31.94	26.94	26.94	32.94	27.94	27.94
7	984	998	13.5	No	**35.73**	29.33	29.33	29.33	30.33	30.33	30.33
8	620	643	32.0	Yes	**37.92**	35.56	30.56	30.56	36.56	31.56	31.56
9	824	833	44.8	Yes	**35.48**	28.08	33.08	28.08	29.08	34.08	29.08
10	1,302	1,306	37.4	No	**29.59**	26.41	26.41	21.41	27.41	27.41	22.41
11	1,629	1,631	36.4	No	**30.26**	23.86	23.86	23.86	24.86	24.86	24.86

Sum 44.46

Noise sensitive area: H 08

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance	Sound distance	Mean height	Visible	Calculated	Day	Evening	Night	Day	Evening	Night
	[m]	[m]	[m]		[dB]	[dB]	[dB]	[dB]	[dB(A)]	[dB(A)]	[dB(A)]
1	1,948	1,952	43.1	Yes	**25.63**	22.45	22.45	17.45	23.45	23.45	18.45
2	1,685	1,689	45.5	Yes	**30.77**	24.37	24.37	24.37	25.37	25.37	25.37
3	1,353	1,360	63.4	Yes	**33.96**	27.56	27.56	27.56	28.56	28.56	28.56
4	1,094	1,101	60.8	Yes	**33.37**	30.19	30.19	25.19	31.19	31.19	26.19
5	842	860	35.3	Yes	**33.70**	27.31	27.31	27.31	28.31	28.31	28.31
6	963	981	31.6	Yes	**32.98**	30.62	25.62	25.62	31.62	26.62	26.62
7	1,138	1,153	20.8	No	**34.18**	27.78	27.78	27.78	28.78	28.78	28.78
8	758	781	41.2	Yes	**36.06**	33.70	28.70	28.70	34.70	29.70	29.70
9	722	735	44.5	Yes	**36.99**	29.59	34.59	29.59	30.59	35.59	30.59
10	1,176	1,183	43.0	No	**30.69**	27.50	27.50	22.50	28.50	28.50	23.50
11	1,489	1,493	43.8	No	**31.29**	24.89	24.89	24.89	25.89	25.89	25.89

Sum 43.93

Noise sensitive area: I 09

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance	Sound distance	Mean height	Visible	Calculated	Day	Evening	Night	Day	Evening	Night
	[m]	[m]	[m]		[dB]	[dB]	[dB]	[dB]	[dB(A)]	[dB(A)]	[dB(A)]
1	1,894	1,899	38.5	Yes	**25.91**	22.72	22.72	17.72	23.72	23.72	18.72
2	1,615	1,621	42.1	Yes	**31.22**	24.82	24.82	24.82	25.82	25.82	25.82
3	1,292	1,302	61.0	Yes	**34.45**	28.06	28.06	28.06	29.05	29.05	29.05
4	1,065	1,074	58.7	Yes	**33.62**	30.43	30.43	25.43	31.43	31.43	26.43
5	1,010	1,029	35.5	Yes	**31.59**	25.20	25.20	25.20	26.20	26.20	26.20
6	1,117	1,136	29.0	No	**30.30**	27.94	22.94	22.94	28.94	23.94	23.94
7	1,259	1,275	14.9	No	**33.07**	26.68	26.68	26.68	27.67	27.67	27.67
8	877	901	33.5	Yes	**34.05**	31.69	26.69	26.69	32.69	27.69	27.69
9	671	690	51.1	Yes	**38.11**	30.71	35.71	30.71	31.71	36.71	31.71
10	1,091	1,100	49.7	Yes	**33.03**	29.85	29.85	24.85	30.85	30.85	25.85
11	1,387	1,393	47.6	Yes	**33.26**	26.86	26.86	26.86	27.86	27.86	27.86

Sum 43.89

Noise sensitive area: J 10

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance	Sound distance	Mean height	Visible	Calculated	Day	Evening	Night	Day	Evening	Night
	[m]	[m]	[m]		[dB]	[dB]	[dB]	[dB]	[dB(A)]	[dB(A)]	[dB(A)]
1	1,815	1,826	17.5	No	**25.69**	22.51	22.51	17.51	23.51	23.51	18.51
2	1,503	1,514	21.9	No	**31.12**	24.73	24.73	24.73	25.73	25.73	25.73
3	1,236	1,254	42.5	Yes	**34.42**	28.03	28.03	28.03	29.03	29.03	29.03
4	1,132	1,148	46.0	Yes	**32.40**	29.21	29.21	24.21	30.21	30.21	25.21
5	1,517	1,537	44.1	Yes	**26.94**	20.55	20.55	20.55	21.55	21.55	21.55
6	1,599	1,620	34.8	Yes	**27.04**	24.68	19.68	19.68	25.68	20.68	20.68
7	1,673	1,692	24.1	No	**29.82**	23.43	23.43	23.43	24.43	24.43	24.43
8	1,303	1,328	44.5	Yes	**29.74**	27.38	22.38	22.38	28.38	23.38	23.38
9	765	792	58.6	Yes	**36.70**	29.30	34.30	29.30	30.29	35.29	30.29
10	977	996	49.5	Yes	**34.25**	31.07	31.07	26.07	32.07	32.07	27.07
11	1,180	1,193	65.7	Yes	**35.71**	29.31	29.31	29.31	30.31	30.31	30.31

Sum 43.04

Licensed user:
Wood Group UK Ltd.
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Calculated:
10/04/2019 16:45/3.2.744

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Noise sensitive area: K 11

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,279	1,302	41.0	Yes	**30.71**	27.53	27.53	22.53	28.53	28.53	23.53
2	1,228	1,251	18.0	No	**33.28**	26.89	26.89	26.89	27.89	27.89	27.89
3	992	1,025	23.0	No	**35.44**	29.04	29.04	29.04	30.04	30.04	30.04
4	728	766	21.9	No	**35.25**	32.06	32.06	27.06	33.06	33.06	28.06
5	1,374	1,405	46.7	Yes	**28.13**	21.73	21.73	21.73	22.73	22.73	22.73
6	1,709	1,737	25.5	No	**25.47**	23.12	18.12	18.12	24.11	19.11	19.11
7	2,096	2,117	-3.7	No	**27.07**	20.67	20.67	20.67	21.67	21.67	21.67
8	1,811	1,836	8.4	No	**24.80**	22.44	17.44	17.44	23.44	18.44	18.44
9	2,025	2,041	9.1	No	**23.54**	16.14	21.14	16.14	17.13	22.13	17.13
10	2,461	2,473	9.6	No	**21.83**	18.65	18.65	13.65	19.65	19.65	14.65
11	2,750	2,759	8.4	No	**23.55**	17.15	17.15	17.15	18.15	18.15	18.15

Sum 40.99

Noise sensitive area: L 12

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	527	581	32.0	Yes	**39.93**	36.75	36.75	31.75	37.75	37.75	32.75
2	785	820	5.3	No	**37.77**	31.38	31.38	31.38	32.38	32.38	32.38
3	921	957	22.7	No	**36.17**	29.78	29.78	29.78	30.77	30.77	30.77
4	1,044	1,071	28.9	No	**31.76**	28.58	28.58	23.58	29.58	29.58	24.58
5	2,447	2,464	51.1	Yes	**20.80**	14.40	14.40	14.40	15.40	15.40	15.40
6	2,767	2,784	34.1	Yes	**19.81**	17.45	12.45	12.45	18.45	13.45	13.45
7	3,117	3,132	14.4	No	**21.74**	15.34	15.34	15.34	16.34	16.34	16.34
8	2,786	2,803	33.2	No	**19.29**	16.93	11.93	11.93	17.93	12.93	12.93
9	2,764	2,776	28.7	No	**19.47**	12.07	17.07	12.07	13.07	18.07	13.07
10	3,105	3,114	17.7	No	**18.61**	15.43	15.43	10.43	16.43	16.43	11.43
11	3,322	3,330	21.3	No	**20.83**	14.44	14.44	14.44	15.44	15.44	15.44

Sum 43.46

Noise sensitive area: M 13

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	582	630	37.8	Yes	**39.31**	36.13	36.13	31.13	37.12	37.12	32.12
2	900	929	8.2	No	**36.47**	30.08	30.08	30.08	31.08	31.08	31.08
3	1,129	1,157	17.4	No	**34.14**	27.74	27.74	27.74	28.74	28.74	28.74
4	1,318	1,338	22.7	No	**29.32**	26.14	26.14	21.14	27.13	27.13	22.13
5	2,780	2,795	52.6	Yes	**19.01**	12.61	12.61	12.61	13.61	13.61	13.61
6	3,096	3,110	38.3	Yes	**18.22**	15.87	10.87	10.87	16.86	11.86	11.86
7	3,437	3,450	21.7	No	**20.29**	13.90	13.90	13.90	14.90	14.90	14.90
8	3,098	3,113	40.7	No	**17.79**	15.43	10.43	10.43	16.43	11.43	11.43
9	3,026	3,036	24.6	No	**18.20**	10.80	15.80	10.80	11.79	16.79	11.79
10	3,339	3,348	13.4	No	**17.54**	14.36	14.36	9.36	15.36	15.36	10.36
11	3,536	3,542	18.4	No	**19.89**	13.50	13.50	13.50	14.49	14.49	14.49

Sum 42.29

Noise sensitive area: N 14

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,136	1,166	90.7	Yes	**33.53**	30.34	30.34	25.34	31.34	31.34	26.34
2	1,239	1,265	80.4	Yes	**35.35**	28.96	28.96	28.96	29.96	29.96	29.96
3	1,569	1,593	65.1	Yes	**31.94**	25.55	25.55	25.55	26.55	26.55	26.55
4	1,897	1,915	35.1	No	**25.11**	21.93	21.93	16.93	22.93	22.93	17.93
5	3,485	3,499	29.8	No	**15.08**	8.69	8.69	8.69	9.68	9.68	9.68
6	3,740	3,754	32.8	No	**14.95**	12.59	7.59	7.59	13.59	8.59	8.59
7	3,986	3,999	35.0	No	**17.97**	11.58	11.58	11.58	12.57	12.57	12.57
8	3,608	3,623	51.4	No	**15.50**	13.15	8.15	8.15	14.15	9.15	9.15
9	3,253	3,265	63.4	Yes	**17.80**	10.40	15.40	10.40	11.39	16.39	11.39
10	3,404	3,414	86.7	Yes	**18.11**	14.93	14.93	9.93	15.93	15.93	10.93
11	3,487	3,495	97.2	Yes	**21.05**	14.65	14.65	14.65	15.65	15.65	15.65

Sum 39.02

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Noise sensitive area: O 15

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,131	1,157	92.7	Yes	**33.70**	30.51	30.51	25.51	31.51	31.51	26.51
2	1,128	1,152	82.6	Yes	**36.66**	30.27	30.27	30.27	31.27	31.27	31.27
3	1,422	1,445	67.2	Yes	**33.26**	26.87	26.87	26.87	27.87	27.87	27.87
4	1,754	1,769	37.7	Yes	**26.81**	23.62	23.62	18.62	24.62	24.62	19.62
5	3,304	3,317	38.7	No	**15.89**	9.50	9.50	9.50	10.49	10.49	10.49
6	3,536	3,549	46.5	No	**15.82**	13.47	8.47	8.47	14.47	9.47	9.47
7	3,751	3,763	47.4	No	**18.95**	12.55	12.55	12.55	13.55	13.55	13.55
8	3,370	3,383	62.8	No	**16.55**	14.20	9.20	9.20	15.19	10.19	10.19
9	2,956	2,966	80.5	Yes	**19.46**	12.06	17.06	12.06	13.06	18.06	13.06
10	3,073	3,082	101.1	No	**18.76**	15.58	15.58	10.58	16.58	16.58	11.58
11	3,136	3,144	103.3	No	**21.69**	15.29	15.29	15.29	16.29	16.29	16.29

Sum 40.04

Noise sensitive area: P 16

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,564	1,575	11.8	No	**27.45**	24.27	24.27	19.27	25.27	25.27	20.27
2	1,250	1,262	14.9	No	**33.19**	26.79	26.79	26.79	27.79	27.79	27.79
3	993	1,012	33.5	Yes	**36.73**	30.33	30.33	30.33	31.33	31.33	31.33
4	921	938	38.0	Yes	**34.57**	31.39	31.39	26.39	32.39	32.39	27.39
5	1,591	1,608	57.2	Yes	**26.65**	20.25	20.25	20.25	21.25	21.25	21.25
6	1,721	1,738	51.8	Yes	**26.49**	24.13	19.13	19.13	25.13	20.13	20.13
7	1,845	1,860	37.9	Yes	**29.38**	22.98	22.98	22.98	23.98	23.98	23.98
8	1,466	1,486	59.2	Yes	**28.68**	26.32	21.32	21.32	27.32	22.32	22.32
9	1,007	1,025	75.4	Yes	**34.00**	26.59	31.59	26.59	27.59	32.59	27.59
10	1,230	1,243	69.3	Yes	**32.07**	28.89	28.89	23.89	29.88	29.88	24.88
11	1,418	1,427	85.7	Yes	**33.87**	27.48	27.48	27.48	28.48	28.48	28.48

Sum 42.85

Noise sensitive area: Q 17

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,592	1,604	7.4	No	**27.24**	24.06	24.06	19.06	25.06	25.06	20.06
2	1,272	1,287	11.5	No	**32.97**	26.58	26.58	26.58	27.58	27.58	27.58
3	1,044	1,066	25.1	Yes	**35.84**	29.45	29.45	29.45	30.44	30.44	30.44
4	1,014	1,032	31.7	Yes	**33.22**	30.03	30.03	25.03	31.03	31.03	26.03
5	1,728	1,746	54.3	Yes	**25.51**	19.12	19.12	19.12	20.12	20.12	20.12
6	1,847	1,865	48.4	Yes	**25.50**	23.14	18.14	18.14	24.14	19.14	19.14
7	1,952	1,969	36.2	No	**27.98**	21.59	21.59	21.59	22.59	22.59	22.59
8	1,576	1,597	57.5	Yes	**27.70**	25.34	20.34	20.34	26.34	21.34	21.34
9	1,059	1,079	71.2	Yes	**33.18**	25.78	30.78	25.78	26.78	31.78	26.78
10	1,226	1,241	73.1	Yes	**32.19**	29.00	29.00	24.00	30.00	30.00	25.00
11	1,382	1,393	87.0	Yes	**34.22**	27.83	27.83	27.83	28.83	28.83	28.83

Sum 42.24

Noise sensitive area: R 18

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,664	1,676	11.3	No	**26.73**	23.54	23.54	18.54	24.54	24.54	19.54
2	1,346	1,359	15.7	No	**32.36**	25.96	25.96	25.96	26.96	26.96	26.96
3	1,106	1,126	33.3	Yes	**35.46**	29.06	29.06	29.06	30.06	30.06	30.06
4	1,053	1,070	37.9	Yes	**33.00**	29.82	29.82	24.82	30.82	30.82	25.82
5	1,670	1,688	53.6	Yes	**25.94**	19.55	19.55	19.55	20.55	20.55	20.55
6	1,777	1,796	46.3	Yes	**25.96**	23.60	18.60	18.60	24.60	19.60	19.60
7	1,872	1,889	34.4	No	**28.49**	22.10	22.10	22.10	23.10	23.10	23.10
8	1,498	1,519	55.7	Yes	**28.31**	25.95	20.95	20.95	26.95	21.95	21.95
9	969	991	69.5	Yes	**34.24**	26.83	31.83	26.83	27.83	32.83	27.83
10	1,143	1,159	69.1	Yes	**32.96**	29.78	29.78	24.78	30.78	30.78	25.78
11	1,310	1,321	84.3	Yes	**34.87**	28.48	28.48	28.48	29.48	29.48	29.48

Sum 42.45

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Wood Group UK Ltd.
St. Vincent Plaza
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+44 (0) 141 227 1700

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Noise sensitive area: S 19

WTG					**Lden(year)**	**L Annual mean**			**Leq24h**		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	**Calculated [dB]**	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,665	1,675	15.4	No	**26.73**	23.55	23.55	18.55	24.54	24.54	19.54
2	1,356	1,367	18.9	No	**32.29**	25.89	25.89	25.89	26.89	26.89	26.89
3	1,079	1,097	38.9	Yes	**35.94**	29.54	29.54	29.54	30.54	30.54	30.54
4	965	982	43.1	Yes	**34.20**	31.02	31.02	26.02	32.02	32.02	27.02
5	1,467	1,485	49.9	Yes	**27.50**	21.11	21.11	21.11	22.11	22.11	22.11
6	1,584	1,603	42.8	Yes	**27.34**	24.98	19.98	19.98	25.98	20.98	20.98
7	1,700	1,717	29.0	No	**29.65**	23.25	23.25	23.25	24.25	24.25	24.25
8	1,322	1,344	50.5	Yes	**29.74**	27.38	22.38	22.38	28.38	23.38	23.38
9	874	896	69.3	Yes	**35.55**	28.15	33.15	28.15	29.14	34.14	29.14
10	1,131	1,146	55.5	Yes	**32.71**	29.52	29.52	24.52	30.52	30.52	25.52
11	1,345	1,355	71.1	Yes	**34.20**	27.81	27.81	27.81	28.81	28.81	28.81

Sum 42.96

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Calculated:
10/04/2019 16:45/3.2.744

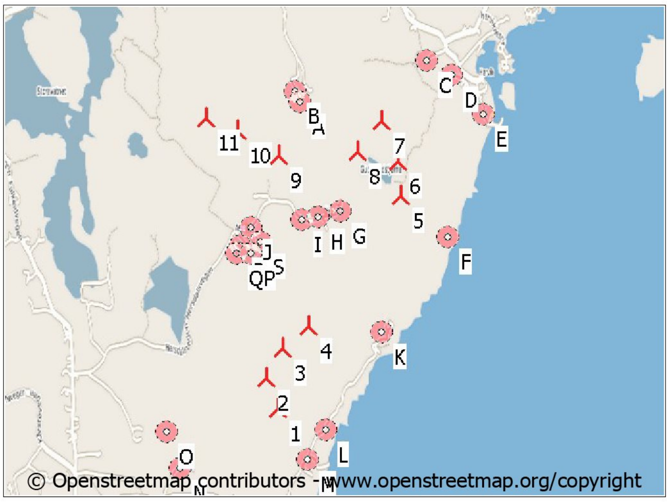
DECIBEL - Main Result

Calculation: Siemens SWT130 85m hh curtailed_ISO

Norwegian rules for noise calculation.
The calculation is based on "Veileder til Miljøverndepartementets retningslinje for behandling av støy I arealplanlegning (støyretningslinjen)", SFT, 2005
The calculation is based on ISO 9613-2 and assumes uniform directional distribution

Noise values in calculation:
Total noise values are Lden values

All coordinates are in
UTM (north)-WGS84 Zone: 32



Scale 1:75,000
New WTG   Noise sensitive area

WTGs

	Easting	Northing	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]	Status	LwA,ref [dB(A)]	Pure tones
1	304,046	6,577,449	201.0	T01	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Evening	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Night	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
2	303,951	6,577,756	193.1	T02	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Evening	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Night	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
3	304,127	6,578,046	214.6	T03	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Evening	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Night	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
4	304,391	6,578,248	193.8	T04	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Evening	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Night	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
5	305,374	6,579,503	249.9	T05	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
											Evening	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
											Night	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
6	305,364	6,579,845	263.5	T06	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Evening	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
											Night	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
7	305,226	6,580,247	258.4	T07	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Evening	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Night	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
8	304,974	6,579,960	260.0	T08	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Evening	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
											Night	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
9	304,188	6,579,956	210.0	T09	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
											Evening	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Night	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
10	303,792	6,580,231	196.0	T10	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Evening	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Night	USER	Mode 6 - Rev. 2 - 2018.11.08	8.0	Interpolated	100.0	No g
11	303,482	6,580,369	180.0	T11	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Evening	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g
											Night	USER	Mode 2 - Rev. 2 - 2018.11.08	8.0	Interpolated	105.0	No g

g) Data calculated from data for other wind speed (uncertain)

Calculation Results

Sound level

Noise sensitive area No.	Name	Easting	Northing	Z [m]	Imission height [m]	Demands Noise [dB]	Sound level From WTGs [dB]	Distance to noise demand [m]	Demands fulfilled ? Noise
A	01	304,423	6,580,486	167.5	4.0	45.0	44.6	21	Yes
A	Day						39.7		
A	Evening						39.6		
A	Night						37.6		
B	02	304,383	6,580,586	152.2	4.0	45.0	43.8	75	Yes
B	Day						38.9		
B	Evening						38.9		
B	Night						36.8		
C	03	305,704	6,580,824	41.0	4.0	45.0	41.6	232	Yes

To be continued on next page...

DECIBEL - Main Result

Calculation: Siemens SWT130 85m hh curtailed_ISO

...continued from previous page

Noise sensitive area						Demands	Sound level		Demands fulfilled ?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB]	From WTGs [dB]	Distance to noise demand [m]	Noise
C	Day						36.3		
C	Evening						35.3		
C	Night						35.0		
D	04	305,947	6,580,671	35.4	4.0	45.0	40.6	298	Yes
D	Day						35.4		
D	Evening						34.4		
D	Night						34.0		
E	05	306,235	6,580,267	22.4	4.0	45.0	38.5	375	Yes
E	Day						33.9		
E	Evening						32.3		
E	Night						31.8		
F	06	305,822	6,579,068	30.3	4.0	45.0	40.3	279	Yes
F	Day						35.4		
F	Evening						34.2		
F	Night						33.5		
G	07	304,772	6,579,374	171.6	4.0	45.0	44.5	63	Yes
G	Day						40.1		
G	Evening						39.0		
G	Night						37.5		
H	08	304,550	6,579,331	154.3	4.0	45.0	43.9	116	Yes
H	Day						39.3		
H	Evening						39.1		
H	Night						36.9		
I	09	304,382	6,579,313	134.3	4.0	45.0	43.9	143	Yes
I	Day						38.9		
I	Evening						39.5		
I	Night						36.8		
J	10	303,877	6,579,257	85.0	4.0	45.0	43.0	278	Yes
J	Day						37.9		
J	Evening						38.7		
J	Night						36.0		
K	11	305,113	6,578,154	36.2	4.0	45.0	41.0	225	Yes
K	Day						36.3		
K	Evening						36.1		
K	Night						33.9		
L	12	304,516	6,577,211	38.4	4.0	45.0	43.5	88	Yes
L	Day						39.0		
L	Evening						39.0		
L	Night						36.2		
M	13	304,314	6,576,932	42.0	4.0	45.0	42.3	152	Yes
M	Day						38.0		
M	Evening						38.0		
M	Night						35.0		
N	14	303,046	6,576,909	20.0	4.0	45.0	39.0	584	Yes
N	Day						34.0		
N	Evening						34.0		
N	Night						32.1		
O	15	302,927	6,577,282	41.1	4.0	45.0	40.0	482	Yes
O	Day						34.9		
O	Evening						34.9		
O	Night						33.2		
P	16	303,863	6,579,003	99.6	4.0	45.0	42.9	323	Yes
P	Day						37.8		
P	Evening						38.1		
P	Night						35.9		
Q	17	303,718	6,579,007	82.5	4.0	45.0	42.2	387	Yes
Q	Day						37.1		
Q	Evening						37.5		
Q	Night						35.3		
R	18	303,756	6,579,088	85.1	4.0	45.0	42.4	444	Yes
R	Day						37.3		
R	Evening						37.8		
R	Night						35.5		
S	19	303,960	6,579,112	95.9	4.0	45.0	43.0	394	Yes

To be continued on next page...

DECIBEL - Main Result

Calculation: Siemens SWT130 85m hh curtailed_ISO

...continued from previous page

Noise sensitive area						**Demands**	**Sound level**		**Demands fulfilled ?**
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB]	From WTGs [dB]	Distance to noise demand [m]	Noise
S	Day						37.9		
S	Evening						38.4		
S	Night						35.9		

Distances (m)

NSA	WTG 1	2	3	4	5	6	7	8	9	10	11
A	3060	2770	2457	2238	1367	1138	838	762	580	680	948
B	3154	2862	2552	2338	1468	1229	908	861	659	689	927
C	3759	3533	3194	2891	1361	1036	749	1131	1747	2001	2268
D	3740	3532	3194	2879	1301	1011	836	1205	1898	2199	2483
E	3568	3394	3061	2734	1151	968	1009	1298	2070	2443	2754
F	2403	2285	1979	1649	624	902	1321	1231	1859	2339	2677
G	2057	1814	1476	1188	616	756	984	620	824	1302	1629
H	1948	1685	1353	1094	842	963	1138	758	722	1176	1489
I	1894	1615	1292	1065	1010	1117	1259	877	671	1091	1387
J	1815	1503	1236	1132	1517	1599	1673	1303	765	977	1180
K	1279	1228	992	728	1374	1709	2096	1811	2025	2461	2750
L	527	785	921	1044	2447	2767	3117	2786	2764	3105	3322
M	582	900	1129	1318	2780	3096	3437	3098	3026	3339	3536
N	1136	1239	1569	1897	3485	3740	3986	3608	3253	3404	3487
O	1131	1128	1422	1754	3304	3536	3751	3370	2956	3073	3136
P	1564	1250	993	921	1591	1721	1845	1466	1007	1230	1418
Q	1592	1272	1044	1014	1728	1847	1952	1576	1059	1226	1382
R	1664	1346	1106	1053	1670	1777	1872	1498	969	1143	1310
S	1665	1356	1079	965	1467	1584	1700	1322	874	1131	1345

Project:
Tysvaer

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St. Vincent Plaza
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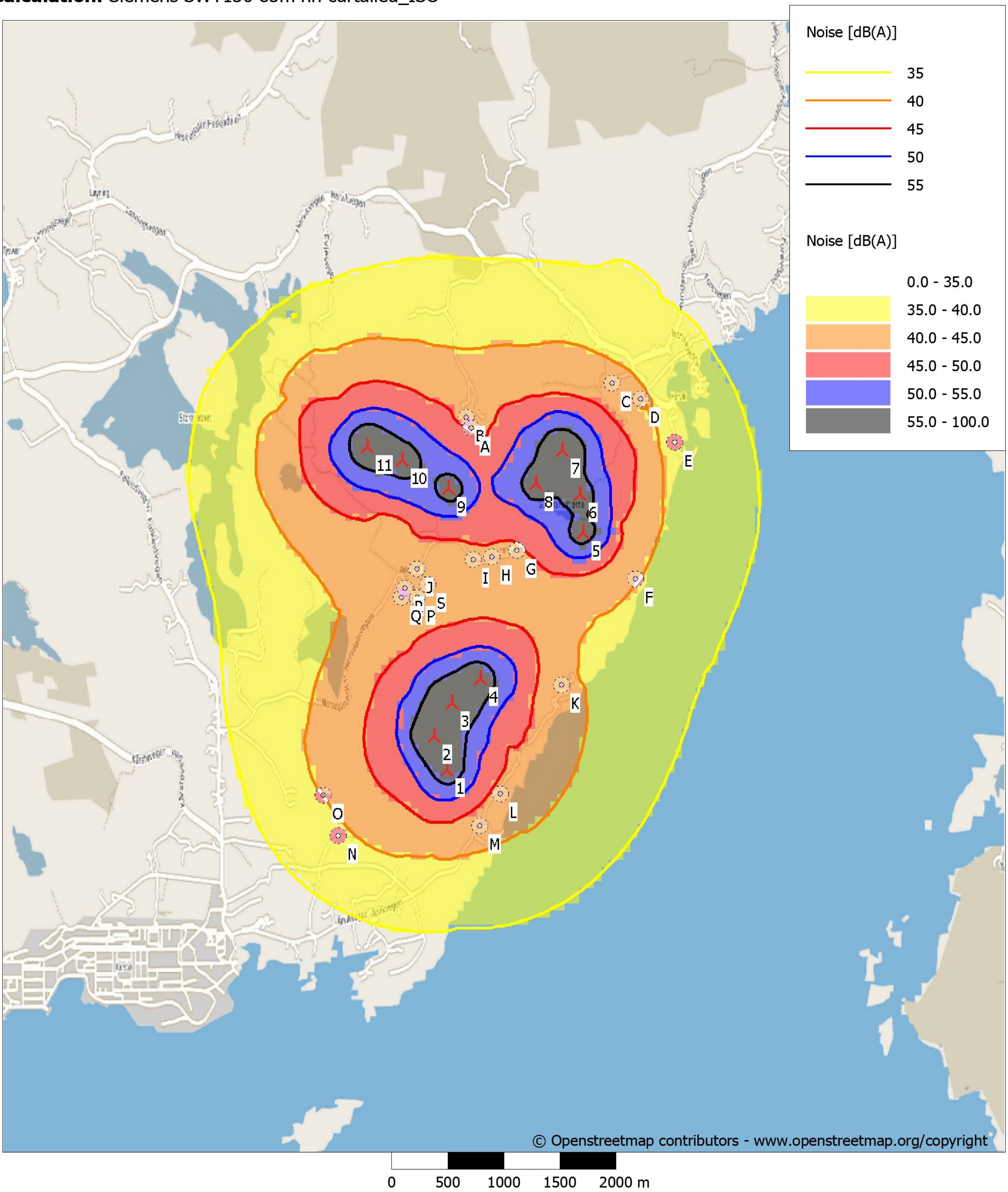
+44 (0) 141 227 1700

Calculated:
10/04/2019 16:45/3.2.744

DECIBEL - Map Lden 8.0 m/s

Calculation: Siemens SWT130 85m hh curtailed_ISO



Map: OSM provided by terrestris , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 304,428 North: 6,578,909

New WTG   Noise sensitive area

Noise calculation model: ISO 9613-2 Norway (Outdated). Wind speed: Lden 8.0 m/s

Height above sea level from active line object

Project:

Tysvaer

Licensed user:

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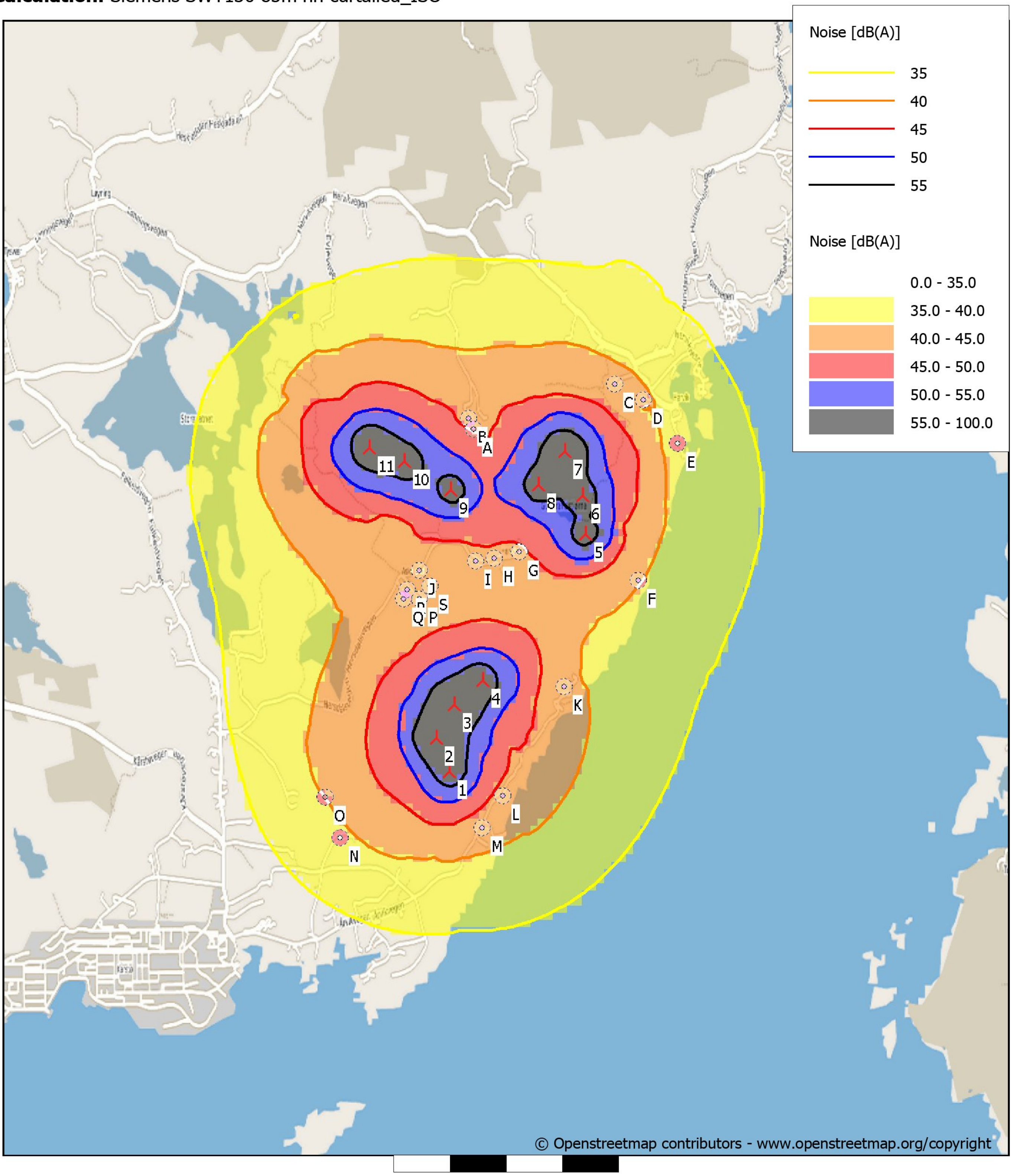
GB-GLASGOW G2 5LP
+44 (0) 141 227 1700

Calculated:

10/04/2019 16:45/3.2.744

DECIBEL - Map Lden 8.0 m/s

Calculation: Siemens SWT130 85m hh curtailed_ISO



Map: OSM provided by terrestris , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 304,428 North: 6,578,909

New WTG   Noise sensitive area

Noise calculation model: ISO 9613-2 Norway (Outdated). Wind speed: Lden 8.0 m/s

Height above sea level from active line object

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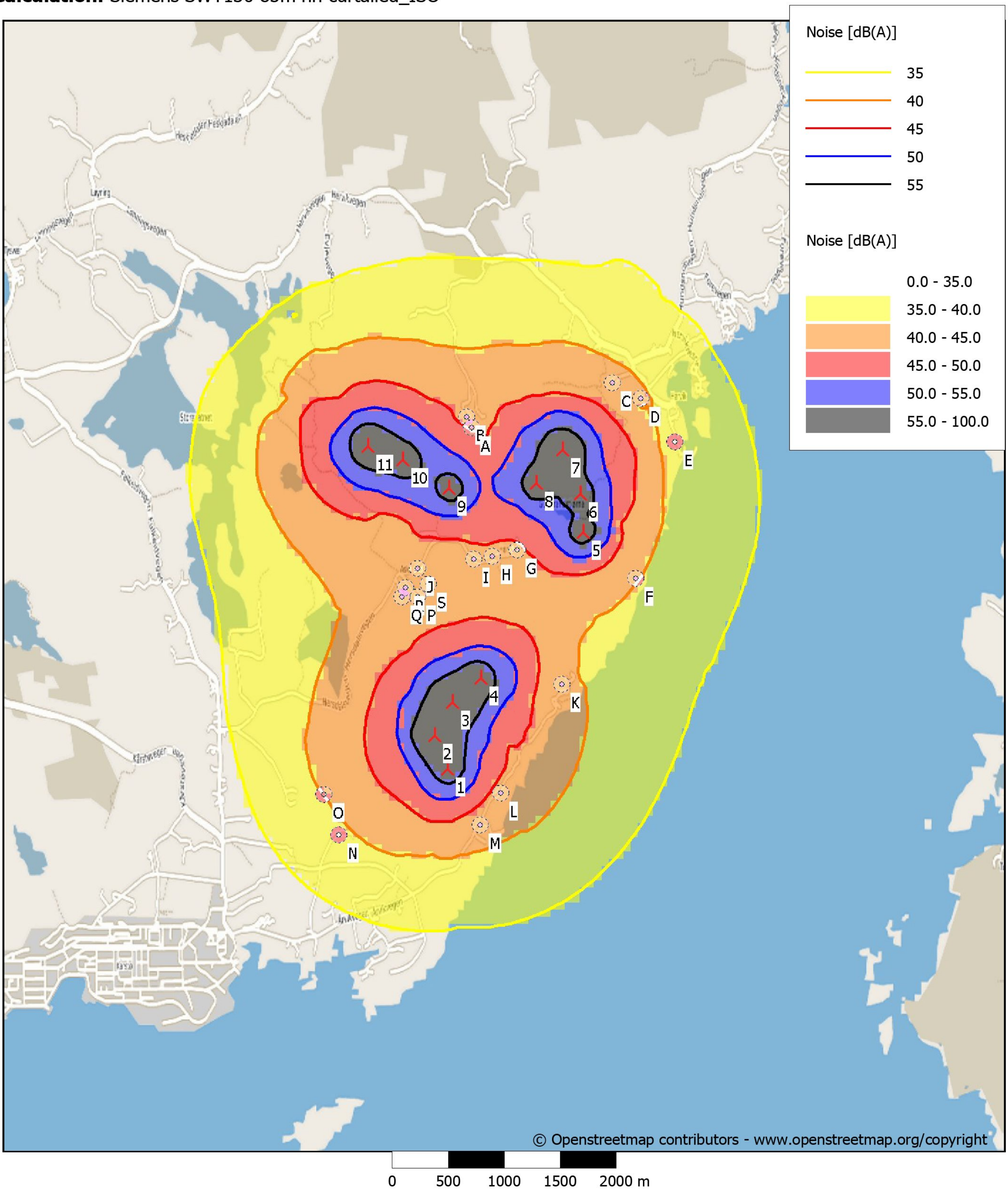
Calculated:
10/04/2019 16:45/3.2.744

DECIBEL - Map Lden 8.0 m/s

Calculation: Siemens SWT130 85m hh curtailed_ISO



Map: OSM provided by terrestris , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 304,428 North: 6,578,909

New WTG   Noise sensitive area

Noise calculation model: ISO 9613-2 Norway (Outdated). Wind speed: Lden 8.0 m/s
Height above sea level from active line object

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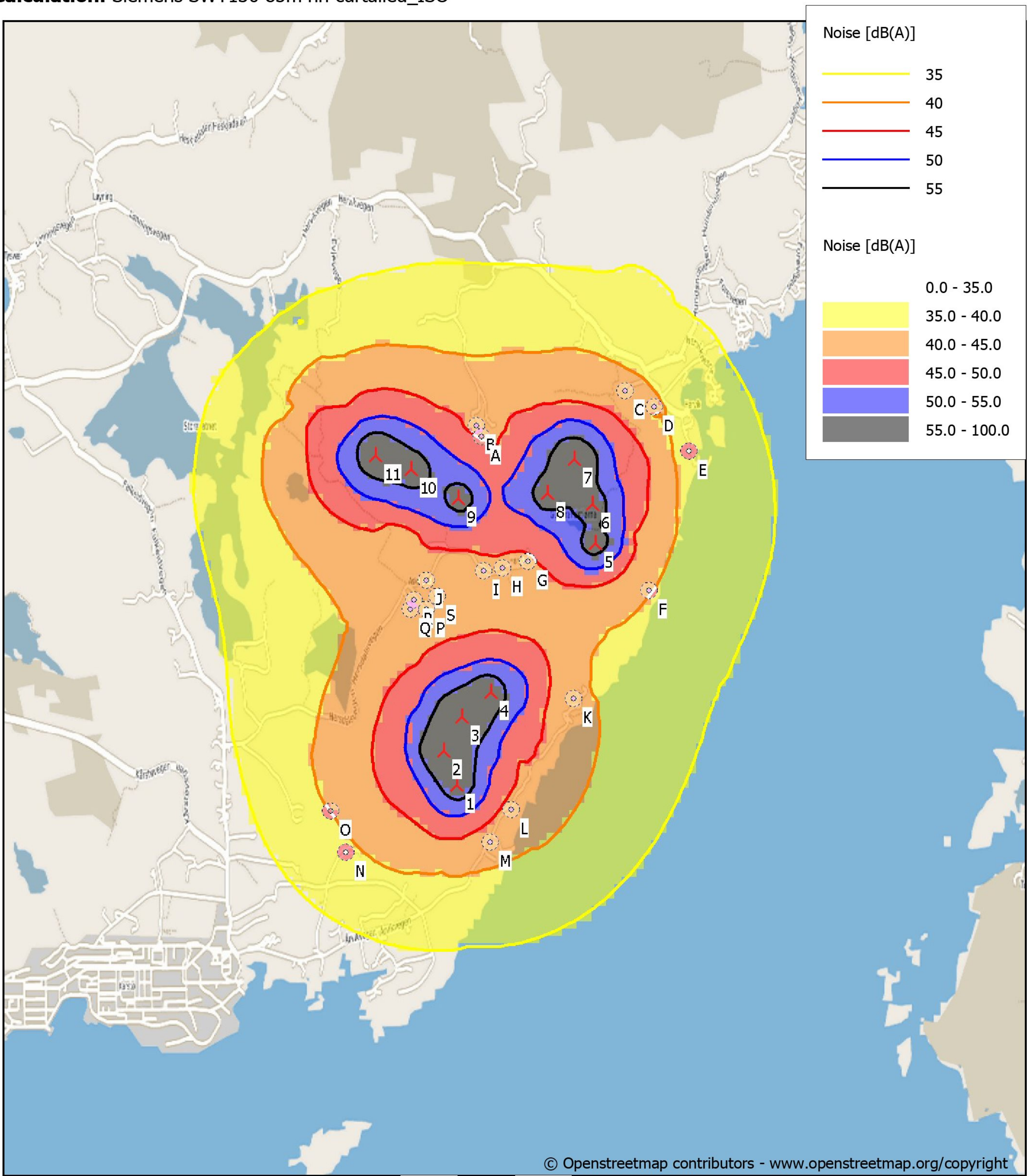
Calculated:
10/04/2019 16:45/3.2.744

DECIBEL - Map Lden 8.0 m/s

Calculation: Siemens SWT130 85m hh curtailed_ISO



0 500 1000 1500 2000 m

Map: OSM provided by terrestris , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 304,428 North: 6,578,909

New WTG   Noise sensitive area

Noise calculation model: ISO 9613-2 Norway (Outdated). Wind speed: Lden 8.0 m/s

Height above sea level from active line object

DECIBEL - Assumptions for noise calculation

Calculation: Siemens SWT130 85m hh un-curtailed_ISO

Noise calculation model:
ISO 9613-2 Norway (Outdated)
Wind speed (in 10 m height):
8.0 m/s
Ground attenuation:
Alternative
Meteorological coefficient, C0:
0.0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Pure tone penalty is subtracted from demand
WTG catalogue
Height above ground level, when no value in NSA object:
4.0 m; Don't allow override of model height with height from NSA object
Uncertainty margin:
0.0 dB; Uncertainty margin in NSA has priority
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
0.0 dB(A)

Setup for Lden calculation

Variant	Name	From hour	To hour	Hours	Penalty [dB]	Days per year
1	Day	7	19	12	0	290
2	Evening	19	23	4	5	290
3	Night	23	7	8	10	290

Octave data used if available
Frequency independent air absorption: 1.9 dB/km

Frequency dependent air absorption

63 [db/km]	125 [db/km]	250 [db/km]	500 [db/km]	1,000 [db/km]	2,000 [db/km]	4,000 [db/km]	8,000 [db/km]
0.1	0.4	1.0	1.9	3.7	9.7	32.8	117.0

WTG: Siemens SWT-DD-130 4300 130.0 !O!
Noise: Mode 1 - Rev. 2 - 2018.11.08

Source	Source/Date	Creator	Edited
SGRE ON TE SYSE-DK LACS SA-40-0000-001AB5D-00, WTG5.9.6.0 / DLL20181107	13/03/2019	USER	13/03/2019 10:43

Status	Hub height [m]	Wind speed [m/s]	LwA,ref [dB(A)]	Pure tones
Interpolated	85.0	8.0	106.0	No

NSA: 01-A
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 02-B
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 03-C
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

DECIBEL - Assumptions for noise calculation

Calculation: Siemens SWT130 85m hh un-curtailed_ISO
Noise demand: 45.0 dB(A)
No distance demand

NSA: 04-D
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 05-E
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 06-F
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 07-G
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 08-H
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 09-I
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 10-J
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 11-K
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

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DECIBEL - Assumptions for noise calculation

Calculation: Siemens SWT130 85m hh un-curtailed_ISO

NSA: 12-L
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 13-M
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 14-N
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 15-O
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 16-P
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 17-Q
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 18-R
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

NSA: 19-S
Predefined calculation standard: Yellow zone
Imission height(a.g.l.): Use standard value from calculation model
Uncertainty margin: Use default value from calculation model

Noise demand: 45.0 dB(A)
No distance demand

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Calculated:
10/04/2019 11:02/3.2.744

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh un-curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Assumptions

Calculated L(DW) = LWA,ref + K + Dc - (Adiv + Aatm + Agr + Abar + Amisc) - Cmet
(when calculated with ground attenuation, then Dc = Domega)

LWA,ref:	Sound pressure level at WTG
K:	Pure tone
Dc:	Directivity correction
Adiv:	the attenuation due to geometrical divergence
Aatm:	the attenuation due to atmospheric absorption
Agr:	the attenuation due to ground effect
Abar:	the attenuation due to a barrier
Amisc:	the attenuation due to miscellaneous other effects
Cmet:	Meteorological correction

Calculation Results

Noise sensitive area: A 01

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,060	3,062	58.6	No	**23.07**	16.67	16.67	16.67	17.67	17.67	17.67
2	2,770	2,772	60.7	No	**24.48**	18.09	18.09	18.09	19.09	19.09	19.09
3	2,457	2,461	74.1	No	**26.11**	19.71	19.71	19.71	20.71	20.71	20.71
4	2,238	2,240	58.9	No	**27.34**	20.95	20.95	20.95	21.95	21.95	21.95
5	1,367	1,377	19.5	No	**33.21**	26.81	26.81	26.81	27.81	27.81	27.81
6	1,138	1,152	28.4	Yes	**36.04**	29.64	29.64	29.64	30.64	30.64	30.64
7	838	855	46.5	Yes	**40.23**	33.83	33.83	33.83	34.83	34.83	34.83
8	762	781	44.7	Yes	**41.25**	34.86	34.86	34.86	35.86	35.86	35.86
9	580	593	33.9	No	**42.02**	35.62	35.62	35.62	36.62	36.62	36.62
10	680	689	34.9	No	**40.52**	34.13	34.13	34.13	35.13	35.13	35.13
11	948	953	34.3	No	**37.22**	30.82	30.82	30.82	31.82	31.82	31.82

Sum 48.05

Noise sensitive area: B 02

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,154	3,157	50.9	No	**22.62**	16.23	16.23	16.23	17.23	17.23	17.23
2	2,862	2,865	51.4	No	**24.02**	17.63	17.63	17.63	18.62	18.62	18.62
3	2,552	2,556	66.0	No	**25.60**	19.20	19.20	19.20	20.20	20.20	20.20
4	2,338	2,341	50.5	No	**26.77**	20.38	20.38	20.38	21.37	21.37	21.37
5	1,468	1,479	16.5	No	**32.40**	26.00	26.00	26.00	27.00	27.00	27.00
6	1,229	1,244	26.8	Yes	**35.09**	28.69	28.69	28.69	29.69	29.69	29.69
7	908	928	44.4	Yes	**39.15**	32.76	32.76	32.76	33.76	33.76	33.76
8	861	881	43.2	Yes	**39.72**	33.33	33.33	33.33	34.33	34.33	34.33
9	659	674	28.3	No	**40.75**	34.35	34.35	34.35	35.35	35.35	35.35
10	689	701	33.0	No	**40.36**	33.96	33.96	33.96	34.96	34.96	34.96
11	927	933	33.2	No	**37.43**	31.04	31.04	31.04	32.04	32.04	32.04

Sum 47.17

Noise sensitive area: C 03

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,759	3,767	-25.0	No	**19.93**	13.53	13.53	13.53	14.53	14.53	14.53
2	3,533	3,540	-30.0	No	**20.90**	14.50	14.50	14.50	15.50	15.50	15.50
3	3,194	3,204	-17.5	No	**22.41**	16.01	16.01	16.01	17.01	17.01	17.01
4	2,891	2,900	-26.2	No	**23.85**	17.45	17.45	17.45	18.45	18.45	18.45
5	1,361	1,392	12.1	No	**33.09**	26.69	26.69	26.69	27.69	27.69	27.69
6	1,036	1,079	30.9	Yes	**36.88**	30.48	30.48	30.48	31.48	31.48	31.48
7	749	806	47.3	Yes	**40.98**	34.59	34.59	34.59	35.59	35.59	35.59
8	1,131	1,170	8.4	No	**35.02**	28.62	28.62	28.62	29.62	29.62	29.62

To be continued on next page...

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Calculated:
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DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh un-curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

...continued from previous page

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
9	1,747	1,764	-9.8	No	**30.32**	23.93	23.93	23.93	24.93	24.93	24.93
10	2,001	2,015	-1.8	No	**28.69**	22.30	22.30	22.30	23.29	23.29	23.29
11	2,268	2,278	-0.1	No	**27.13**	20.73	20.73	20.73	21.73	21.73	21.73

Sum 44.08

Noise sensitive area: D 04

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,740	3,748	-23.7	No	**20.01**	13.61	13.61	13.61	14.61	14.61	14.61
2	3,532	3,540	-29.4	No	**20.90**	14.50	14.50	14.50	15.50	15.50	15.50
3	3,194	3,204	-16.4	No	**22.40**	16.01	16.01	16.01	17.01	17.01	17.01
4	2,879	2,889	-23.9	No	**23.90**	17.51	17.51	17.51	18.51	18.51	18.51
5	1,301	1,334	17.6	No	**33.57**	27.17	27.17	27.17	28.17	28.17	28.17
6	1,011	1,057	38.0	No	**36.11**	29.72	29.72	29.72	30.72	30.72	30.72
7	836	890	49.9	Yes	**39.87**	33.48	33.48	33.48	34.48	34.48	34.48
8	1,205	1,243	9.9	No	**34.35**	27.96	27.96	27.96	28.96	28.96	28.96
9	1,898	1,916	-14.8	No	**29.32**	22.93	22.93	22.93	23.92	23.92	23.92
10	2,199	2,212	-7.9	No	**27.51**	21.11	21.11	21.11	22.11	22.11	22.11
11	2,483	2,493	-9.5	No	**25.93**	19.54	19.54	19.54	20.54	20.54	20.54

Sum 43.27

Noise sensitive area: E 05

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	3,568	3,577	-7.0	No	**20.74**	14.34	14.34	14.34	15.34	15.34	15.34
2	3,394	3,403	-27.1	No	**21.50**	15.11	15.11	15.11	16.11	16.11	16.11
3	3,061	3,074	-15.2	No	**23.01**	16.62	16.62	16.62	17.62	17.62	17.62
4	2,734	2,745	-20.5	No	**24.62**	18.22	18.22	18.22	19.22	19.22	19.22
5	1,151	1,191	15.4	No	**34.82**	28.43	28.43	28.43	29.42	29.42	29.42
6	968	1,020	30.0	No	**36.50**	30.10	30.10	30.10	31.10	31.10	31.10
7	1,009	1,057	35.0	No	**36.11**	29.72	29.72	29.72	30.72	30.72	30.72
8	1,298	1,336	1.3	No	**33.55**	27.16	27.16	27.16	28.16	28.16	28.16
9	2,070	2,087	-37.5	No	**28.25**	21.85	21.85	21.85	22.85	22.85	22.85
10	2,443	2,456	-31.4	No	**26.14**	19.74	19.74	19.74	20.74	20.74	20.74
11	2,754	2,765	-34.6	No	**24.52**	18.13	18.13	18.13	19.12	19.12	19.12

Sum 42.03

Noise sensitive area: F 06

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	2,403	2,416	43.6	No	**26.35**	19.96	19.96	19.96	20.96	20.96	20.96
2	2,285	2,298	10.1	No	**27.02**	20.62	20.62	20.62	21.62	21.62	21.62
3	1,979	1,997	20.8	No	**28.81**	22.41	22.41	22.41	23.41	23.41	23.41
4	1,649	1,667	20.2	No	**31.00**	24.61	24.61	24.61	25.60	25.60	25.60
5	624	692	33.6	Yes	**42.17**	35.77	35.77	35.77	36.77	36.77	36.77
6	902	955	10.7	No	**37.19**	30.80	30.80	30.80	31.80	31.80	31.80
7	1,321	1,356	-15.6	No	**33.38**	26.99	26.99	26.99	27.99	27.99	27.99
8	1,231	1,269	-14.9	No	**34.13**	27.73	27.73	27.73	28.73	28.73	28.73
9	1,859	1,877	-32.8	No	**29.57**	23.17	23.17	23.17	24.17	24.17	24.17
10	2,339	2,352	-43.0	No	**26.71**	20.31	20.31	20.31	21.31	21.31	21.31
11	2,677	2,687	-47.9	No	**24.92**	18.52	18.52	18.52	19.52	19.52	19.52

Sum 44.93

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh un-curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Noise sensitive area: G 07

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	2,057	2,060	52.3	Yes	**29.29**	22.89	22.89	22.89	23.89	23.89	23.89
2	1,814	1,817	49.4	Yes	**30.90**	24.50	24.50	24.50	25.50	25.50	25.50
3	1,476	1,481	66.6	Yes	**33.93**	27.53	27.53	27.53	28.53	28.53	28.53
4	1,188	1,193	68.6	Yes	**36.79**	30.39	30.39	30.39	31.39	31.39	31.39
5	616	636	25.4	Yes	**42.72**	36.33	36.33	36.33	37.33	37.33	37.33
6	756	776	23.7	No	**39.33**	32.94	32.94	32.94	33.94	33.94	33.94
7	984	998	13.5	No	**36.73**	30.33	30.33	30.33	31.33	31.33	31.33
8	620	643	32.0	Yes	**42.96**	36.56	36.56	36.56	37.56	37.56	37.56
9	824	833	44.8	Yes	**40.48**	34.08	34.08	34.08	35.08	35.08	35.08
10	1,302	1,306	37.4	No	**33.81**	27.41	27.41	27.41	28.41	28.41	28.41
11	1,629	1,631	36.4	No	**31.26**	24.86	24.86	24.86	25.86	25.86	25.86

Sum 48.81

Noise sensitive area: H 08

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,948	1,952	43.1	Yes	**29.84**	23.45	23.45	23.45	24.45	24.45	24.45
2	1,685	1,689	45.5	Yes	**31.77**	25.37	25.37	25.37	26.37	26.37	26.37
3	1,353	1,360	63.4	Yes	**34.96**	28.56	28.56	28.56	29.56	29.56	29.56
4	1,094	1,101	60.8	Yes	**37.59**	31.19	31.19	31.19	32.19	32.19	32.19
5	842	860	35.3	Yes	**39.70**	33.31	33.31	33.31	34.31	34.31	34.31
6	963	981	31.6	Yes	**38.02**	31.62	31.62	31.62	32.62	32.62	32.62
7	1,138	1,153	20.8	No	**35.18**	28.78	28.78	28.78	29.78	29.78	29.78
8	758	781	41.2	Yes	**41.10**	34.70	34.70	34.70	35.70	35.70	35.70
9	722	735	44.5	Yes	**41.99**	35.59	35.59	35.59	36.59	36.59	36.59
10	1,176	1,183	43.0	No	**34.90**	28.50	28.50	28.50	29.50	29.50	29.50
11	1,489	1,493	43.8	No	**32.29**	25.89	25.89	25.89	26.89	26.89	26.89

Sum 48.05

Noise sensitive area: I 09

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,894	1,899	38.5	Yes	**30.12**	23.72	23.72	23.72	24.72	24.72	24.72
2	1,615	1,621	42.1	Yes	**32.22**	25.82	25.82	25.82	26.82	26.82	26.82
3	1,292	1,302	61.0	Yes	**35.45**	29.06	29.06	29.06	30.05	30.05	30.05
4	1,065	1,074	58.7	Yes	**37.83**	31.43	31.43	31.43	32.43	32.43	32.43
5	1,010	1,029	35.5	Yes	**37.59**	31.20	31.20	31.20	32.20	32.20	32.20
6	1,117	1,136	29.0	No	**35.33**	28.94	28.94	28.94	29.94	29.94	29.94
7	1,259	1,275	14.9	No	**34.07**	27.68	27.68	27.68	28.67	28.67	28.67
8	877	901	33.5	Yes	**39.08**	32.69	32.69	32.69	33.69	33.69	33.69
9	671	690	51.1	Yes	**43.10**	36.71	36.71	36.71	37.71	37.71	37.71
10	1,091	1,100	49.7	Yes	**37.24**	30.85	30.85	30.85	31.85	31.85	31.85
11	1,387	1,393	47.6	Yes	**34.26**	27.86	27.86	27.86	28.86	28.86	28.86

Sum 47.82

Noise sensitive area: J 10

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,815	1,826	17.5	No	**29.91**	23.51	23.51	23.51	24.51	24.51	24.51
2	1,503	1,514	21.9	No	**32.12**	25.73	25.73	25.73	26.73	26.73	26.73
3	1,236	1,254	42.5	Yes	**35.42**	29.03	29.03	29.03	30.03	30.03	30.03
4	1,132	1,148	46.0	Yes	**36.61**	30.21	30.21	30.21	31.21	31.21	31.21
5	1,517	1,537	44.1	Yes	**32.94**	26.55	26.55	26.55	27.55	27.55	27.55
6	1,599	1,620	34.8	Yes	**32.08**	25.68	25.68	25.68	26.68	26.68	26.68
7	1,673	1,692	24.1	No	**30.82**	24.43	24.43	24.43	25.43	25.43	25.43
8	1,303	1,328	44.5	Yes	**34.78**	28.38	28.38	28.38	29.38	29.38	29.38
9	765	792	58.6	Yes	**41.69**	35.30	35.30	35.30	36.29	36.29	36.29
10	977	996	49.5	Yes	**38.47**	32.07	32.07	32.07	33.07	33.07	33.07
11	1,180	1,193	65.7	Yes	**36.71**	30.31	30.31	30.31	31.31	31.31	31.31

Sum 46.53

Project:
Tysvaer

Licensed user:
Wood Group UK Ltd.
St. Vincent Plaza
GB-GLASGOW G2 5LP
+44 (0) 141 227 1700

Calculated:
10/04/2019 11:02/3.2.744

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh un-curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Noise sensitive area: K 11

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,279	1,302	41.0	Yes	**34.92**	28.53	28.53	28.53	29.53	29.53	29.53
2	1,228	1,251	18.0	No	**34.28**	27.89	27.89	27.89	28.89	28.89	28.89
3	992	1,025	23.0	No	**36.44**	30.04	30.04	30.04	31.04	31.04	31.04
4	728	766	21.9	No	**39.46**	33.06	33.06	33.06	34.06	34.06	34.06
5	1,374	1,405	46.7	Yes	**34.13**	27.73	27.73	27.73	28.73	28.73	28.73
6	1,709	1,737	25.5	No	**30.51**	24.12	24.12	24.12	25.11	25.11	25.11
7	2,096	2,117	-3.7	No	**28.07**	21.67	21.67	21.67	22.67	22.67	22.67
8	1,811	1,836	8.4	No	**29.84**	23.44	23.44	23.44	24.44	24.44	24.44
9	2,025	2,041	9.1	No	**28.53**	22.14	22.14	22.14	23.13	23.13	23.13
10	2,461	2,473	9.6	No	**26.04**	19.65	19.65	19.65	20.65	20.65	20.65
11	2,750	2,759	8.4	No	**24.55**	18.15	18.15	18.15	19.15	19.15	19.15

Sum 44.11

Noise sensitive area: L 12

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	527	581	32.0	Yes	**44.14**	37.75	37.75	37.75	38.75	38.75	38.75
2	785	820	5.3	No	**38.77**	32.38	32.38	32.38	33.38	33.38	33.38
3	921	957	22.7	No	**37.17**	30.78	30.78	30.78	31.77	31.77	31.77
4	1,044	1,071	28.9	No	**35.97**	29.58	29.58	29.58	30.58	30.58	30.58
5	2,447	2,464	51.1	Yes	**26.80**	20.40	20.40	20.40	21.40	21.40	21.40
6	2,767	2,784	34.1	Yes	**24.84**	18.45	18.45	18.45	19.45	19.45	19.45
7	3,117	3,132	14.4	No	**22.74**	16.34	16.34	16.34	17.34	17.34	17.34
8	2,786	2,803	33.2	No	**24.33**	17.93	17.93	17.93	18.93	18.93	18.93
9	2,764	2,776	28.7	No	**24.47**	18.07	18.07	18.07	19.07	19.07	19.07
10	3,105	3,114	17.7	No	**22.82**	16.43	16.43	16.43	17.43	17.43	17.43
11	3,322	3,330	21.3	No	**21.83**	15.44	15.44	15.44	16.44	16.44	16.44

Sum 46.49

Noise sensitive area: M 13

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	582	630	37.8	Yes	**43.52**	37.13	37.13	37.13	38.12	38.12	38.12
2	900	929	8.2	No	**37.47**	31.08	31.08	31.08	32.08	32.08	32.08
3	1,129	1,157	17.4	No	**35.14**	28.74	28.74	28.74	29.74	29.74	29.74
4	1,318	1,338	22.7	No	**33.53**	27.14	27.14	27.14	28.13	28.13	28.13
5	2,780	2,795	52.6	Yes	**25.01**	18.61	18.61	18.61	19.61	19.61	19.61
6	3,096	3,110	38.3	Yes	**23.26**	16.87	16.87	16.87	17.86	17.86	17.86
7	3,437	3,450	21.7	No	**21.29**	14.90	14.90	14.90	15.90	15.90	15.90
8	3,098	3,113	40.7	No	**22.83**	16.43	16.43	16.43	17.43	17.43	17.43
9	3,026	3,036	24.6	No	**23.19**	16.80	16.80	16.80	17.79	17.79	17.79
10	3,339	3,348	13.4	No	**21.75**	15.36	15.36	15.36	16.36	16.36	16.36
11	3,536	3,542	18.4	No	**20.89**	14.50	14.50	14.50	15.49	15.49	15.49

Sum 45.43

Noise sensitive area: N 14

WTG No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Lden(year) Calculated [dB]	L Annual mean Day [dB]	Evening [dB]	Night [dB]	Leq24h Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,136	1,166	90.7	Yes	**37.74**	31.34	31.34	31.34	32.34	32.34	32.34
2	1,239	1,265	80.4	Yes	**36.35**	29.96	29.96	29.96	30.96	30.96	30.96
3	1,569	1,593	65.1	Yes	**32.94**	26.55	26.55	26.55	27.55	27.55	27.55
4	1,897	1,915	35.1	No	**29.33**	22.93	22.93	22.93	23.93	23.93	23.93
5	3,485	3,499	29.8	No	**21.08**	14.69	14.69	14.69	15.68	15.68	15.68
6	3,740	3,754	32.8	No	**19.98**	13.59	13.59	13.59	14.59	14.59	14.59
7	3,986	3,999	35.0	No	**18.97**	12.58	12.58	12.58	13.57	13.57	13.57
8	3,608	3,623	51.4	No	**20.54**	14.15	14.15	14.15	15.15	15.15	15.15
9	3,253	3,265	63.4	Yes	**22.79**	16.40	16.40	16.40	17.39	17.39	17.39
10	3,404	3,414	86.7	Yes	**22.32**	15.93	15.93	15.93	16.93	16.93	16.93
11	3,487	3,495	97.2	Yes	**22.05**	15.65	15.65	15.65	16.65	16.65	16.65

Sum 41.47

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh un-curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Noise sensitive area: O 15

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,131	1,157	92.7	Yes	**37.91**	31.51	31.51	31.51	32.51	32.51	32.51
2	1,128	1,152	82.6	Yes	**37.66**	31.27	31.27	31.27	32.27	32.27	32.27
3	1,422	1,445	67.2	Yes	**34.26**	27.87	27.87	27.87	28.87	28.87	28.87
4	1,754	1,769	37.7	Yes	**31.02**	24.62	24.62	24.62	25.62	25.62	25.62
5	3,304	3,317	38.7	No	**21.89**	15.50	15.50	15.50	16.49	16.49	16.49
6	3,536	3,549	46.5	No	**20.86**	14.47	14.47	14.47	15.47	15.47	15.47
7	3,751	3,763	47.4	No	**19.95**	13.55	13.55	13.55	14.55	14.55	14.55
8	3,370	3,383	62.8	No	**21.59**	15.20	15.20	15.20	16.19	16.19	16.19
9	2,956	2,966	80.5	Yes	**24.45**	18.06	18.06	18.06	19.06	19.06	19.06
10	3,073	3,082	101.1	No	**22.98**	16.58	16.58	16.58	17.58	17.58	17.58
11	3,136	3,144	103.3	No	**22.69**	16.29	16.29	16.29	17.29	17.29	17.29

Sum 42.34

Noise sensitive area: P 16

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,564	1,575	11.8	No	**31.67**	25.27	25.27	25.27	26.27	26.27	26.27
2	1,250	1,262	14.9	No	**34.19**	27.79	27.79	27.79	28.79	28.79	28.79
3	993	1,012	33.5	Yes	**37.73**	31.33	31.33	31.33	32.33	32.33	32.33
4	921	938	38.0	Yes	**38.79**	32.39	32.39	32.39	33.39	33.39	33.39
5	1,591	1,608	57.2	Yes	**32.65**	26.25	26.25	26.25	27.25	27.25	27.25
6	1,721	1,738	51.8	Yes	**31.53**	25.13	25.13	25.13	26.13	26.13	26.13
7	1,845	1,860	37.9	Yes	**30.38**	23.98	23.98	23.98	24.98	24.98	24.98
8	1,466	1,486	59.2	Yes	**33.71**	27.32	27.32	27.32	28.32	28.32	28.32
9	1,007	1,025	75.4	Yes	**38.99**	32.59	32.59	32.59	33.59	33.59	33.59
10	1,230	1,243	69.3	Yes	**36.28**	29.89	29.89	29.89	30.88	30.88	30.88
11	1,418	1,427	85.7	Yes	**34.87**	28.48	28.48	28.48	29.48	29.48	29.48

Sum 45.97

Noise sensitive area: Q 17

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,592	1,604	7.4	No	**31.45**	25.06	25.06	25.06	26.06	26.06	26.06
2	1,272	1,287	11.5	No	**33.97**	27.58	27.58	27.58	28.58	28.58	28.58
3	1,044	1,066	25.1	Yes	**36.84**	30.45	30.45	30.45	31.44	31.44	31.44
4	1,014	1,032	31.7	Yes	**37.43**	31.03	31.03	31.03	32.03	32.03	32.03
5	1,728	1,746	54.3	Yes	**31.51**	25.12	25.12	25.12	26.12	26.12	26.12
6	1,847	1,865	48.4	Yes	**30.54**	24.14	24.14	24.14	25.14	25.14	25.14
7	1,952	1,969	36.2	No	**28.98**	22.59	22.59	22.59	23.59	23.59	23.59
8	1,576	1,597	57.5	Yes	**32.74**	26.34	26.34	26.34	27.34	27.34	27.34
9	1,059	1,079	71.2	Yes	**38.17**	31.78	31.78	31.78	32.78	32.78	32.78
10	1,226	1,241	73.1	Yes	**36.40**	30.00	30.00	30.00	31.00	31.00	31.00
11	1,382	1,393	87.0	Yes	**35.22**	28.83	28.83	28.83	29.83	29.83	29.83

Sum 45.28

Noise sensitive area: R 18

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,664	1,676	11.3	No	**30.94**	24.54	24.54	24.54	25.54	25.54	25.54
2	1,346	1,359	15.7	No	**33.36**	26.96	26.96	26.96	27.96	27.96	27.96
3	1,106	1,126	33.3	Yes	**36.46**	30.06	30.06	30.06	31.06	31.06	31.06
4	1,053	1,070	37.9	Yes	**37.21**	30.82	30.82	30.82	31.82	31.82	31.82
5	1,670	1,688	53.6	Yes	**31.94**	25.55	25.55	25.55	26.55	26.55	26.55
6	1,777	1,796	46.3	Yes	**31.00**	24.60	24.60	24.60	25.60	25.60	25.60
7	1,872	1,889	34.4	No	**29.49**	23.10	23.10	23.10	24.10	24.10	24.10
8	1,498	1,519	55.7	Yes	**33.35**	26.95	26.95	26.95	27.95	27.95	27.95
9	969	991	69.5	Yes	**39.23**	32.83	32.83	32.83	33.83	33.83	33.83
10	1,143	1,159	69.1	Yes	**37.17**	30.78	30.78	30.78	31.78	31.78	31.78
11	1,310	1,321	84.3	Yes	**35.87**	29.48	29.48	29.48	30.48	30.48	30.48

Sum 45.61

Licensed user:
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Calculated:
10/04/2019 11:02/3.2.744

DECIBEL - Detailed results

Calculation: Siemens SWT130 85m hh un-curtailed_ISO**Noise calculation model:** ISO 9613-2 Norway (Outdated) 8.0 m/s

Noise sensitive area: S 19

WTG					Lden(year)	L Annual mean			Leq24h		
No.	Distance [m]	Sound distance [m]	Mean height [m]	Visible	Calculated [dB]	Day [dB]	Evening [dB]	Night [dB]	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
1	1,665	1,675	15.4	No	**30.94**	24.55	24.55	24.55	25.54	25.54	25.54
2	1,356	1,367	18.9	No	**33.29**	26.89	26.89	26.89	27.89	27.89	27.89
3	1,079	1,097	38.9	Yes	**36.94**	30.54	30.54	30.54	31.54	31.54	31.54
4	965	982	43.1	Yes	**38.42**	32.02	32.02	32.02	33.02	33.02	33.02
5	1,467	1,485	49.9	Yes	**33.50**	27.11	27.11	27.11	28.11	28.11	28.11
6	1,584	1,603	42.8	Yes	**32.38**	25.98	25.98	25.98	26.98	26.98	26.98
7	1,700	1,717	29.0	No	**30.65**	24.25	24.25	24.25	25.25	25.25	25.25
8	1,322	1,344	50.5	Yes	**34.78**	28.38	28.38	28.38	29.38	29.38	29.38
9	874	896	69.3	Yes	**40.54**	34.15	34.15	34.15	35.14	35.14	35.14
10	1,131	1,146	55.5	Yes	**36.92**	30.52	30.52	30.52	31.52	31.52	31.52
11	1,345	1,355	71.1	Yes	**35.20**	28.81	28.81	28.81	29.81	29.81	29.81

Sum 46.33

Project:
Tysvaer

Licensed user:
Wood Group UK Ltd.
St. Vincent Plaza
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+44 (0) 141 227 1700

Calculated:
10/04/2019 11:02/3.2.744

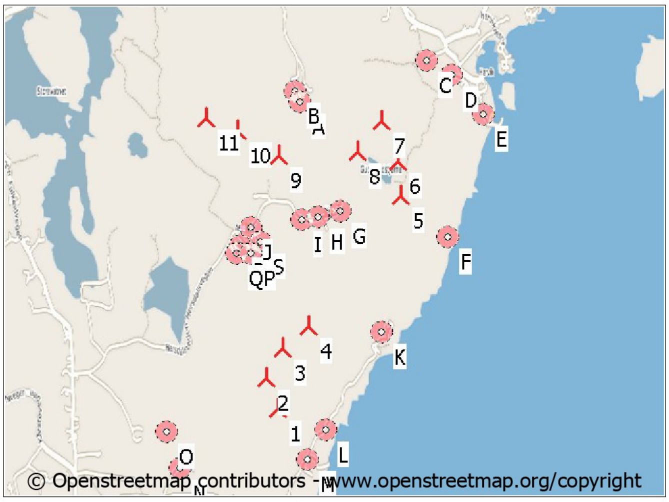
DECIBEL - Main Result

Calculation: Siemens SWT130 85m hh un-curtailed_ISO

Norwegian rules for noise calculation.
The calculation is based on "Veileder til Miljøverndepartementets retningslinje for behandling av støy I arealplanlegning (støyretningslinjen)", SFT, 2005
The calculation is based on ISO 9613-2 and assumes uniform directional distribution

Noise values in calculation:
Total noise values are Lden values

All coordinates are in
UTM (north)-WGS84 Zone: 32



Scale 1:75,000
New WTG   Noise sensitive area

WTGs

	Easting	Northing	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]	Status	LwA,ref [dB(A)]	Pure tones
1	304,046	6,577,449	201.0	T01	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
2	303,951	6,577,756	193.1	T02	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
3	304,127	6,578,046	214.6	T03	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
4	304,391	6,578,248	193.8	T04	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
5	305,374	6,579,503	249.9	T05	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
6	305,364	6,579,845	263.5	T06	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
7	305,226	6,580,247	258.4	T07	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
8	304,974	6,579,960	260.0	T08	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
9	304,188	6,579,956	210.0	T09	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
10	303,792	6,580,231	196.0	T10	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
11	303,482	6,580,369	180.0	T11	Yes	Siemens	SWT-DD-130-4,300	4,300	130.0	85.0	Day	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Evening	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g
											Night	USER	Mode 1 - Rev. 2 - 2018.11.08	8.0	Interpolated	106.0	No g

g) Data calculated from data for other wind speed (uncertain)

Calculation Results

Sound level

Noise sensitive area No.	Name	Easting	Northing	Z [m]	Imission height [m]	Demands Noise [dB]	Sound level From WTGs [dB]	Distance to noise demand [m]	Demands fulfilled ? Noise
A	01	304,423	6,580,486	167.5	4.0	45.0	48.1	-435	**No**
A	Day						41.7		
A	Evening						41.7		
A	Night						41.7		
B	02	304,383	6,580,586	152.2	4.0	45.0	47.2	-341	**No**
B	Day						40.8		
B	Evening						40.8		
B	Night						40.8		
C	03	305,704	6,580,824	41.0	4.0	45.0	44.1	80	Yes

To be continued on next page...

DECIBEL - Main Result

Calculation: Siemens SWT130 85m hh un-curtailed_ISO

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Noise sensitive area						Demands	Sound level		Demands fulfilled ?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB]	From WTGs [dB]	Distance to noise demand [m]	Noise
C	Day						37.7		
C	Evening						37.7		
C	Night						37.7		
D	04	305,947	6,580,671	35.4	4.0	45.0	43.3	130	Yes
D	Day						36.9		
D	Evening						36.9		
D	Night						36.9		
E	05	306,235	6,580,267	22.4	4.0	45.0	42.0	189	Yes
E	Day						35.6		
E	Evening						35.6		
E	Night						35.6		
F	06	305,822	6,579,068	30.3	4.0	45.0	44.9	5	Yes
F	Day						38.5		
F	Evening						38.5		
F	Night						38.5		
G	07	304,772	6,579,374	171.6	4.0	45.0	48.8	-782	**No**
G	Day						42.4		
G	Evening						42.4		
G	Night						42.4		
H	08	304,550	6,579,331	154.3	4.0	45.0	48.0	-894	**No**
H	Day						41.7		
H	Evening						41.7		
H	Night						41.7		
I	09	304,382	6,579,313	134.3	4.0	45.0	47.8	-771	**No**
I	Day						41.4		
I	Evening						41.4		
I	Night						41.4		
J	10	303,877	6,579,257	85.0	4.0	45.0	46.5	-305	**No**
J	Day						40.1		
J	Evening						40.1		
J	Night						40.1		
K	11	305,113	6,578,154	36.2	4.0	45.0	44.1	91	Yes
K	Day						37.7		
K	Evening						37.7		
K	Night						37.7		
L	12	304,516	6,577,211	38.4	4.0	45.0	46.5	-137	**No**
L	Day						40.1		
L	Evening						40.1		
L	Night						40.1		
M	13	304,314	6,576,932	42.0	4.0	45.0	45.4	-32	**No**
M	Day						39.0		
M	Evening						39.0		
M	Night						39.0		
N	14	303,046	6,576,909	20.0	4.0	45.0	41.5	362	Yes
N	Day						35.1		
N	Evening						35.1		
N	Night						35.1		
O	15	302,927	6,577,282	41.1	4.0	45.0	42.3	296	Yes
O	Day						35.9		
O	Evening						35.9		
O	Night						35.9		
P	16	303,863	6,579,003	99.6	4.0	45.0	46.0	-176	**No**
P	Day						39.6		
P	Evening						39.6		
P	Night						39.6		
Q	17	303,718	6,579,007	82.5	4.0	45.0	45.3	-40	**No**
Q	Day						38.9		
Q	Evening						38.9		
Q	Night						38.9		
R	18	303,756	6,579,088	85.1	4.0	45.0	45.6	-115	**No**
R	Day						39.2		
R	Evening						39.2		
R	Night						39.2		
S	19	303,960	6,579,112	95.9	4.0	45.0	46.3	-303	**No**

To be continued on next page...

DECIBEL - Main Result

Calculation: Siemens SWT130 85m hh un-curtailed_ISO

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Noise sensitive area						Demands	Sound level		Demands fulfilled ?
No.	Name	Easting	Northing	Z [m]	Imission height [m]	Noise [dB]	From WTGs [dB]	Distance to noise demand [m]	Noise
S	Day						39.9		
S	Evening						39.9		
S	Night						39.9		

Distances (m)

NSA	WTG 1	2	3	4	5	6	7	8	9	10	11
A	3060	2770	2457	2238	1367	1138	838	762	580	680	948
B	3154	2862	2552	2338	1468	1229	908	861	659	689	927
C	3759	3533	3194	2891	1361	1036	749	1131	1747	2001	2268
D	3740	3532	3194	2879	1301	1011	836	1205	1898	2199	2483
E	3568	3394	3061	2734	1151	968	1009	1298	2070	2443	2754
F	2403	2285	1979	1649	624	902	1321	1231	1859	2339	2677
G	2057	1814	1476	1188	616	756	984	620	824	1302	1629
H	1948	1685	1353	1094	842	963	1138	758	722	1176	1489
I	1894	1615	1292	1065	1010	1117	1259	877	671	1091	1387
J	1815	1503	1236	1132	1517	1599	1673	1303	765	977	1180
K	1279	1228	992	728	1374	1709	2096	1811	2025	2461	2750
L	527	785	921	1044	2447	2767	3117	2786	2764	3105	3322
M	582	900	1129	1318	2780	3096	3437	3098	3026	3339	3536
N	1136	1239	1569	1897	3485	3740	3986	3608	3253	3404	3487
O	1131	1128	1422	1754	3304	3536	3751	3370	2956	3073	3136
P	1564	1250	993	921	1591	1721	1845	1466	1007	1230	1418
Q	1592	1272	1044	1014	1728	1847	1952	1576	1059	1226	1382
R	1664	1346	1106	1053	1670	1777	1872	1498	969	1143	1310
S	1665	1356	1079	965	1467	1584	1700	1322	874	1131	1345

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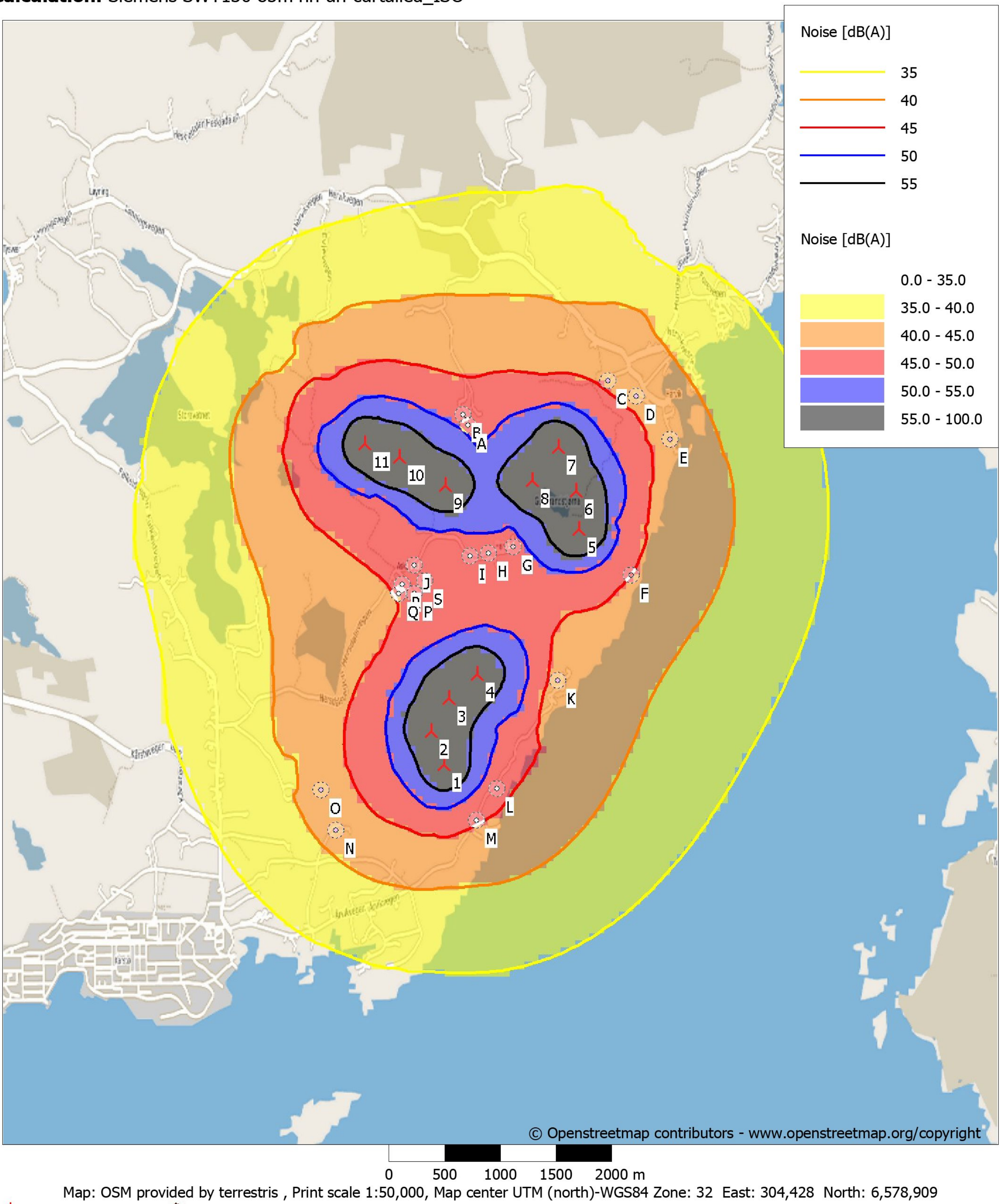
DECIBEL - Map Lden 8.0 m/s

Calculation: Siemens SWT130 85m hh un-curtailed_ISO



Map: OSM provided by terrestris , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 304,428 North: 6,578,909

New WTG   Noise sensitive area

Noise calculation model: ISO 9613-2 Norway (Outdated). Wind speed: Lden 8.0 m/s
Height above sea level from active line object

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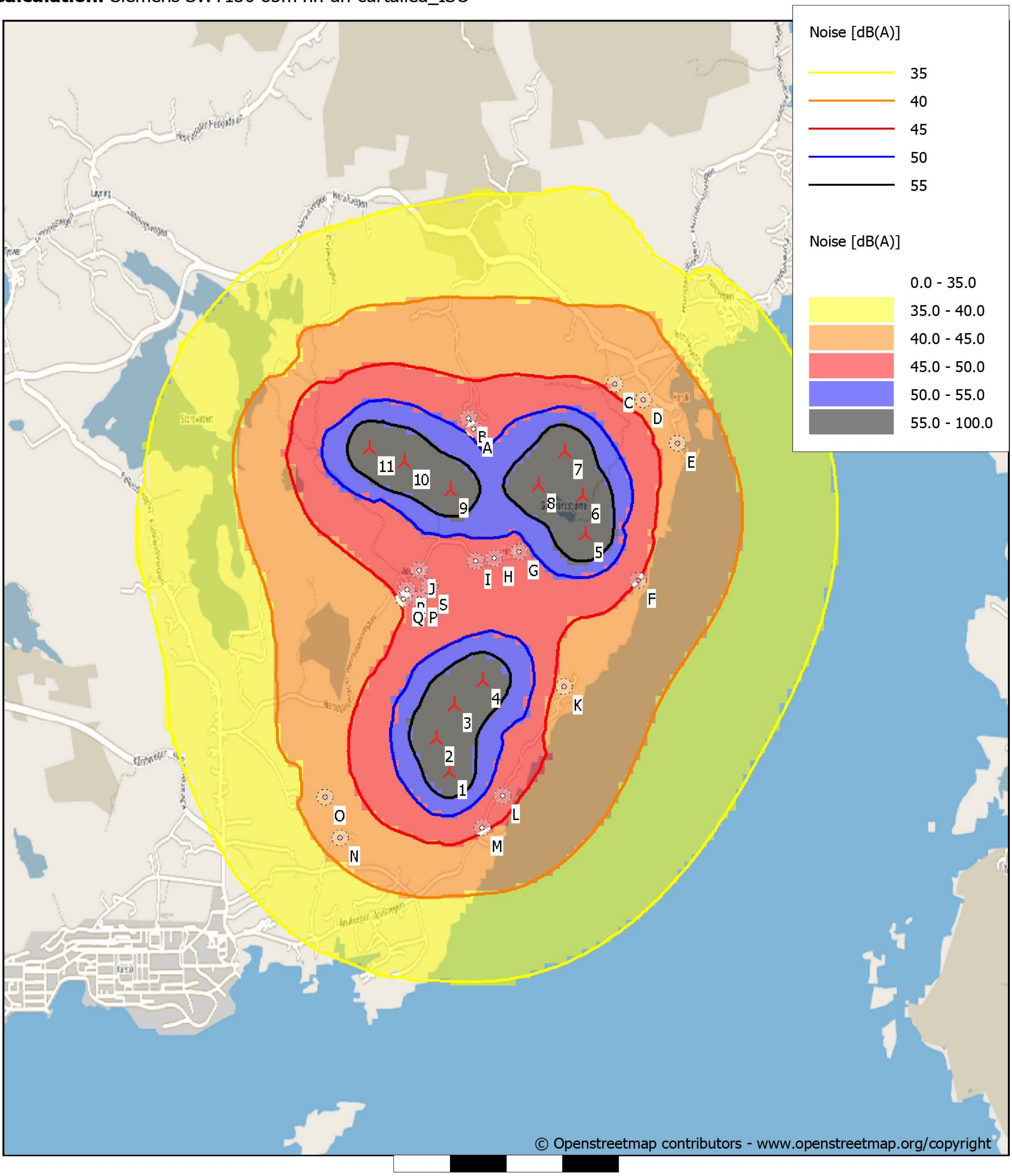

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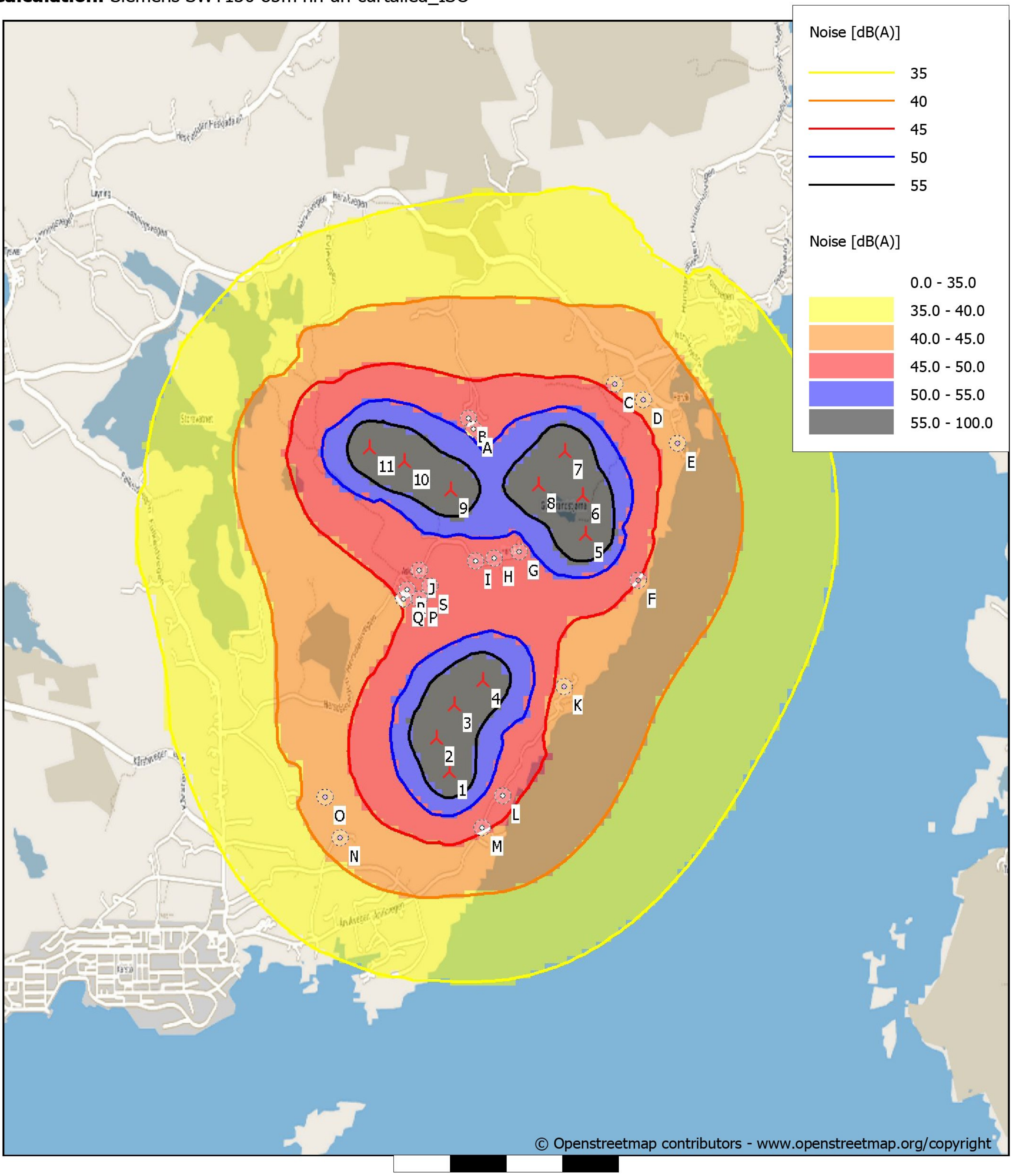

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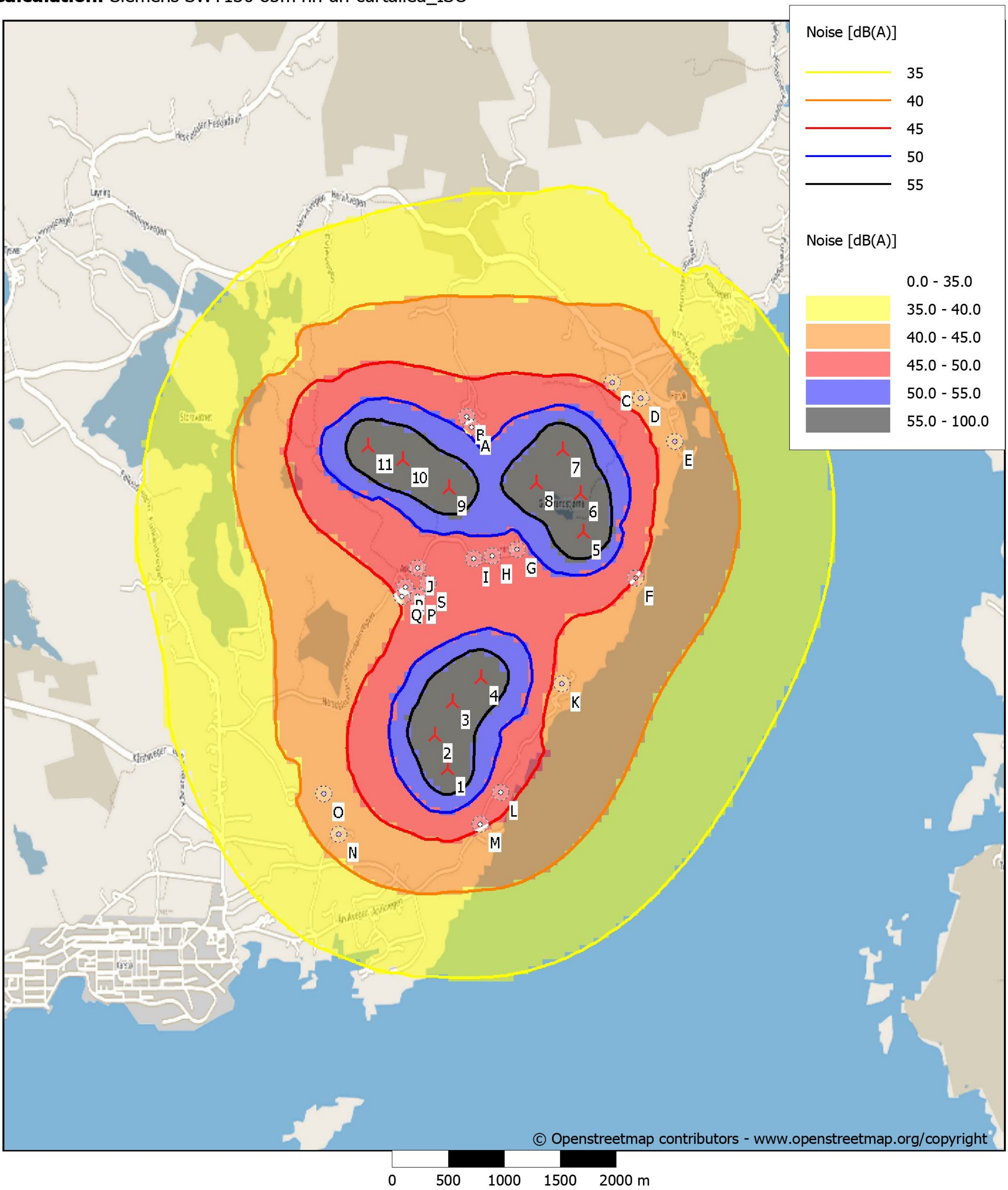

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