D NOISE IMPACT ASSESSMENT

WISOKOLAMSON ENERGY LP

WISOKOLAMSON ENERGY PROJECT

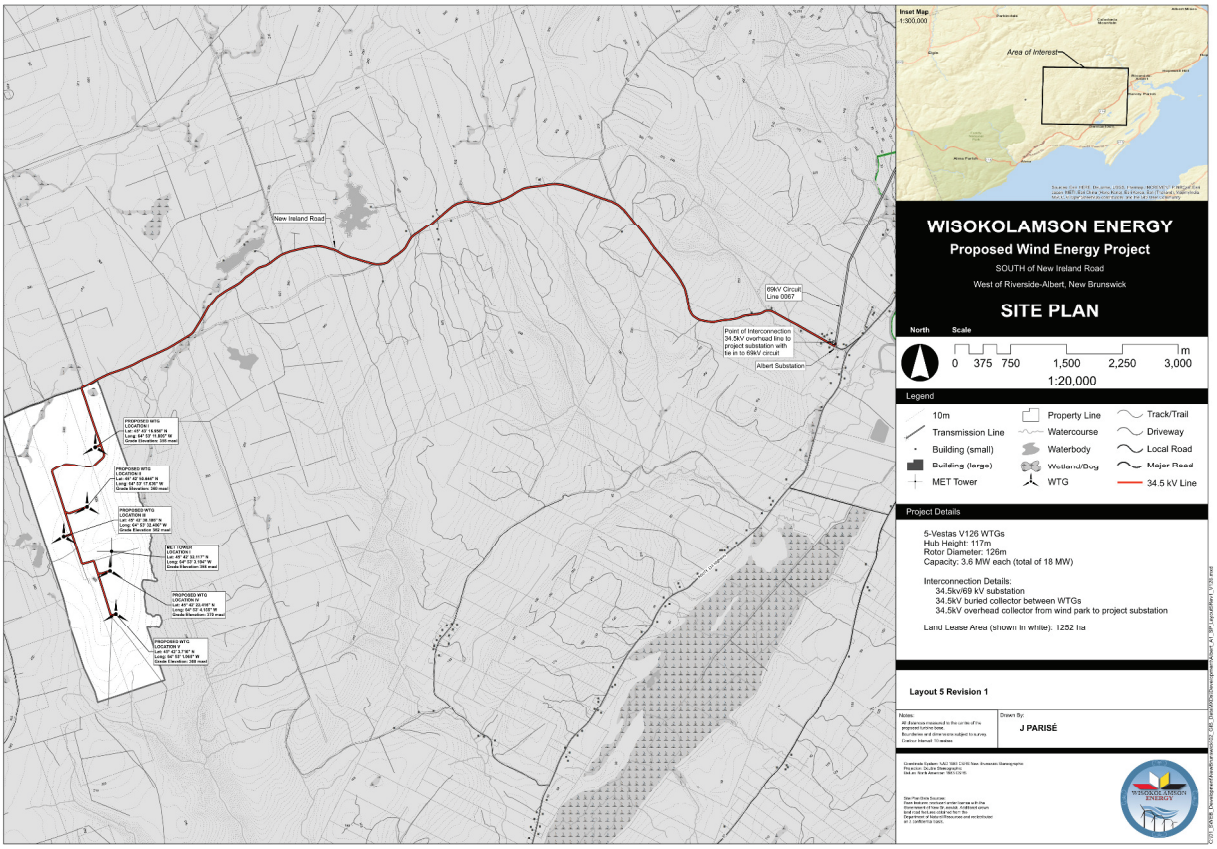
NOISE IMPACT ASSESSMENT

ALBERT COUNTY, NEW BRUNSWICK

WSP REF.: 161-08790-00

DATE : 12 APRIL 2018

CONFIDENTIAL



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REPORT (FINAL VERSION)

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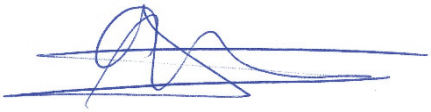

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1 INTRODUCTION

1.1 CONTEXT

Wisokolamson Energy LP (WISK) is undertaking the development of a five (5) wind turbine generators (WTGs), 18 MW wind energy project, west of Riverside-Albert in Albert County, New Brunswick.

WSP Canada Inc. (WSP) was retained by WISK to complete a Noise Impact Assessment (NIA) for the wind energy project (the Project).

The purpose of the NIA is to determine the potential noise impact resulting from the Project's operation, and the Project's compliance with the New Brunswick Department of Environment and Local Government's (NBDELG) Environment Impact Assessment (EIA) Sector Guidelines for Wind Turbines [1].

1.2 PROJECT DETAILS

The Project includes the installation of five (5) WTGs (Vestas V126, 3.6 MW each). The five WTG locations are positioned in one cluster, south of New Ireland Road, west of Riverside-Albert. The Project's substation will be located at the base of New Ireland Road, opposite the existing NB Power-operated Albert substation (see Figure 1).

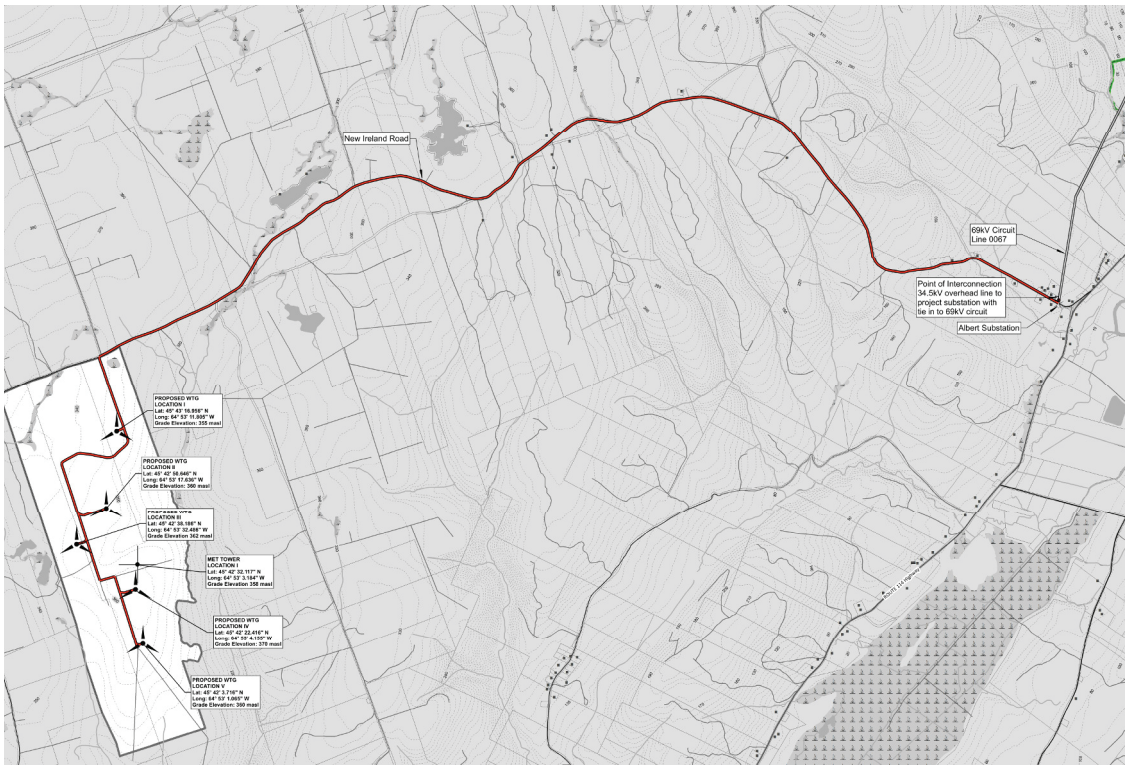


Figure 1 Project Location

2 EXISTING ACOUSTIC ENVIRONMENT

The existing acoustic environment surrounding the Project site, was determined by way of an ambient sound measuring campaign.

2.1 DATA COLLECTION

Ambient sound levels were measured at four (4) receptor locations over a 24-hour period. Sound level data was collected on November 1st, 2017, from midnight to midnight the following day.

The receptor points are located at the following locations:

- Receptor R1: cabin located south of New Ireland Road at 45°43’45’’ N | 64°52’47’’ W;
- Receptor R2: warming shack located next to Kent Road intersection at 45°43’43’’ N | 64°53’16’’ W;
- Receptor R3: located by Priest Lake at 45°42’25’’ N | 64°53’47’’ W, which corresponds to a recreational use;
- Receptor R4: located by New Ireland Road, next to the proposed substation location at 45°43’56’’ N | 64°45’30’’ W.

Receptor R3 doesn’t correspond to an existing residential building but was selected for the sensitive aspect of the area, as per NBDELG guidelines for wind turbines which specify that a noise impact study is required for all noise sensitive locations surrounding the project, including recreational, residential and institutional uses.

Receptor R4 was selected in order to characterize the existing ambient sound in the vicinity of the proposed substation. This receptor is representative of the sound climate of the inhabited areas surrounding the proposed substation.

The microphones were located away from any large reflecting surfaces and approximately 1.5 m above ground. Sound measurements were performed using the following sound level meters and an acoustic calibrator:

- Larson Davis sound level meters, models LXT, SN: 2611, 4823, 4824 and 4826;
- Larson Davis precision acoustic calibrator, model CAL200.

The sound level meters meet the IEC 61672 Class I specifications. All instruments had a valid calibration certificate issued by an independent laboratory.

Site calibration was also performed at the beginning and end of the monitoring period. The differential calibration did not exceed 0.5 dBA.

2.2 ANALYSIS AND RESULTS

Sound measurements were analyzed and extraordinary events (such as people speaking and animal noises close to the microphone or helicopters flying overhead, etc.), were excluded from the analysis.

Table 1 presents a summary of the ambient sound measurement results. Sound evolutions are presented in Appendix A.

Table 1 Summary of Ambient Sound Levels

Receptor	$L_{Aeq, 24h}$ (dBA)[1]	$L_{Aeq, 1h\ min}$ (dBA)[2]	$L_{Aeq, 1h\ max}$ (dBA)[3]
R1	30	25	35
R2	36	23	44
R3	32	23	40
R4	40	34	44

1 $L_{Aeq, 24h}$: equivalent continuous sound level over the 24 hour period, in dBA;
2 $L_{Aeq, 1h\ min}$: minimum 1 hour equivalent continuous sound level, in dBA;
3 $L_{Aeq, 1h\ max}$: maximum 1 hour equivalent continuous sound level, in dBA.

The existing acoustic environment surrounding the Project site is characterized as mainly quiet, with the dominant sound being natural sources (wind, birds, etc.), and an occasional contribution from local road traffic. The sound contribution from road traffic is greater at receptor R4 (proposed substation), as R4 is close to Road NB-104 and New Ireland Road.

3 SOUND LEVEL CRITERIA

3.1 WIND TURBINE NOISE

NBDELG recommends sound criteria for wind turbines in the EIA Sector Guidelines for Wind Turbines [1]. These guidelines suggest that a noise impact assessment should be performed for all sensitive receptors within 1 km of the nearest projected WTG, to show compliance with the criteria presented in Table 2.

Table 2 Recommended Sound Criteria for Wind Turbines

Wind Speed (m/s)	4	5	6	7	8	9	10	11
Wind Turbine Noise Criteria (dBA)	40	40	40	43	45	49	51	53

3.2 SUBSTATION NOISE

The EIA Sector Guidelines for Wind Turbines does not discuss substation noise requirements. In addition, to WSP's knowledge, neither the city, the county, nor the province of New Brunswick regulates outdoor noise. Therefore, the following sections aim to discuss information gathered from various documents to establish a sound level criteria which could be applied to the substation noise.

3.2.1 HEALTH CANADA

Health Canada does not intend to regulate noise by providing threshold limits that should not be exceeded. Rather, the organization aims to provide information on the potential impact of noise on health, providing guidelines which indicate values and criteria to evaluate during the completion of a noise impact study. Thus, in the « Health Canada Noise Impact Assessment Guidance for Environmental Assessment » [2], a method is described for the preparation of impact assessments of noise on health. This method uses the different possible interactions of sound with a human being and provides recommendations on threshold noise levels to mitigate potential concerns or impacts relating to the following: hearing loss caused by exposure to noise, sleep disturbance, interference with speech comprehension, noise complaints, and elevated discomfort.

Health Canada recommends a night-time continuous noise level $L_{n,\,int}$[1,2] (background noise outside of a specific event) below 30 dBA inside the bedroom of a dwelling or receptor. Given that it is common to sleep with windows slightly open (acoustical isolation of approximately 15 dBA), recommendations imply that 45 dBA $L_{n,\,ext}$[3] (continuous) is acceptable for outdoor noise.

This same document defines criteria for « Highly Annoyed Percentage », HA%. This criteria considers a collection of parameters from the noise climate (i.e. type of noise, impulsive or very impulsive noise, tone, low frequency, etc.) and allows for the comparison of two situations to evaluate the variation of the quality of a noise environment. A HA% criterion increase of over 6.5% is considered problematic and requires a solution implementation plan for the reduction of noise.

[1] L_n: night-time continuous noise level, between 10 pm and 7 am.
[2] $_{int}$: prefix signifying interior, to specify that the noise level is evaluated inside the bedroom of a dwelling or receptor.
[3] $_{ext}$: prefix signifying exterior, to specify that the noise level is evaluated outside the dwelling or receptor.

3.2.2 WORLD HEALTH ORGANIZATION

The proposed thresholds proposed by Health Canada are consistent with those provided by the World Health Organization (WHO) in the « Guidelines for Community Noise » [3] document.

The WHO has also more recently published the document « Night Noise Guidelines for Europe » [4] which presents the findings from a large number of studies on the annoyance due to noise in exterior $L_{n,\,ext}$ of 40 dBA and a maximal limit of 55 dBA. This maximum limit is a compromise, taking into consideration the imperatives of urban planning, but implies a possible impact on the quality of sleep of inhabitants, specifically those who are most vulnerable (children, chronic illnesses, senior citizens, etc.).

3.2.3 SELECTED CRITERIA

Following a review of the documents noted in this section, WSP proposes a substation noise limit of 45 dBA at the window panes or facades of nearby dwellings.

4 NOISE IMPACT ASSESSMENT

4.1 METHODOLOGY

The dispersion and attenuation of sound in the atmosphere is modelled using algorithms based on the conversion of energy and the absorption of the expanding sound waves by the atmosphere and barriers in the path. The SoundPLAN® version 7.4 software was used to conduct the Project's sound modelling.

The Project's sound contribution at each sensitive receptor was calculated based on the ISO 9613-2 model. This noise propagation model is widely accepted as an appropriate model for the assessment of wind farms when appropriate inputs are used. The ISO 9613-2 model has the ability to take into account the distance between the source and receptor, topography, hardness of the ground and atmospheric absorption at different frequencies.

The ISO 9613-2 model is based on meteorological conditions favourable to sound propagation. According to the standard these conditions are for downwind propagation, or, equivalently, propagation under a well-developed moderate ground-based temperature inversion.

The assessment has been based on the following inputs.

4.1.1 METEOROLOGICAL FACTORS

The following meteorological conditions were considered for the NIA:

- Ambient air temperature: 10°C;
- Ambient barometric pressure: 101.32 kPa;
- Relative humidity: 70%.

These are the standard values recommended as per ISO 9613-2 as they maximize sound transmission.

4.1.2 TERRAIN AND VEGETATION

The following inputs were considered:

- Local topography;
- Global ground absorption factor: 0.7.

The ground absorption factor is a decimal value varying from 0 (perfect reflection) to 1.0 (perfect absorption).

4.1.3 WIND TURBINE SOUND LEVEL

Vestas V126 – 3.6 MW WTGs with a 117 m hub height will be used for the Project. Blades will not have serrated trailing edges. The WTG's broadband and third-octave band sound power levels were provided by Vestas, the turbine manufacturer. The acoustic emission levels used in this assessment are shown in Table 3.

Table 3 Vestas V126 – 3.6 MW – Sound Power Levels – Mode PO1-0S (Blades without Serrated Trailing Edge)

Wind Speed (m/s)	4	5	6	7	8	9	10	11
Broadband sound power level (dBA)	92.3	94.4	98.0	101.6	105.0	107.6	108.0	108.0

At this stage in the Project's development, the substation design is not yet complete. Nevertheless the transformer specifications are expected to be 12/16/20 MVA based on ONAN/ONAF/OFAF modes. With these preliminary specifications, it is possible to establish the sound emission level of such a transformer, from a known empirical formula[4]. For a 20 MVA transformer, the sound pressure level at 150 m would be 37 dBA (which is also equivalent to 42 dBA at 80 m and 45 dBA at 60 m).

4.1.4 RECEPTORS

The noise sensitive receptors include the locations (including recreational, residential and institutional) that are located within 1 km of the nearest turbine. There are three (3) noise sensitive receptors located within 1 km of the Project, corresponding with the three measuring locations R1, R2 and R3. The receptor locations, with respect to the wind turbines, are presented in Figure 2.

[4] Noise and Vibration Control Engineering, Second edition, I. L. Vér and L. L. Beranek, 2005.

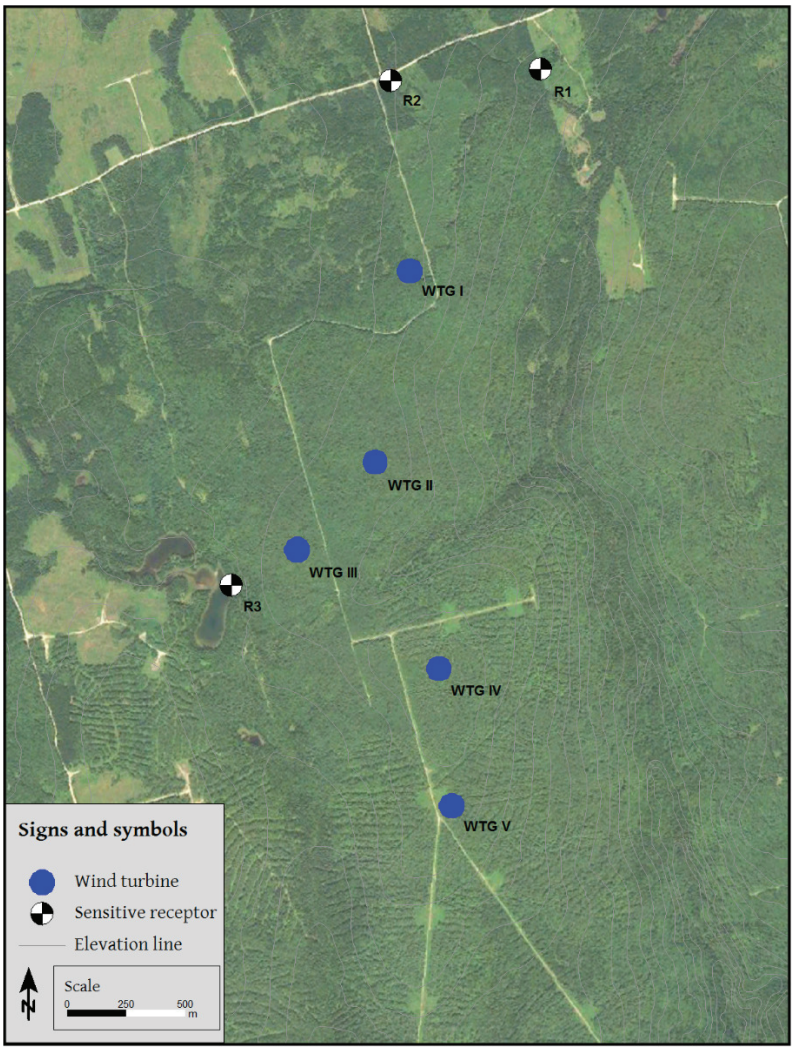


Figure 2 Receptor Locations with Respect to the Wind Turbines

Regarding the substation, its preliminary proposed location is 45°43’55’’ N | 64°45’30’’ W. The closest sensitive receptor to this location, which is the residence located at 46 New Ireland Road, is approximately 80 m away. The residential building location, with respect to the substation, is presented in Figure 3.

Figure 3 **Receptor Locations with Respect to the Substation**

4.2 RESULTS

4.2.1 TURBINE NOISE IMPACT ASSESSMENT

The predicted sound pressure levels by wind speed, at each sensitive receptor within 1 km to the closest turbine, are presented in Table 4. These predictions assume that the Project is composed of five (5) Vestas V126 – 3.6 MW WTGs.

Table 4 **Predicted Sound Pressure Levels at Sensitive Receptors**

Wind Speed (m/s)	4	5	6	7	8	9	10	11
R1	18	20	24	27	31	33	34	34
R2	20	22	26	30	33	36	36	36
R3	29	31	35	39	42	45	45	45

These predicted sound pressure levels are below the recommended sound criteria for wind turbines presented in Table 2, for all sensitive receptors within 1 km of the Project, and for all wind speeds. A detailed noise map is presented in Appendix B, for a wind speed of 11 m/s.

4.2.2 SUBSTATION PRELIMINARY SOUND ASSESSMENT

Regarding the substation, it has been established (section 4.1.3), as a preliminary assessment, that it would produce a sound pressure level of 45 dBA, which is also the selected criteria (section 3.2.3), at a distance of 60 m from the transformer.

The closest residence to the proposed preliminary location of the substation is at a distance of 80 m. At such a distance, the sound level of the transformer is expected to be 42 dBA, which is below the 45 dBA selected criteria.

5 CONCLUSION

In the assessed scenario, considering five (5) Vestas V126 – 3.6 MW turbines with 117 m hub height, all sensitive receptors are expected to receive sound pressure levels from the Project that are in compliance with the recommended criteria from the NBDELG.

Regarding the substation, which is not covered by any provincial noise requirement, it is expected that its sound contribution is in compliance with the selected criteria from Health Canada.

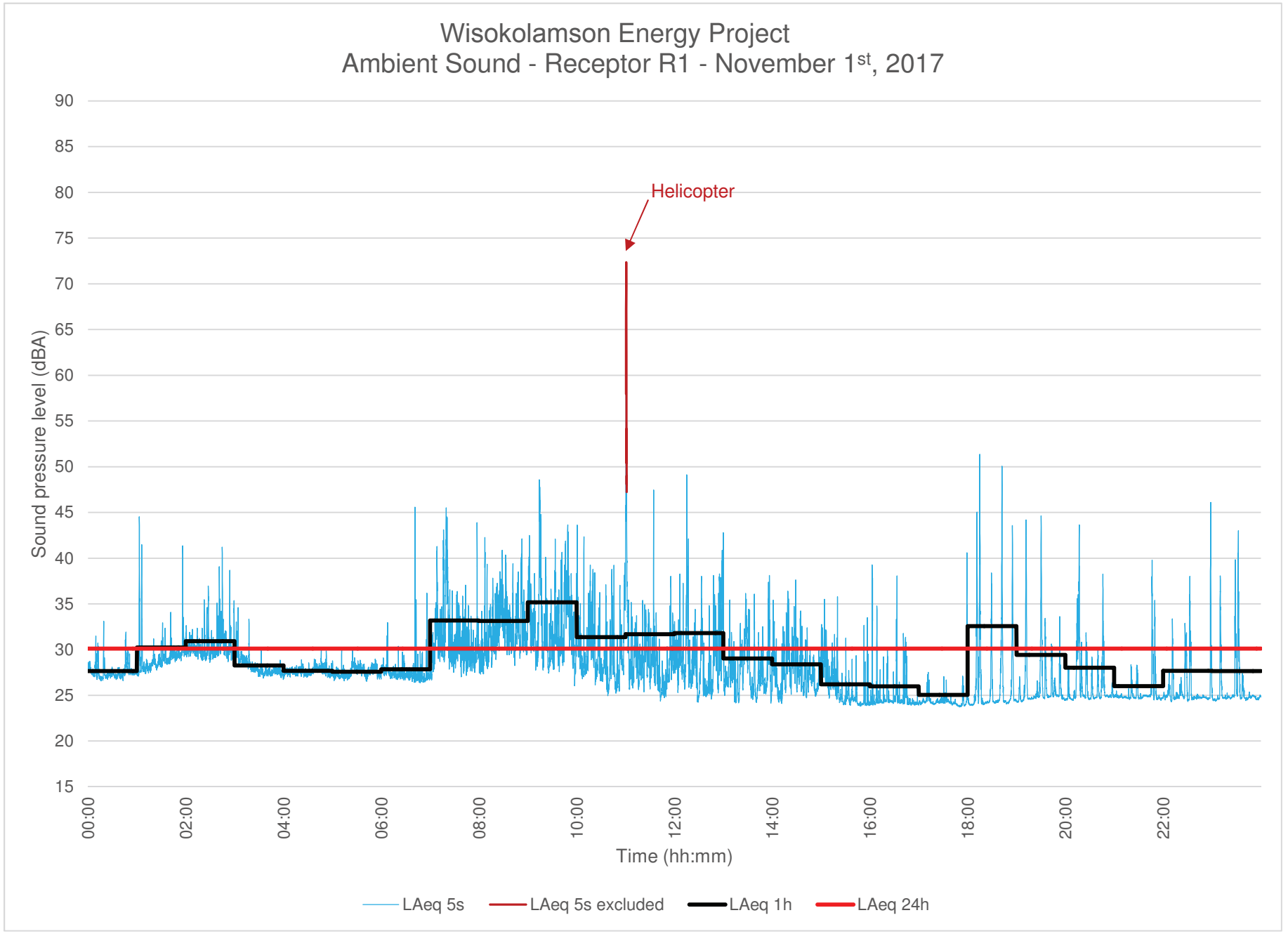
Given the results of this study, no mitigation measures are required.

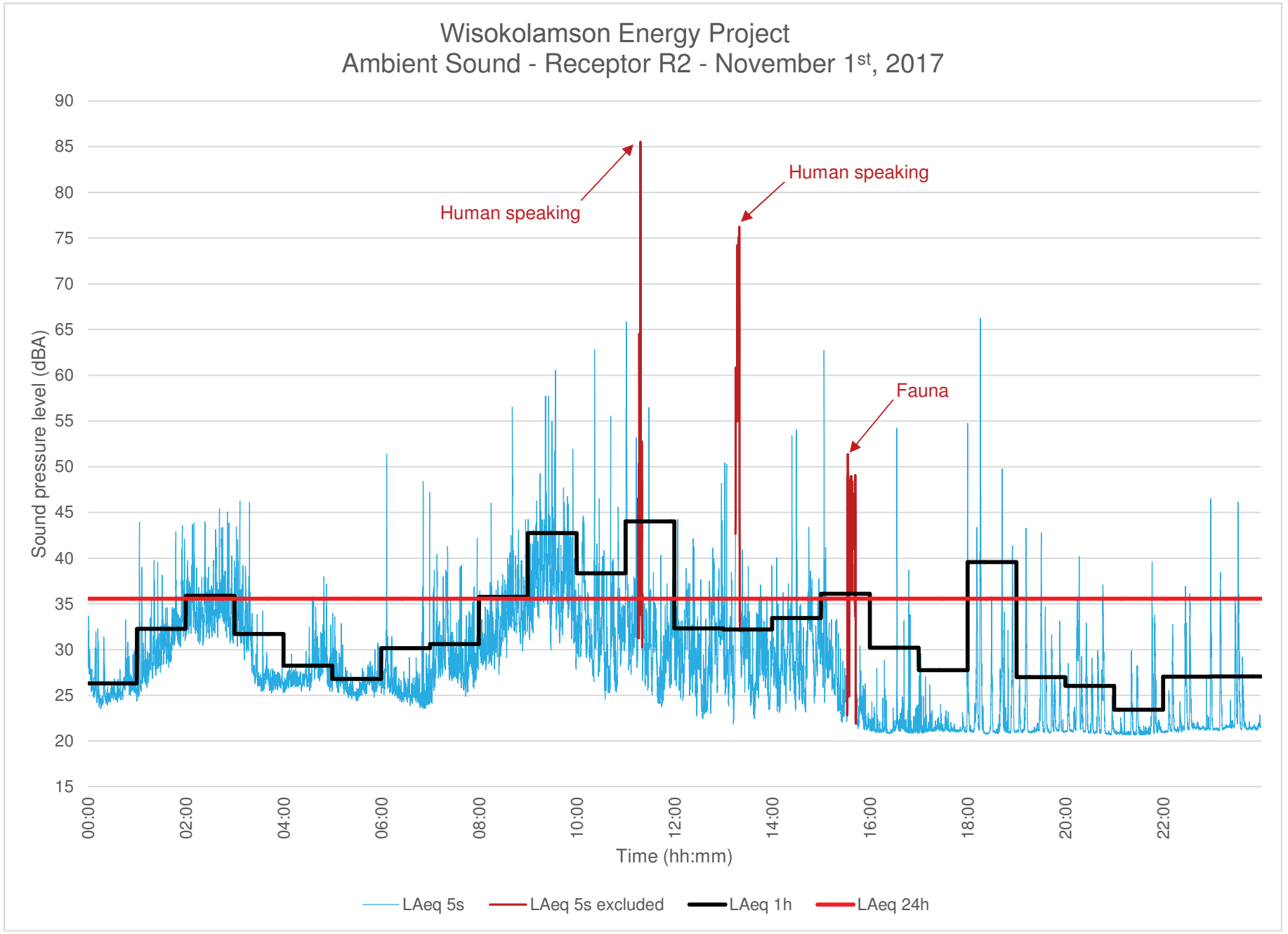
6 BIBLIOGRAPHY

- [1] Government of New Brunswick, Additional Information Requirements for Wind Turbines, undated.
- [2] Health Canada, Noise Impact Assessment Guidance for Environmental Assessment, February 2010.
- [3] World Health Organization, Guidelines for Community Noise, Geneva, March 1999.
- [4] World Health Organization, Night Noise Guidelines for Europe, Geneva, 2009.

APPENDICES

A MEASURED AMBIENT SOUND LEVELS


Wisokolamson Energy Project
Ambient Sound - Receptor R1 - November 1st, 2017
Helicopter
Sound pressure level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Time (hh:mm)
LAeq 5s
LAeq 5s excluded
LAeq 1h
LAeq 24h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Ambient Sound - Receptor R2 - November 1st, 2017
Sound pressure level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
Human speaking
Human speaking
Fauna
00:00
02:00
04:00
06:00
08:00
10:00
12:00
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16:00
18:00
20:00
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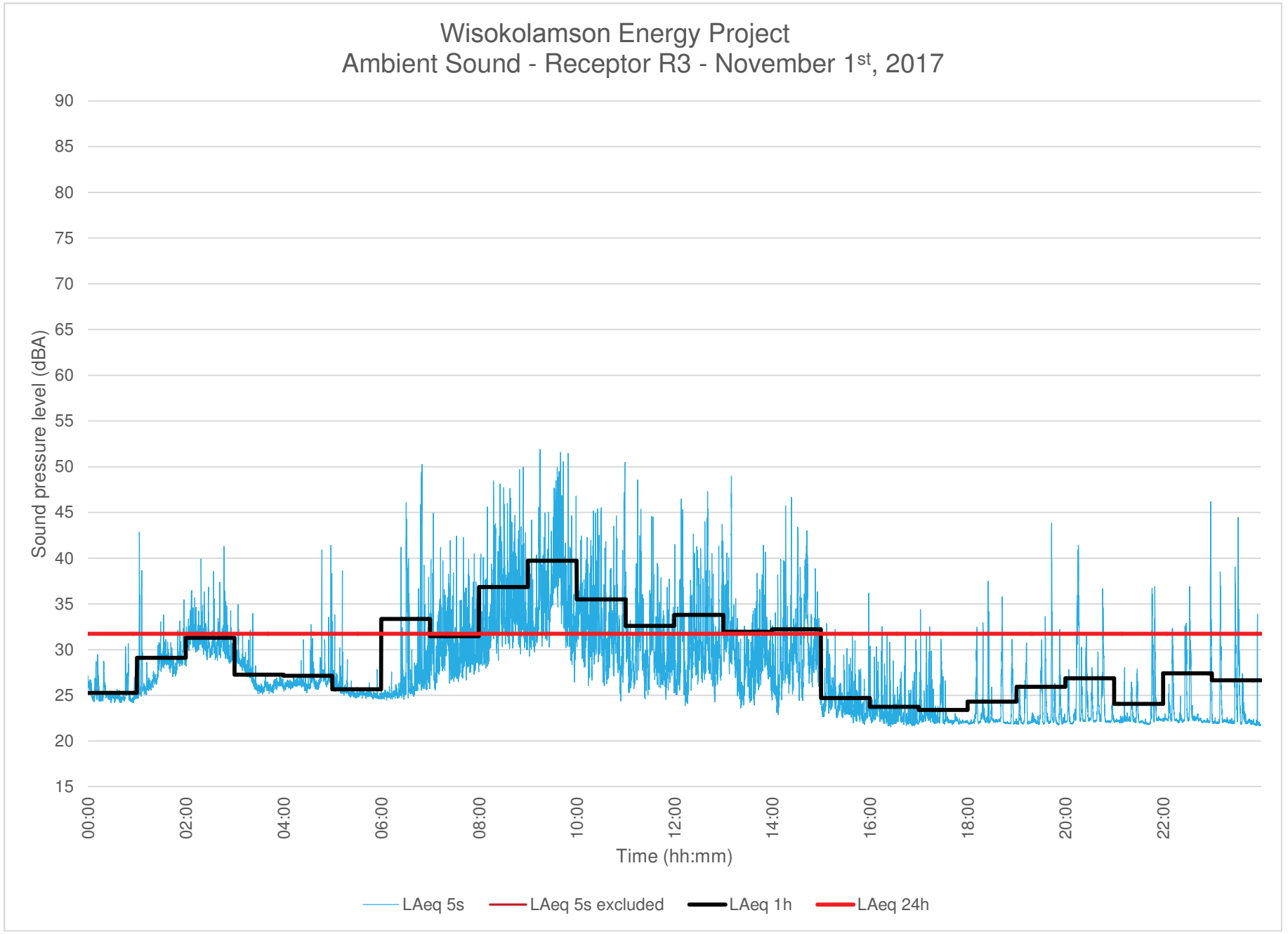
Time (hh:mm)
LAeq 5s
LAeq 5s excluded
LAeq 1h
LAeq 24h


Wisokolamson Energy Project
Ambient Sound - Receptor R3 - November 1st, 2017
Sound pressure level (dBA)
90
85
80
75
70
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55
50
45
40
35
30
25
20
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00:00
02:00
04:00
06:00
08:00
10:00
12:00
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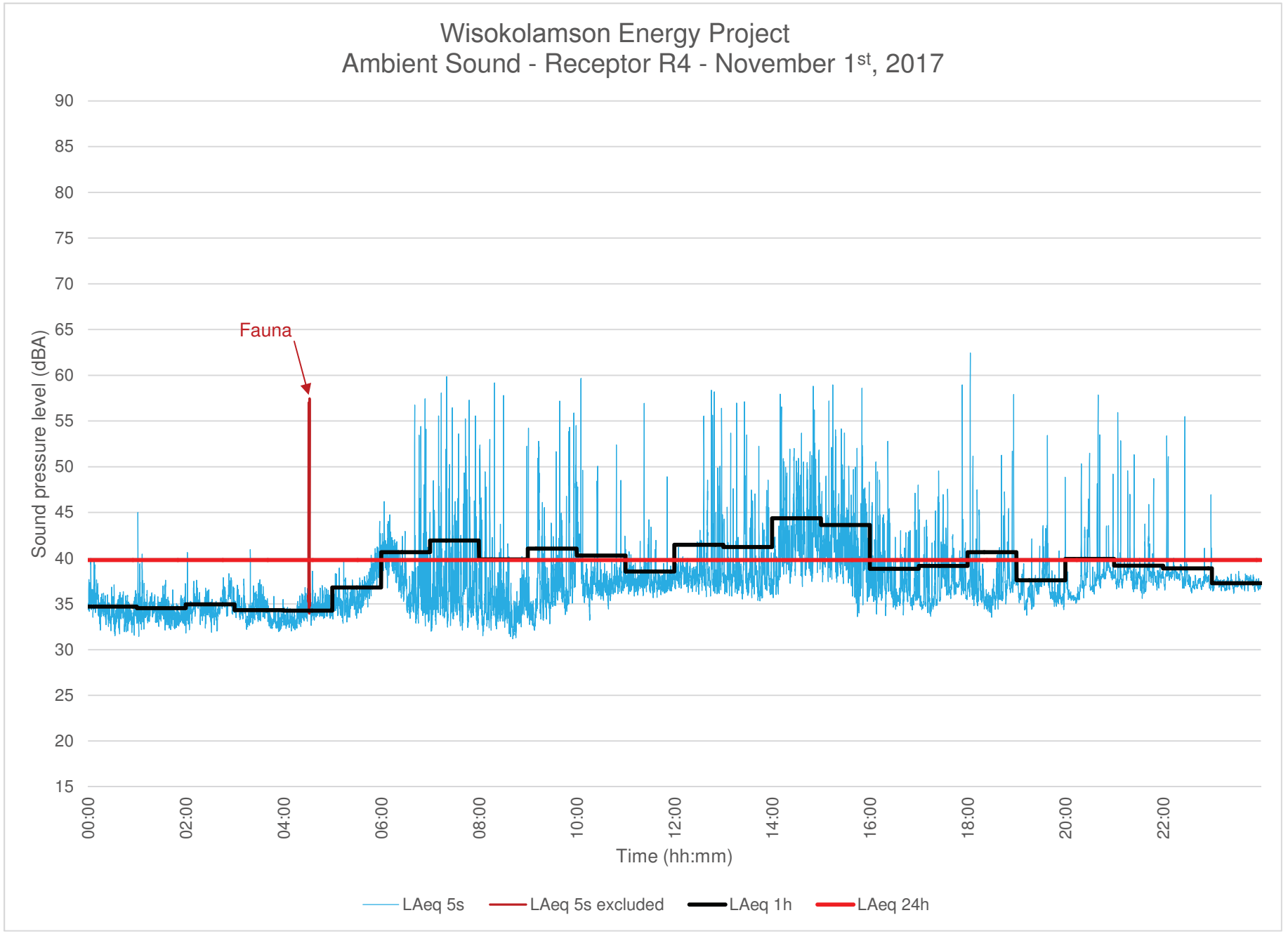
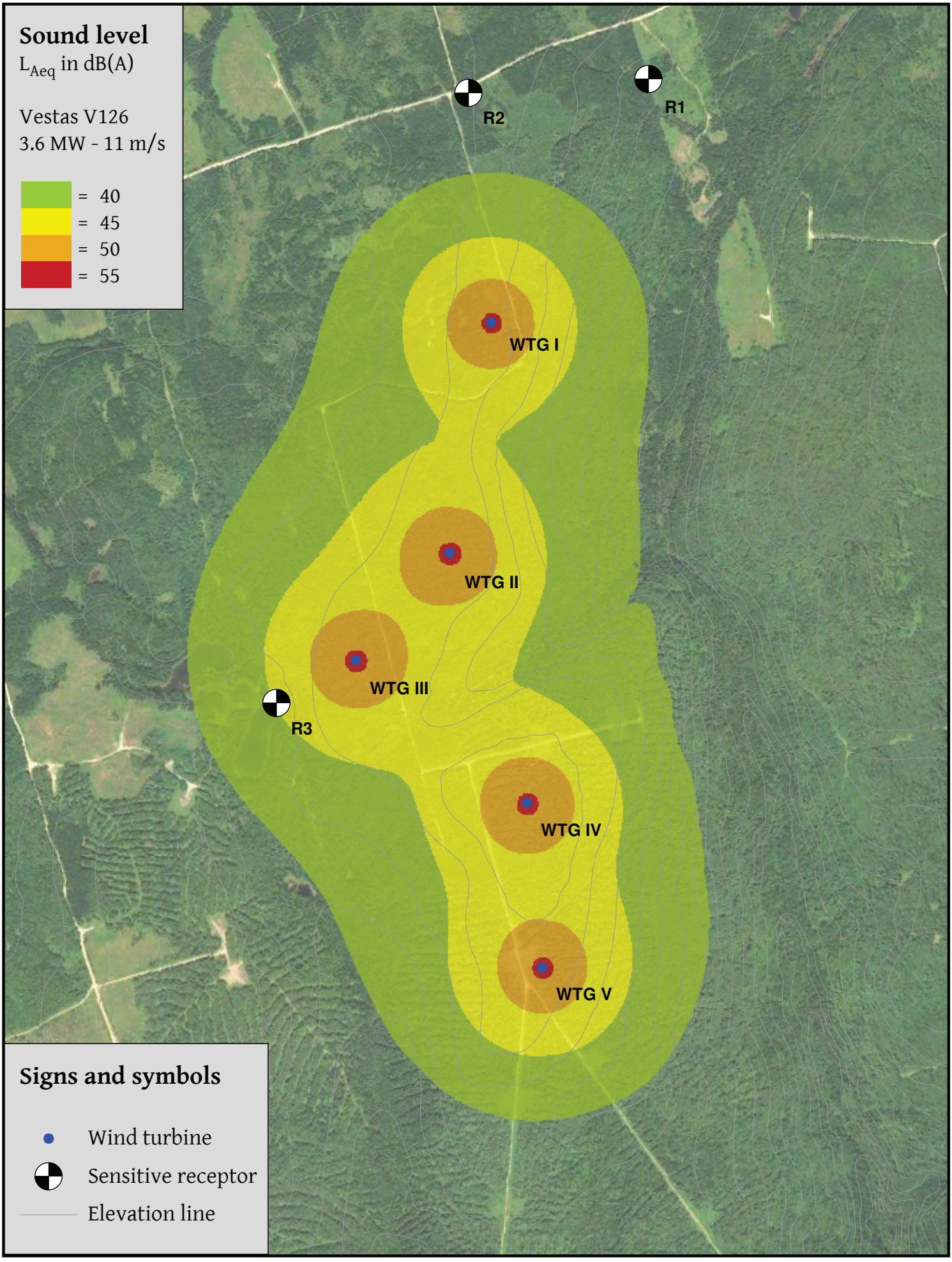
22:00
Time (hh:mm)
LAeq 5s
LAeq 5s excluded
LAeq 1h
LAeq 24h


Wisokolamson Energy Project
Ambient Sound - Receptor R4 - November 1st, 2017
Sound pressure level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
Fauna
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Time (hh:mm)
LAeq 5s
LAeq 5s excluded
LAeq 1h
LAeq 24h

B

NOISE MAP WITH WIND SPEED AT 11 M/S


Sound level
L_{Aeq} in dB(A)
Vestas V126
3.6 MW - 11 m/s
= 40
= 45
= 50
= 55
R2
R1
WTG I
WTG II
WTG III
R3
WTG IV
WTG V
Signs and symbols
Wind turbine
Sensitive receptor
Elevation line