# Appendiks II
# Støj-, LF- og skyggekastberegninger

**Til:**
**Miljøkonsekvensrapport**
Indeholdende miljøvurdering af det konkrete projekt

Belysning af de miljømæssige konsekvenser ved opstilling af en vindmølle på Thyborøn Sydhavn, Lemvig Kommune

**Maj 2022**

# Norre Nissum Bredning

# Noise Calculation

| | Name: | Date: | Signature: |
|---|---|---|---|
| **Written by:** | Dhanya Narayanan | 20220408 | DHNAY |
| **Reviewed by:** | Kiranamayee Behera | 20220408 | KABAA |
| **File name:** | 20220408_Noise Assessment _Norre Nissum Bredning.pdf | | |
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T13 0119-1247 Ver 03 - Approved- Exported from DMS: 2022-04-13 by TR

# Table of Content

# Comments to calculations

This Assessment has been completed based on the following:

- Neighboring WTG locations, WTG type, hub height and Noise sensitive location is provided by the customer in the data file named “DECIBEL_1 stk. SWT-7.0-154_120HH.pdf” has been used for the calculation and noise limit of 37dB and 39dB has been considered for 6m/s and 8m/s respectively for the noise sensitive location.

- 4 x V80-2.0MW HH78m + 4 x Bonus-2.3MW HH78.8m + 4 x SWT 7.0-154-7.0MW HH97.3m + 1 x SWT-7.0 154 - 7.0MW HH120m are considered in this calculation. No other existing turbines are included in the noise calculations.

- Generic source Noise Data has been used for the neighboring WTGs wherever applicable.

- The noise calculation has been carried out using the windPRO software.

## Remarks to the calculations:

The calculations have been performed according to the best practice.

Please check the user parameter settings in the attached reports. Any changes in these parameters will result in different calculated noise. Such changes might lead to a different operational solution for the turbines.

The calculation standards, the calculation settings and the detailed results of the noise calculations can be found in the attached report.

The results obtained are estimated values only. It is strongly advised that the Customer procures qualified third party advice.

Noise calculations performed must be considered as a guideline. Vestas does not warrant the results of any noise calculation. The only warranty on noise is in the contract.

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# DECIBEL - Main Result

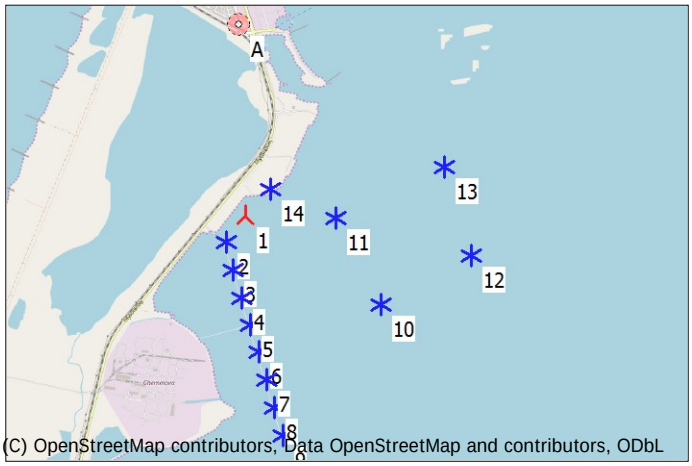
## Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs

Noise calculation model:
Danish 2019

The calculation is based on "BEK nr 135 af 07/02/2019" from the Danish Environmental Agency.

The noise impact from WTGs are not allowed to exceed the following limits: (Wind speeds in 10 m height)
1) At outdoor areas maximum 15 m from neighbor settlements in the open land.
a) 44 db(A) at wind speed 8 m/s.
b) 42 db(A) at wind speed 6 m/s.
2) At outdoor areas in residential or recreational areas.
a) 39 db(A) at wind speed 8 m/s in residential areas.
b) 37 db(A) at wind speed 6 m/s in residential areas.
The low frequency noise impact from WTGs are not allowed to exceed 20 dB indoor at wind speeds 8 and 6 m/s
The limits are not to be taken into acount for houses belonging to WTG owner

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




Scale 1:75,000

New WTG  Existing WTG  Noise sensitive area

## WTGs

| | Easting | Northing | Z | Row data/Description | WTG type Valid | Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | Noise data Creator | Name | First wind speed | LwaRef | | Last wind speed | LwaRef | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | | | | | [kW] | [m] | [m] | | | [m/s] | [dB(A)] | | [m/s] | [dB(A)] | |
| 1 | 452,160 | 6,281,227 | 0.0 | VESTAS V174-9.5 9500 1... | Yes | VESTAS | V174-9.5-9,500 | 9,500 | 174.0 | 130.0 | USER | Octave Data - 9.6MW | 6.0 | 112.1 | | 8.0 | 112.6 | |
| 2 | 451,967 | 6,280,967 | 0.0 | VESTAS V80-2.0MW 2000... | Yes | VESTAS | V80-2.0MW-2,000 | 2,000 | 80.0 | 78.0 | USER | Octave Data | 6.0 | 103.3 | | 8.0 | 105.3 | |
| 3 | 452,043 | 6,280,695 | 0.0 | VESTAS V80-2.0MW 2000... | Yes | VESTAS | V80-2.0MW-2,000 | 2,000 | 80.0 | 78.0 | USER | Octave Data | 6.0 | 103.3 | | 8.0 | 105.3 | |
| 4 | 452,122 | 6,280,420 | 0.0 | VESTAS V80-2.0MW 2000... | Yes | VESTAS | V80-2.0MW-2,000 | 2,000 | 80.0 | 78.0 | USER | Octave Data | 6.0 | 103.3 | | 8.0 | 105.3 | |
| 5 | 452,200 | 6,280,145 | 0.0 | VESTAS V80-2.0MW 2000... | Yes | VESTAS | V80-2.0MW-2,000 | 2,000 | 80.0 | 78.0 | USER | Octave Data | 6.0 | 103.3 | | 8.0 | 105.3 | |
| 6 | 452,277 | 6,279,880 | 0.0 | BONUS 2.3 MW 2300-400 ... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | EMD | Level 0 - -octave - 07-2003 | 6.0 | 104.0 | a | 8.0 | 107.0 | |
| 7 | 452,355 | 6,279,600 | 0.0 | BONUS 2.3 MW 2300-400 ... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | EMD | Level 0 - -octave - 07-2003 | 6.0 | 104.0 | a | 8.0 | 107.0 | |
| 8 | 452,433 | 6,279,330 | 0.0 | BONUS 2.3 MW 2300-400 ... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | EMD | Level 0 - -octave - 07-2003 | 6.0 | 104.0 | a | 8.0 | 107.0 | |
| 9 | 452,511 | 6,279,050 | 0.0 | BONUS 2.3 MW 2300-400 ... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | EMD | Level 0 - -octave - 07-2003 | 6.0 | 104.0 | a | 8.0 | 107.0 | |
| 10 | 453,510 | 6,280,335 | 0.0 | Siemens Gamesa SG 6.0-1... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 105.0 | f | 8.0 | 109.3 | a |
| 11 | 453,064 | 6,281,196 | 0.0 | Siemens Gamesa SG 6.0-1... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 105.0 | f | 8.0 | 109.3 | a |
| 12 | 454,407 | 6,280,817 | 0.0 | Siemens Gamesa SG 6.0-1... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 105.0 | f | 8.0 | 109.3 | a |
| 13 | 454,153 | 6,281,691 | 0.0 | Siemens Gamesa SG 6.0-1... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 105.0 | f | 8.0 | 109.3 | a |
| 14 | 452,415 | 6,281,494 | 0.0 | Siemens Gamesa SG 6.0-1... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 120.0 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 105.0 | f | 8.0 | 109.3 | a |

f) From other hub height
a) Generic data based on turbine power (very uncertain)

# Calculation Results

## Sound level

| Noise sensitive area | | | | | | Demands | Sound level | | Demands fulfilled ? |
|---|---|---|---|---|---|---|---|---|---|
| No. | Name | Easting | Northing | Z | Immission height | Wind speed | Noise | From WTGs | Distance to noise demand | Noise |
| | | | | [m] | [m] | [m/s] | [dB(A)] | [dB(A)] | [m] | |
| A | Ærøvej | 452,119 | 6,283,132 | 0.0 | 1.5 | 6.0 | 37.0 | 34.7 | 357 | Yes |
| A | | | | | | 8.0 | 39.0 | 37.5 | 254 | Yes |

## Distances (m)

| WTG | A |
|---|---|
| 1 | 1905 |
| 2 | 2170 |
| 3 | 2438 |
| 4 | 2712 |
| 5 | 2988 |
| 6 | 3256 |
| 7 | 3540 |
| 8 | 3815 |
| 9 | 4101 |
| 10 | 3124 |
| 11 | 2154 |
| 12 | 3255 |

To be continued on next page...

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## DECIBEL - Main Result

Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs

...continued from previous page

| WTG | A |
|---|---|
| 13 | 2493 |
| 14 | 1665 |

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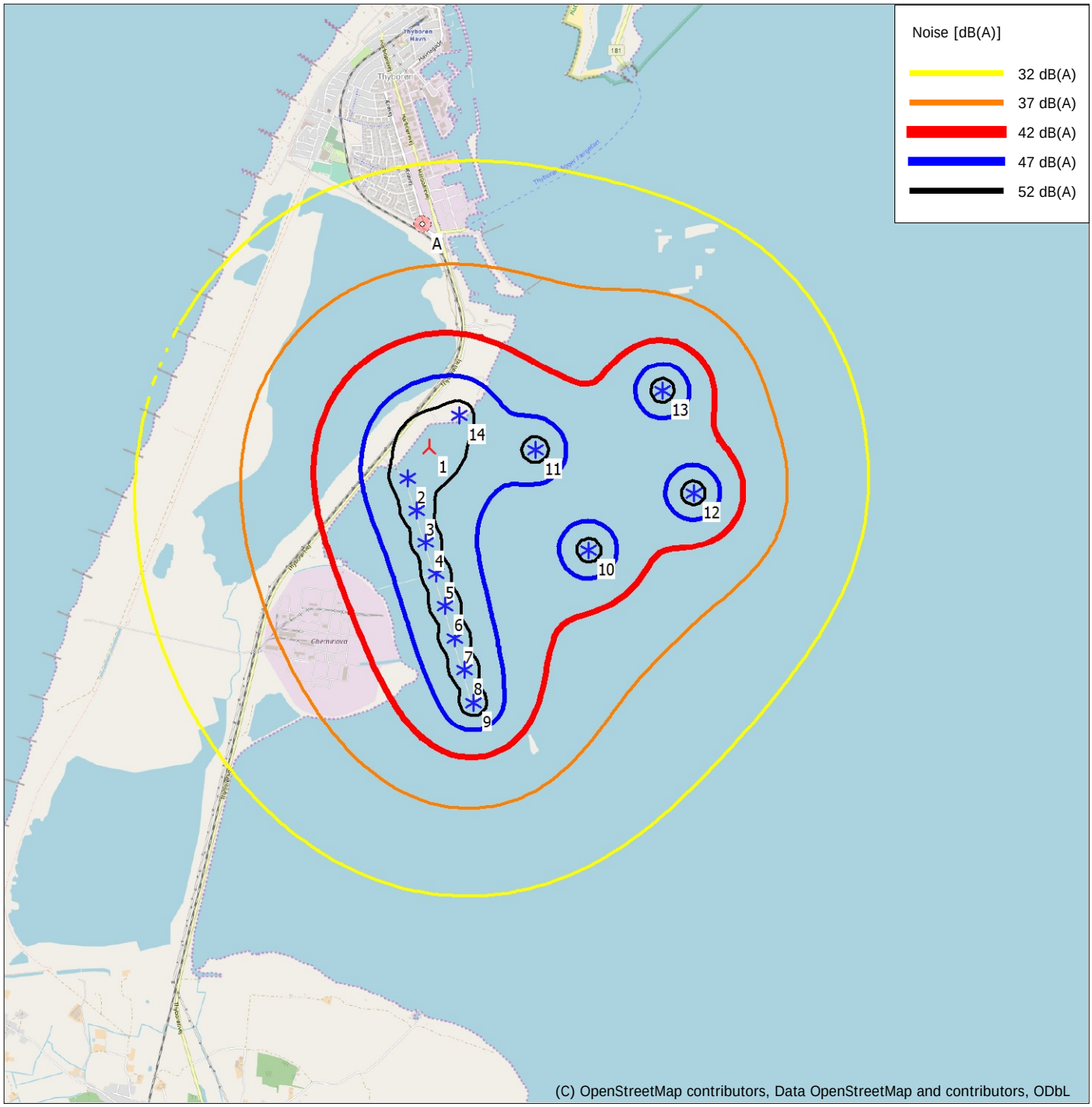
Calculated:
05/04/2022 15:20/3.5.552

# DECIBEL - Map 6.0 m/s

Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs




0 500 1000 1500 2000 m

Map: EMD OpenStreetMap , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 453,187 North: 6,280,370

New WTG | Existing WTG | Noise sensitive area

Noise calculation model: Danish 2019. Wind speed: 6.0 m/s
Height above sea level from active line object

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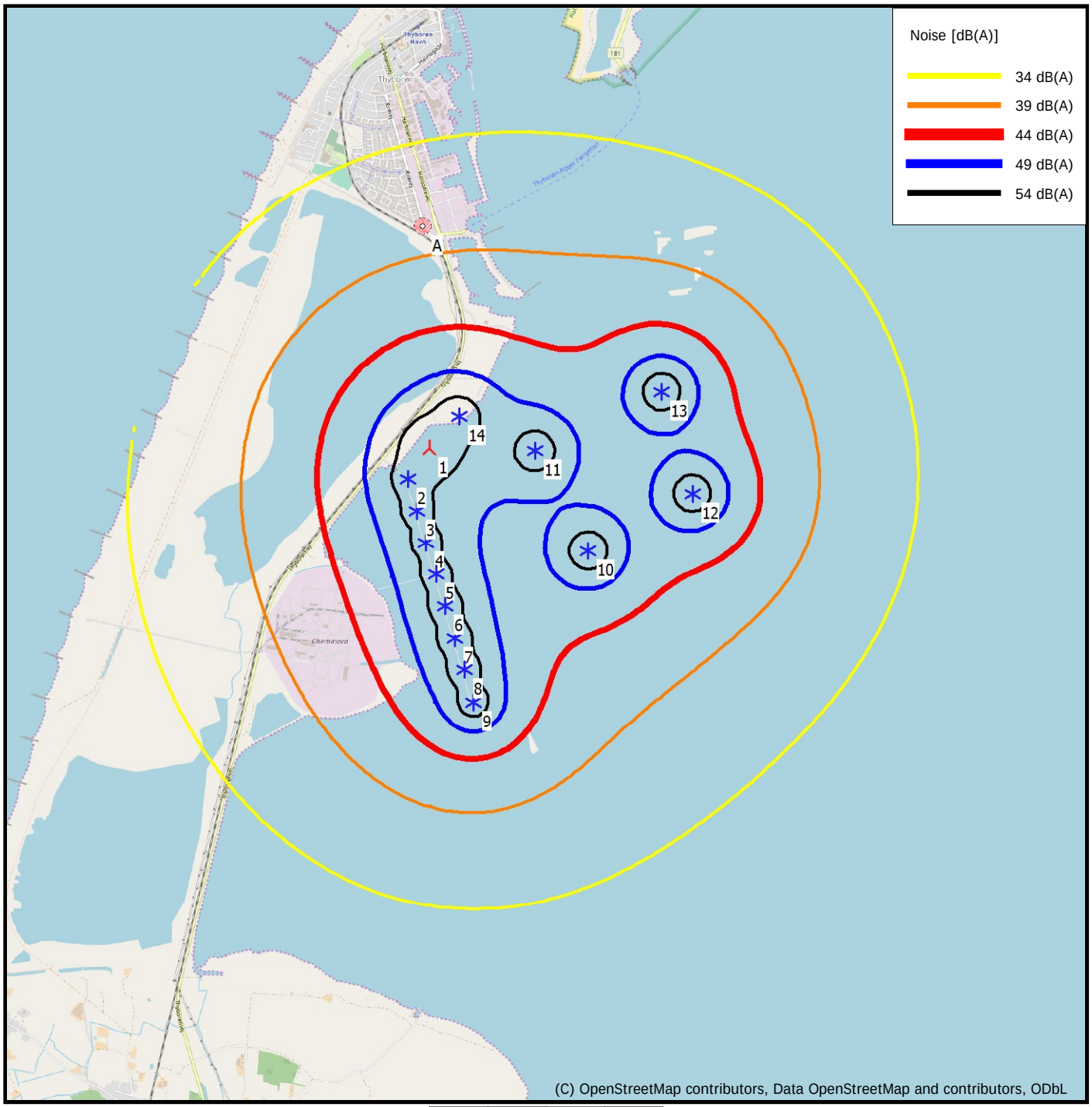
Calculated:
05/04/2022 15:20/3.5.552

# DECIBEL - Map 8.0 m/s

Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs




0 500 1000 1500 2000 m

Map: EMD OpenStreetMap , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 453,187 North: 6,280,370

New WTG | Existing WTG | Noise sensitive area

Noise calculation model: Danish 2019. Wind speed: 8.0 m/s
Height above sea level from active line object

# Norre Nissum Bredning

# Noise Calculation

| | Name: | Date: | Signature: |
|---|---|---|---|
| **Written by:** | Dhanya Narayanan | 20220408 | DHNAY |
| **Reviewed by:** | Kiranamayee Behera | 20220408 | KABAA |
| **File name:** | 20220408_Low frequency Noise Assessment _Norre Nissum Bredning.pdf | | |
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- 4 x V80-2.0MW HH78m + 4 x Bonus-2.3MW HH78.8m + 4 x SWT 7.0-154-7.0MW HH97.3m + 1 x SWT-7.0 154 - 7.0MW HH120m are considered in this calculation. No other existing turbines are included in the noise calculations.

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- The noise calculation has been carried out using the windPRO software.

### Remarks to the calculations:

The calculations have been performed according to the best practice.

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Noise calculations performed must be considered as a guideline. Vestas does not warrant the results of any noise calculation. The only warranty on noise is in the contract.

Project:
Norre Nissum Bredning

Description:
Auto generated project

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Calculated:
08/04/2022 17:03/3.5.552

# DECIBEL - Main Result

## Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs_lf

Noise calculation model:
Danish low frequency 2019

The calculation is based on "BEK nr 135 af 07/02/2019" from the Danish Environmental Agency.

The noise impact from WTGs are not allowed to exceed the following limits: (Wind speeds in 10 m height)
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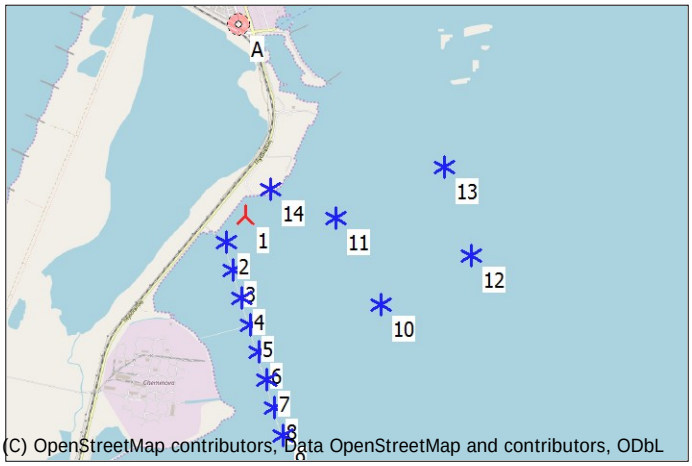
a) 44 db(A) at wind speed 8 m/s.
b) 42 db(A) at wind speed 6 m/s.
2) At outdoor areas in residential or recreational areas.
a) 39 db(A) at wind speed 8 m/s in residential areas.
b) 37 db(A) at wind speed 6 m/s in residential areas.
The low frequency noise impact from WTGs are not allowed to exceed 20 dB indoor at wind speeds 8 and 6 m/s
The limits are not to be taken into acount for houses belonging to WTG owner
Den lavfrekvente støj beregnes indendøre og må ikke overstige 20 dB ved vindhastigheder på 6 og 8 m/s i 10 m højde

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




Scale 1:75,000

New WTG  Existing WTG  Noise sensitive area

### WTGs

| | Easting | Northing | Z | Row data/Description | WTG type Valid | Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | Noise data Creator | Name | First wind speed | LwaRef | | Last wind speed | LwaRef | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | | | | | [kW] | [m] | [m] | | | [m/s] | [dB(A)] | | [m/s] | [dB(A)] | |
| 1 | 452,160 | 6,281,227 | 0.0 | VESTAS V174-9.5 9500 174.... | Yes | VESTAS | V174-9.5-9,500 | 9,500 | 174.0 | 130.0 | USER | Octave Data - 9.6MW | 6.0 | 97.7 | | 8.0 | 99.1 | |
| 2 | 451,967 | 6,280,967 | 0.0 | VESTAS V80-2.0MW offshor... | Yes | VESTAS | V80-2.0MW offshore-2,000 | 2,000 | 80.0 | 78.0 | EMD | Level 0 - -106.4 dB -03-2008 | 6.0 | 92.9 | b | 8.0 | 95.2 | b |
| 3 | 452,043 | 6,280,695 | 0.0 | VESTAS V80-2.0MW offshor... | Yes | VESTAS | V80-2.0MW offshore-2,000 | 2,000 | 80.0 | 78.0 | EMD | Level 0 - -106.4 dB -03-2008 | 6.0 | 92.9 | b | 8.0 | 95.2 | b |
| 4 | 452,122 | 6,280,420 | 0.0 | VESTAS V80-2.0MW offshor... | Yes | VESTAS | V80-2.0MW offshore-2,000 | 2,000 | 80.0 | 78.0 | EMD | Level 0 - -106.4 dB -03-2008 | 6.0 | 92.9 | b | 8.0 | 95.2 | b |
| 5 | 452,200 | 6,280,145 | 0.0 | VESTAS V80-2.0MW offshor... | Yes | VESTAS | V80-2.0MW offshore-2,000 | 2,000 | 80.0 | 78.0 | EMD | Level 0 - -106.4 dB -03-2008 | 6.0 | 92.9 | b | 8.0 | 95.2 | b |
| 6 | 452,277 | 6,279,880 | 0.0 | BONUS 2.3 MW 2300-400 8... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | EMD | Level 0 - -octave - 07-2003 | 6.0 | 92.9 | a | 8.0 | 95.2 | a |
| 7 | 452,355 | 6,279,600 | 0.0 | BONUS 2.3 MW 2300-400 8... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | EMD | Level 0 - -octave - 07-2003 | 6.0 | 92.9 | a | 8.0 | 95.2 | a |
| 8 | 452,433 | 6,279,330 | 0.0 | BONUS 2.3 MW 2300-400 8... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | EMD | Level 0 - -octave - 07-2003 | 6.0 | 92.9 | a | 8.0 | 95.2 | a |
| 9 | 452,511 | 6,279,050 | 0.0 | BONUS 2.3 MW 2300-400 8... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | EMD | Level 0 - -octave - 07-2003 | 6.0 | 92.9 | a | 8.0 | 95.2 | a |
| 10 | 453,510 | 6,280,335 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 92.9 | a | 8.0 | 95.2 | a |
| 11 | 453,064 | 6,281,196 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 92.9 | a | 8.0 | 95.2 | a |
| 12 | 454,407 | 6,280,817 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 92.9 | a | 8.0 | 95.2 | a |
| 13 | 454,153 | 6,281,691 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 92.9 | a | 8.0 | 95.2 | a |
| 14 | 452,415 | 6,281,494 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 120.0 | EMD | (AM 0, 6.6MW) - 105dB(A) | 6.0 | 92.9 | a | 8.0 | 95.2 | a |

b) Data from Danish Environmental Agency
a) Generic data based on turbine power (very uncertain)

# Calculation Results

## Sound level

| Noise sensitive area No. | Name | Easting | Northing | Z [m] | Immission height [m] | Wind speed [m/s] | Demands Noise [dB(A)] | Sound level From WTGs [dB(A)] | Distance to noise demand [m] | Demands fulfilled ? Noise |
|---|---|---|---|---|---|---|---|---|---|---|
| A | Ærøvej_Lf | 452,119 | 6,283,132 | 0.0 | 1.5 | 6.0 | 20.0 | 9.6 | 1,404 | Yes |
| A | | | | | | 8.0 | 20.0 | 12.0 | 1,250 | Yes |

## Distances (m)

| WTG | A |
|---|---|
| 1 | 1905 |
| 2 | 2170 |
| 3 | 2438 |
| 4 | 2712 |
| 5 | 2988 |
| 6 | 3256 |
| 7 | 3540 |
| 8 | 3815 |
| 9 | 4101 |
| 10 | 3124 |
| 11 | 2154 |
| 12 | 3255 |
| 13 | 2493 |
| 14 | 1665 |

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08/04/2022 17:03/3.5.552

# DECIBEL - Map 6.0 m/s Regular dwellings

Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs_lf


0 500 1000 1500 2000 m

Map: EMD OpenStreetMap , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 453,187 North: 6,280,370

New WTG  Existing WTG  Noise sensitive area

Noise calculation model: Danish low frequency 2019. Wind speed: 6.0 m/s Regular dwellings
Height above sea level from active line object

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Calculated:
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# DECIBEL - Map 6.0 m/s Cottage zones

Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs_lf


0 500 1000 1500 2000 m

Map: EMD OpenStreetMap , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 453,187 North: 6,280,370

New WTG | Existing WTG | Noise sensitive area

Noise calculation model: Danish low frequency 2019. Wind speed: 6.0 m/s Cottage zones
Height above sea level from active line object

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Calculated:
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# DECIBEL - Map 8.0 m/s Regular dwellings

Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs_lf


0 500 1000 1500 2000 m

Map: EMD OpenStreetMap , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 453,187 North: 6,280,370

New WTG  Existing WTG  Noise sensitive area

Noise calculation model: Danish low frequency 2019. Wind speed: 8.0 m/s Regular dwellings
Height above sea level from active line object

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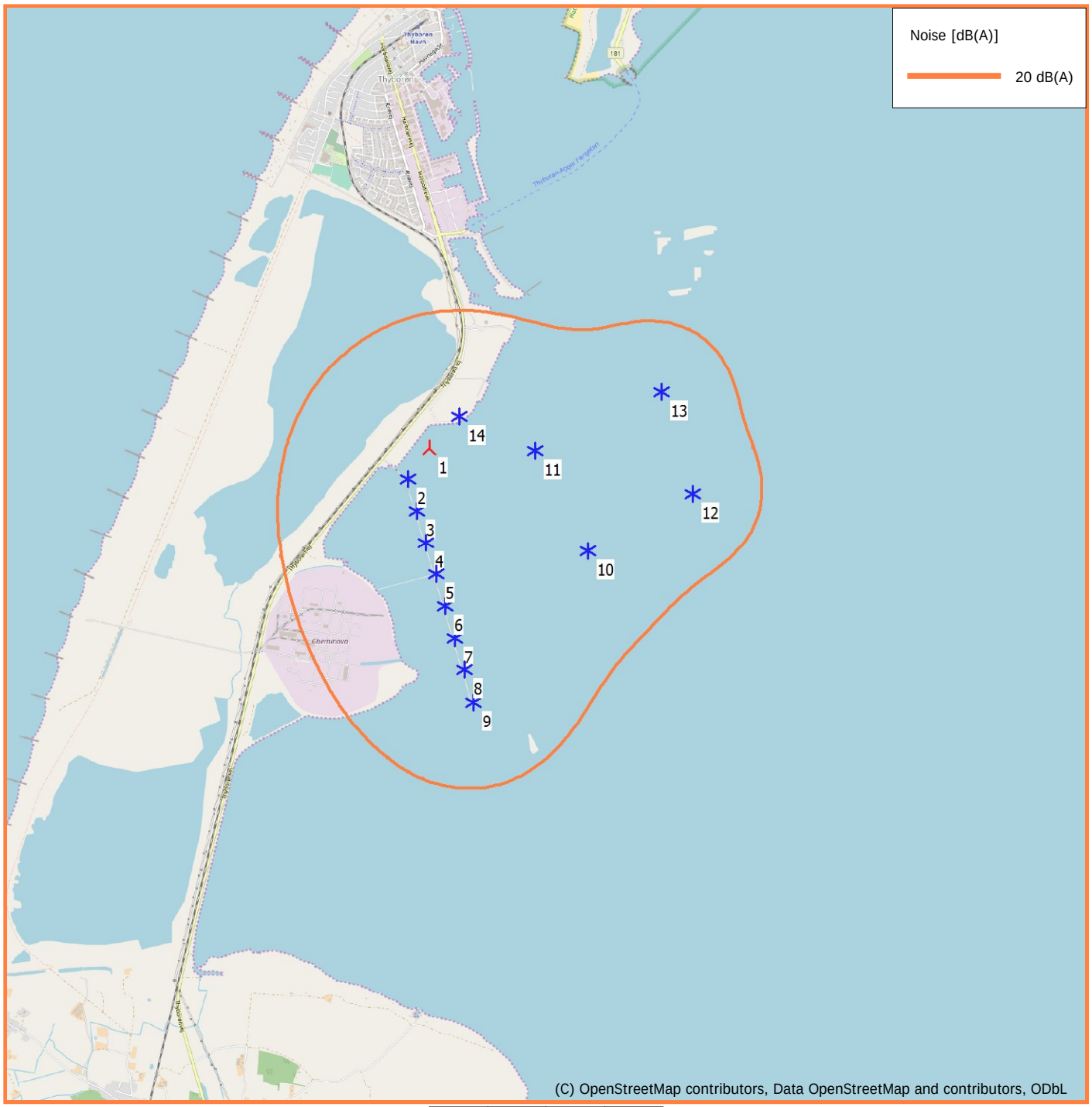
Calculated:
08/04/2022 17:03/3.5.552

# DECIBEL - Map 8.0 m/s Cottage zones

Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs_lf




0 500 1000 1500 2000 m

Map: EMD OpenStreetMap , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 453,187 North: 6,280,370

New WTG  Existing WTG  Noise sensitive area

Noise calculation model: Danish low frequency 2019. Wind speed: 8.0 m/s Cottage zones
Height above sea level from active line object

# Norre Nissum Bredning
# Shadow Calculation

## 1 X V174-9.6 MW HH130m

| | Name: | Date: | Signature: |
|---|---|---|---|
| **Written by:** | Dhanya Narayanan | 2022-04-08 | DHNAY |
| **Reviewed by:** | Kiranamayee behere | 2022-04-08 | KABAA |
| **File name:** | 20220408_Norre Nissum Bredning_Shadow Report.pdf | | |
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# Comments to calculation

This report contains shadow calculation for Norre Nissum Bredning, Denmark and the assessment has been completed based on the following:

- Neighboring WTG locations, WTG type and hub height for the turbines are provided by the customer in the file named “DECIBEL_1 stk. SWT-7.0-154_120HH.pdf” have been used for shadow calculation on the the following pages.
- Coordinates and settings of the shadow receptor are provided by the customer in the data file named “SHADOW_1 stk. SWT-7.0-154_120HH”.
- The shadow calculation has been carried out using the windPRO software.

The calculations have been performed according to the best practice. Please check the user parameter settings in the attached reports. Any changes in these parameters will result in different calculated hours.

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Dhanya / dhnay@vestas.com
Calculated:
08/04/2022 13:57/3.5.552

# SHADOW - Main Result

## Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs

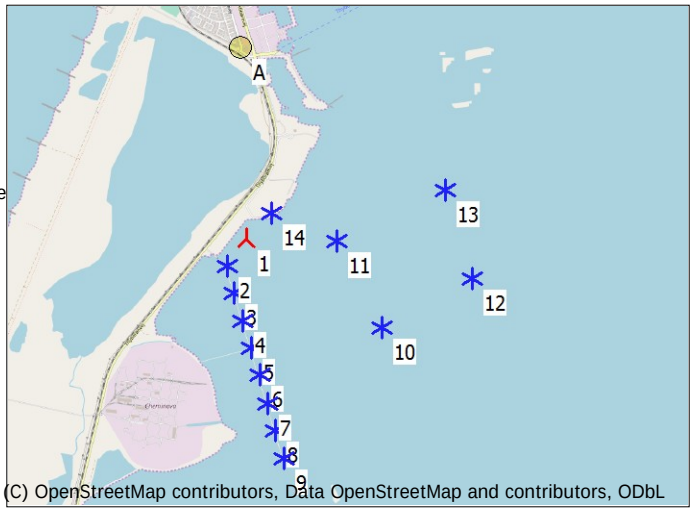
### Assumptions for shadow calculations

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

| | |
|---|---|
| Minimum sun height over horizon for influence | 3 ° |
| Day step for calculation | 1 days |
| Time step for calculation | 1 minutes |
| Time series from: | WTG 10min data_16888 (Matrix MCP using Mesoscale Point)_wake |
| Start date | 01/10/2000 |
| Sun shine signal: Mean wind speed | |
| Threshold | > 0.00 |
| Mean wind speed in hub height for all WTGs | 0.0 m/s |

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Height Contours: CONTOURLINE_CopernicusDEM_0.map (1)
Obstacles used in calculation
Receptor grid resolution: 1.0 m

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




Scale 1:75,000
New WTG  Existing WTG  Shadow receptor

### WTGs

| | Easting | Northing | Z | Row data/Description | WTG type Valid | Manufact. | Type-generator | Power, rated | Rotor diameter | Hub height | Shadow data Calculation distance | RPM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | | | | | [kW] | [m] | [m] | [m] | [RPM] |
| 1 | 452,160 | 6,281,227 | 0.0 | V174-9.5MW-MK3A-N/A hub... | Yes | Vestas | V174-9.5MW-MK3A-N/A: Power Mode 9.6 MW (Running as: 9.6MW)-9,600 | 9,600 | 174.0 | 130.0 | 2,500 | 0.0 |
| 2 | 451,967 | 6,280,967 | 0.0 | VESTAS V80-2.0MW offshor... | Yes | VESTAS | V80-2.0MW offshore-2,000 | 2,000 | 80.0 | 78.0 | 1,582 | 18.1 |
| 3 | 452,043 | 6,280,695 | 0.0 | VESTAS V80-2.0MW offshor... | Yes | VESTAS | V80-2.0MW offshore-2,000 | 2,000 | 80.0 | 78.0 | 1,582 | 18.1 |
| 4 | 452,122 | 6,280,420 | 0.0 | VESTAS V80-2.0MW offshor... | Yes | VESTAS | V80-2.0MW offshore-2,000 | 2,000 | 80.0 | 78.0 | 1,582 | 18.1 |
| 5 | 452,200 | 6,280,145 | 0.0 | VESTAS V80-2.0MW offshor... | Yes | VESTAS | V80-2.0MW offshore-2,000 | 2,000 | 80.0 | 78.0 | 1,582 | 18.1 |
| 6 | 452,277 | 6,279,880 | 0.0 | BONUS 2.3 MW 2300-400 8... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | 1,354 | 17.0 |
| 7 | 452,355 | 6,279,600 | 0.0 | BONUS 2.3 MW 2300-400 8... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | 1,354 | 17.0 |
| 8 | 452,433 | 6,279,330 | 0.0 | BONUS 2.3 MW 2300-400 8... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | 1,354 | 17.0 |
| 9 | 452,511 | 6,279,050 | 0.0 | BONUS 2.3 MW 2300-400 8... | No | BONUS | 2.3 MW-2,300/400 | 2,300 | 82.4 | 78.8 | 1,354 | 17.0 |
| 10 | 453,510 | 6,280,335 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | 2,008 | 9.3 |
| 11 | 453,064 | 6,281,196 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | 2,008 | 9.3 |
| 12 | 454,407 | 6,280,817 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | 2,008 | 9.3 |
| 13 | 454,153 | 6,281,691 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 97.3 | 2,008 | 9.3 |
| 14 | 452,415 | 6,281,494 | 0.0 | Siemens Gamesa SG 6.0-155... | Yes | Siemens Gamesa | SG 6.0-155-6,600 | 6,600 | 155.0 | 120.0 | 2,006 | 9.3 |

### Shadow receptor-Input

| No. | Easting | Northing | Z | Width | Height | Elevation a.g.l. | Slope of window | Direction mode | Eye height (ZVI) a.g.l. |
|---|---|---|---|---|---|---|---|---|---|
| | | | [m] | [m] | [m] | [m] | [°] | | [m] |
| A | 452,129 | 6,283,132 | 0.0 | 15.0 | 15.0 | 1.0 | 0.0 | "Green house mode" | 1.0 |

### Calculation Results

Shadow receptor

| No. | Shadow, expected values Shadow hours per year [h/year] |
|---|---|
| A | 0:00 |

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

| No. | Name | Worst case [h/year] | Expected [h/year] |
|---|---|---|---|
| 1 | V174-9.5MW-MK3A-N/A hub: 130.0 m (TOT: 217.0 m) (25) | 0:00 | 0:00 |
| 2 | VESTAS V80-2.0MW offshore 2000 80.0 !O! hub: 78.0 m (TOT: 118.0 m) (1) | 0:00 | 0:00 |
| 3 | VESTAS V80-2.0MW offshore 2000 80.0 !O! hub: 78.0 m (TOT: 118.0 m) (2) | 0:00 | 0:00 |
| 4 | VESTAS V80-2.0MW offshore 2000 80.0 !O! hub: 78.0 m (TOT: 118.0 m) (3) | 0:00 | 0:00 |
| 5 | VESTAS V80-2.0MW offshore 2000 80.0 !O! hub: 78.0 m (TOT: 118.0 m) (4) | 0:00 | 0:00 |
| 6 | BONUS 2.3 MW 2300-400 82.4 !O! hub: 78.8 m (TOT: 120.0 m) (5) | 0:00 | 0:00 |

To be continued on next page...

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## SHADOW - Main Result

### Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs

...continued from previous page

| No. | Name | Worst case [h/year] | Expected [h/year] |
|---|---|---|---|
| 7 | BONUS 2.3 MW 2300-400 82.4 !O! hub: 78.8 m (TOT: 120.0 m) (6) | 0:00 | 0:00 |
| 8 | BONUS 2.3 MW 2300-400 82.4 !O! hub: 78.8 m (TOT: 120.0 m) (7) | 0:00 | 0:00 |
| 9 | BONUS 2.3 MW 2300-400 82.4 !O! hub: 78.8 m (TOT: 120.0 m) (8) | 0:00 | 0:00 |
| 10 | Siemens Gamesa SG 6.0-155 6600 155.0 !O! hub: 97.3 m (TOT: 174.8 m) (9) | 0:00 | 0:00 |
| 11 | Siemens Gamesa SG 6.0-155 6600 155.0 !O! hub: 97.3 m (TOT: 174.8 m) (10) | 0:00 | 0:00 |
| 12 | Siemens Gamesa SG 6.0-155 6600 155.0 !O! hub: 97.3 m (TOT: 174.8 m) (11) | 0:00 | 0:00 |
| 13 | Siemens Gamesa SG 6.0-155 6600 155.0 !O! hub: 97.3 m (TOT: 174.8 m) (12) | 0:00 | 0:00 |
| 14 | Siemens Gamesa SG 6.0-155 6600 155.0 !O! hub: 120.0 m (TOT: 197.5 m) (22) | 0:00 | 0:00 |

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

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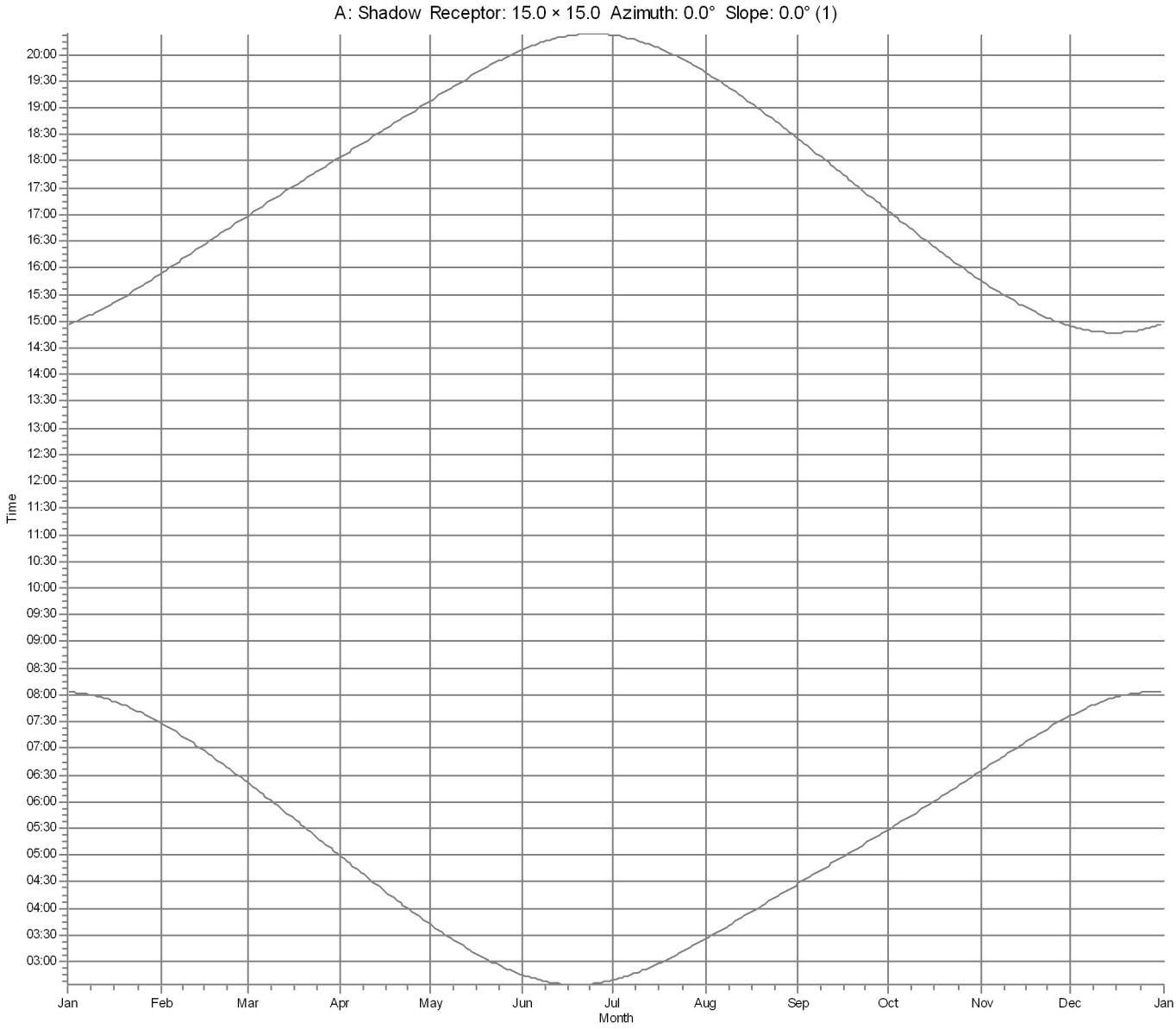
## SHADOW - Calendar, graphical

Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGsShadow receptor: A - Shadow Receptor: 15.0 × 15.0 Azimuth: 0.0° Slope: 0.0° (1)




WTGs

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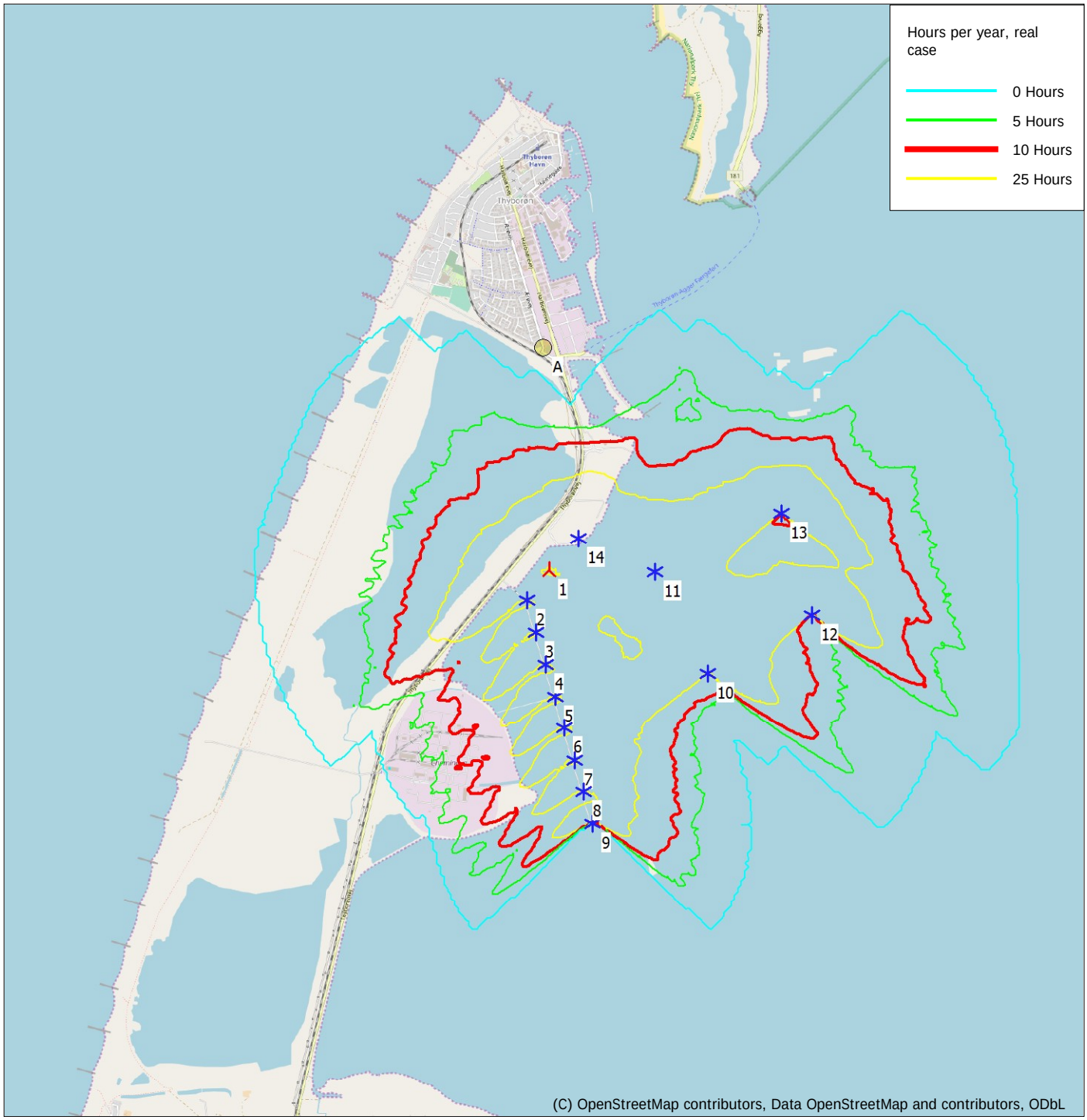
Calculated:
08/04/2022 13:57/3.5.552

## SHADOW - Map

Calculation: L8_1 x V174-9.6MW HH130m + nearby WTGs




0 500 1000 1500 2000 m

Map: EMD OpenStreetMap , Print scale 1:50,000, Map center UTM (north)-WGS84 Zone: 32 East: 452,160 North: 6,281,370

New WTG  Existing WTG  Shadow receptor

Flicker map level: Height Contours: CONTOURLINE_CopernicusDEM_0.map (1)

Time step: 4 minutes, Day step: 14 days, Map resolution: 30 m, Visibility resolution: 15 m, Eye height: 1.0 m