MEMO

MARSHALL DAY Acoustics

Project:	Swansons Lane Wind Farm	**Document No.:**	Mm 001		
To:	RE Future Pty Ltd	**Date:**	7 November 2024		
Project No.:	20200544	**No. Pages:**	8	**Attachments:**	No
Subject:	Noise modelling predictions information				

REF Developments Pty Ltd (the proponent) is proposing to develop a wind farm known as the Swansons Lane Wind Farm (the wind farm) within the Victorian local government area of Moyne Shire and Corangamite Shire, approximately 8 km southwest of Terang. The wind farm is proposed to comprise 5 wind turbines.

Marshall Day Acoustics Pty Ltd (MDA) conducted an environmental noise assessment of the proposed wind farm. Full details of the noise assessment have been documented in the report[1] which was prepared for submission with the planning permit application for the wind farm.

This memo summarises the key elements of the assessment.

A glossary of terminology is provided in Appendix A.

WIND FARM NOISE LIMITS

In Victoria, the *Environment Protection Regulations 2021* (EP Regulations) require commercial premises, including wind farms, to comply with various noise limits.

The noise limits applicable to the wind farm are set by New Zealand Standard NZS 6808:2010 *Acoustics – Wind farm noise* (the New Zealand Standard) and summarised in Table 1. More information on the limits, and the legislation and standard that apply to the wind farm are given in Appendix B.

Table 1: Applicable noise limits, dB L_{A90}

Receiver status	Noise limit
Non stakeholder	40 dB base noise limit or background (L_{A90}) + 5 dB, whichever is greater
Stakeholder within the project boundary	Not applicable Reference level of 45 dB or background (L_{A90}) + 5 dB, whichever is greater

In the absence of background noise levels, the base noise limit or reference level apply at all wind speeds.

WIND FARM NOISE PREDICTIONS

Noise levels from the wind farm have been predicted based on the following input data:

- candidate wind turbine model details, such as rated power (the electricity generation of the turbines in megawatts or MW), rotor diameter, and hub height
- wind turbine sound power levels, supplied by the manufacturer
- location of turbines and receivers
- topographical information of the site and surrounds.

Noise levels are predicted outdoors at receiver locations. Noise levels inside dwellings would typically be lower, although the amount of noise reduction depends on several factors including construction and ventilation, such as open windows.

[1] MDA Report Rp 001 R01 20200544 *Swansons Lane Wind Farm – Environmental Noise Assessment,* dated 27 February 2024

SOUND POWER LEVELS

Sound power levels refer to the total sound energy emitted by a source, in this case, the total amount of sound energy emitted by a wind turbine. These turbine sound emissions are distinct from the noise levels occurring at distant locations, such as receivers, which include the effect of sound propagating across the landscape and refer to 'noise', a term broadly used to describe unwanted sounds.

A final wind turbine model would be selected during the detail design of the project if the wind farm is approved. The proponent is seeking approval to develop wind turbines extending to a tip height of up to 252 m.

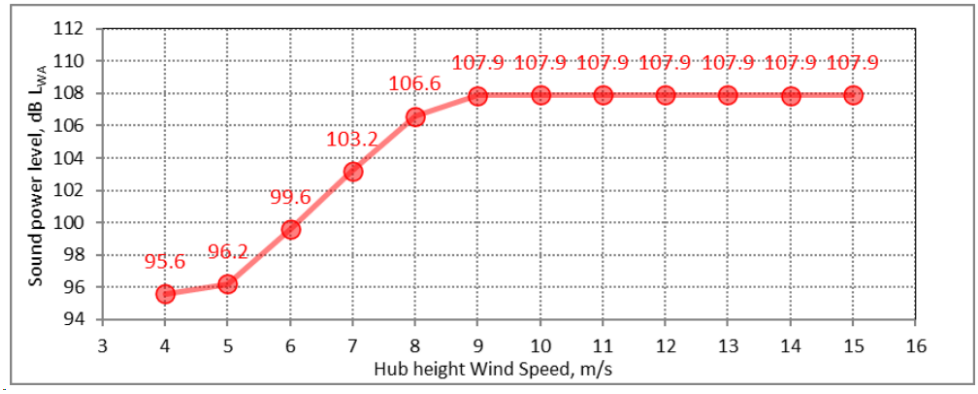
For the noise modelling, we have referenced candidate wind turbine models currently being considered by the proponent. Of these candidates, the Vestas V172-7.2 MW (V172) turbine was used as it resulted in the most conservative assessment (i.e. highest predicted noise levels at receivers).

For modern variable speed wind turbines, such as the V172, sound power level profile is typically characterised as follows:

- The wind turbine starts operating at cut-in wind speed (typically 3-4 m/s at the turbine hub height).
- Wind turbine sound emissions rise as wind speed and power output increases.
- Wind turbine sound emissions plateau at a constant level as the wind turbine approaches its maximum or 'rated' power output.

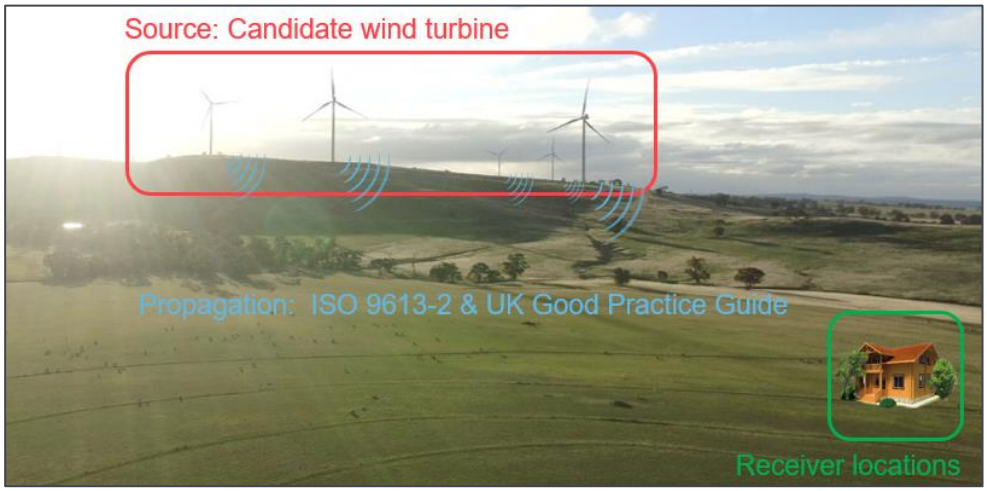
Wind turbine sound power levels for the V172 are shown in Figure 1.

Figure 1: Sound power levels (manufacturer's specification + 1dB margin for uncertainty), dB L_{WA}



Sound power levels at the wind turbines and propagation through the landscape as predicted in the noise model combine to give results at receivers. This process is visualised in Figure 2.

Figure 2: Wind farm noise prediction visualisation



RESULTS

Wind turbine noise predictions are typically presented in terms of noise contours, which show the predicted worst-case noise levels around the site. These predicted contours are conservative due to assumptions such as the following:

- Each location is modelled as downwind of all turbines at once, as discussed in Appendix C.
- The predictions shown are based on the highest wind turbine sound power level occurring at hub height wind speeds of 9 m/s and above. For lower wind speeds, wind farm noise levels are predicted to be lower.

The predicted noise contour map for the wind farm is shown in Appendix D.

Noise levels at receivers with predicted levels at 30 dB L_{A90} or above are given in Table 2, including for those receivers within the project boundary where noise limits from the New Zealand Standard do not apply.

Table 2: Highest predicted noise level at receivers with predicted levels 30 dB L_{A90} or above

Receiver	Predicted level, dB L_{A90}
Outside the project boundary	
51	33.0
53	32.6
57	32.4
59	30.4
64	30.2
69	32.8
74	30.7
122	30.3
123	32.4
Within the project boundary	
62	36.4
63	36.7
65	36.6

The key points from the above table are as follows:

- Receivers outside the project boundary: the predicted noise levels at are significantly lower than the applicable base (minimum) noise limit of 40 dB L_{A90} by a margin of at least 7.0 dB.
- Receivers within the project boundary: the predicted noise levels are significantly lower than the base (minimum) reference noise level of 45 dB L_{A90} by a margin of at least 8.3 dB.

These findings provide a clear indication that the wind farm can be readily designed and operated to comply with the noise limits which apply under Victorian legislation.

Irrespective of these findings, any proposed wind farm project which is approved for development is subject to ongoing noise controls and must undergo further compliance checks at various points throughout the lifetime of the project. These requirements would apply to the Swansons Lane Wind Farm and are discussed further in Appendix E.

APPENDIX A GLOSSARY OF TERMINOLOGY

The basic quantities used within this document to describe noise adopt the conventions outlined in ISO 1996-1:2016 *Acoustics – Description measurement and assessment of environmental noise – Basic quantities and assessment procedures.* Accordingly, all frequency weighted sound pressure levels are expressed as decibels (dB) in this document. For example, sound pressure levels measured using an "A" frequency weighting are expressed as dB L_A. Alternative ways of expressing A-weighted decibels such as dBA or dB(A) are therefore not used in this document.

Term	Definition	Abbreviation
A-weighting	A method of adjusting sound levels to reflect the human ear's varied sensitivity to different frequencies of sound.	See discussion below this table.
A-weighted 90th centile	The A-weighted pressure level that is exceeded for 90 % of a defined measurement period. It is used to describe the underlying background sound level in the absence of a source of sound that is being investigated, as well as the sound level of steady, or semi steady, sound sources. The New Zealand Standard provides the following commentary relating to the use of the L_{A90} metric: *The* [L_{A90}...] *is unaffected by higher sound levels of short-term influence* [...] *which would* [...] *not represent the sound level due to wind farm operation alone.*	L_{A90}
Decibel	The unit of sound level. The decibel scale is logarithmic. An increase of 10 decibels (written as 10 dB), for example an increase from 30 dB to 40 dB, corresponds to a doubling of loudness.	dB
Hertz	The unit for describing the frequency of a sound in terms of the number of cycles per second.	Hz
Octave Band	A range of frequencies. Octave bands are referred to by their logarithmic centre frequencies, these being 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound.	-
Sound power level	A measure of the total sound energy emitted by a source, expressed in decibels.	L_W
Sound pressure level	A measure of the level of sound expressed in decibels.	L_p

If you would like further information concerning the definition of sound and the different ways in which sound is characterised, a separate and more detailed MDA memorandum entitled Mm 002 *Description of sound* can be provided upon request.

APPENDIX B NOISE STANDARD, LEGISLATION AND LIMITS

In relation to noise from wind turbines, regulation 131D of the EP regulations requires compliance with noise limits determined in accordance with New Zealand Standard NZS 6808:2010 *Acoustics – Wind farm noise* (the New Zealand Standard).

The relevant noise limits established by the New Zealand Standard are generally defined as follows:

> *…at any wind speed wind farm sound levels ($L_{A90(10\ min)}$) should not exceed the background sound level by more than 5 dB, or a level of 40 dB $L_{A90(10min)}$, whichever is the greater.*

Under the New Zealand Standard and EPA Publication 2061[2], receivers that are in specific types of land zoning can require additional assessments to determine if lower noise limits should apply at low wind speeds (referred to as high amenity noise limits). None of the receivers around the proposed Swansons Lane Wind Farm are in these types of zones.

The use of background sound levels to determine noise limits means that an assessment of wind farm noise will often involve background noise measurements. However, the New Zealand standard specifies that background noise measurements are not required at receivers with predicted wind farm noise levels at a sufficient level below the noise limits (less than 35 dB L_{A90}).

The noise limits:

- Apply outside noise sensitive locations, as defined in the New Zealand Standard (referred to herein as 'receivers')

  These are typically habitable or education spaces.

- Do not apply at receivers within the wind farm site boundary.

  For these receivers, the Victorian Wind Energy Guidelines[3] provide guidance:

  > *A 45-decibel limit is recommended for stakeholder dwellings. A stakeholder dwelling is a dwelling located on the same land as the wind energy facility…*

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[2] EPA Publication 2061 *Wind Energy Facility Turbine Noise Regulation Guidelines*

At the date of preparation of this report, EPA Publication 2061 is not available as a version controlled formal document. This report is based on the EPA webpage version of this publication, last updated on 26 January 2024

[3] Victorian Department of Transport and Planning publication *Planning Guidelines for Development of Wind Energy Facilities* dated September 2023

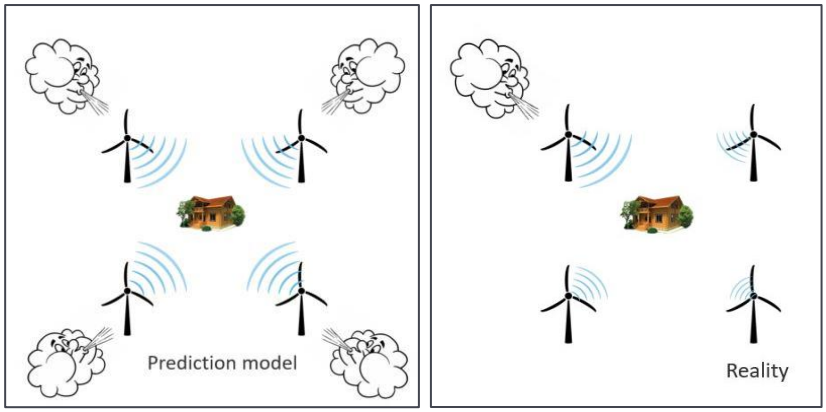
APPENDIX C NOISE PROPAGATION AND MODELLING

Noise propagation is calculated using the broadly accepted standard ISO 9613-2 *Acoustics – Attenuation of sound during propagation outdoors* and recommendations from the UK Institute of Acoustics publication *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (UK Institute of Acoustics guidance).

The noise model assumes worst-case conditions meteorological conditions for wind farm noise. For example, the model assumes that a receiver is downwind (where the wind blows from the turbines towards the receiver, somewhat increasing noise levels at the receiver) of all wind turbines at once as shown in Figure 3.

For receivers located near to the wind farm, this worst-case condition would not typically happen in practice. Therefore, this aspect of the modelling is conservative, as noise levels at these receivers would be over-predicted compared to typical atmospheric conditions.

Figure 3: Noise prediction model wind direction vs realistic situation

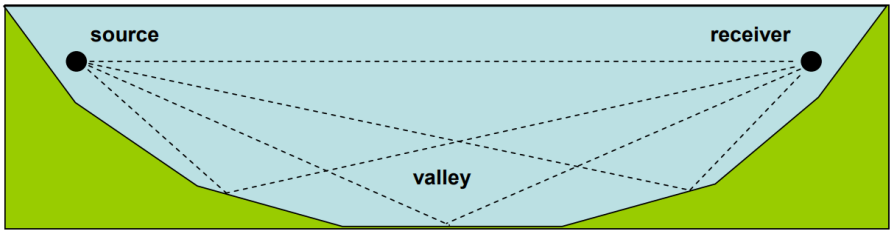


The noise prediction model includes the effects of terrain height on noise levels, including the following adjustments specific to wind turbines from the UK Institute of Acoustics guidance:

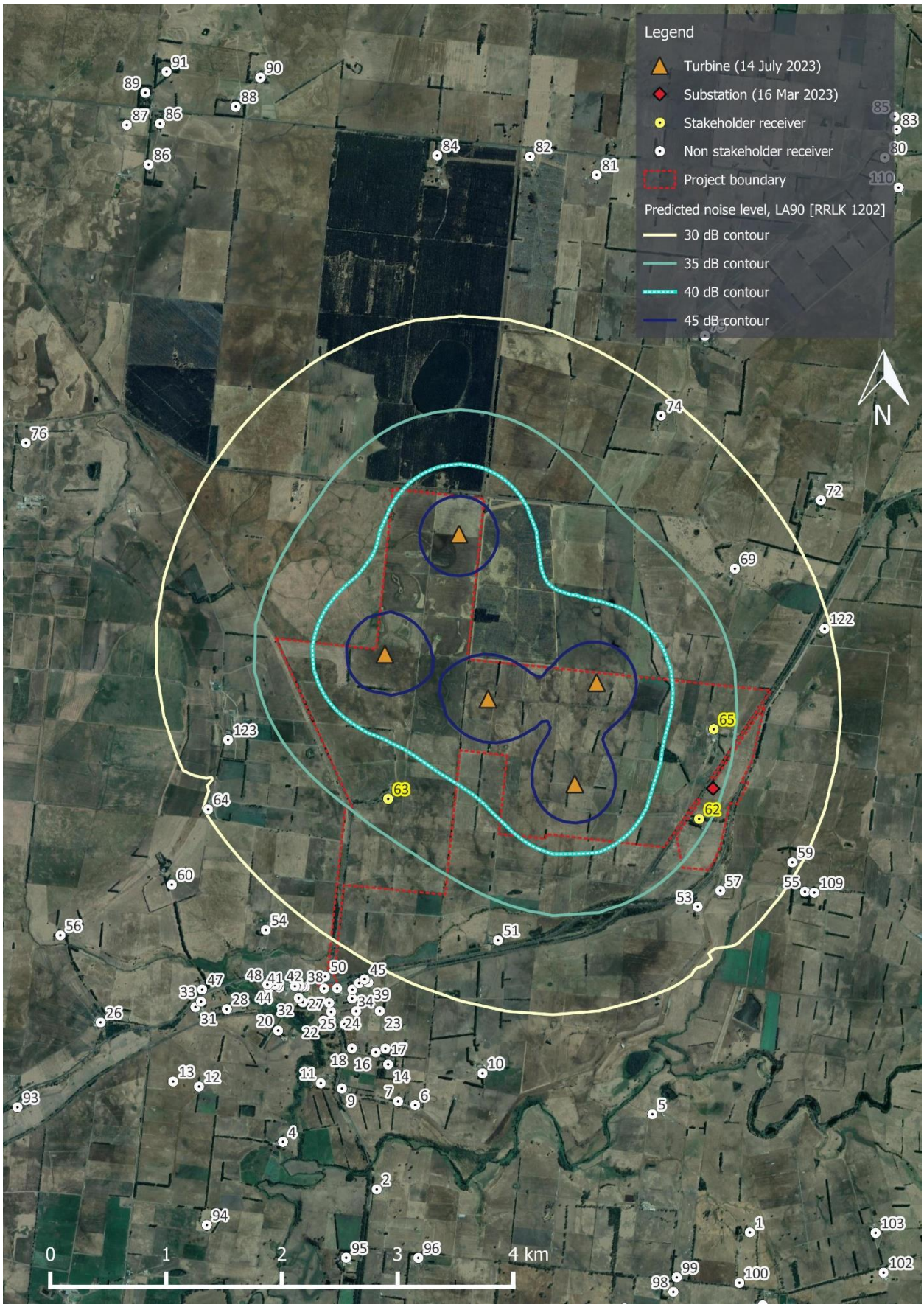
- Limiting the effect of topographical shielding which decreases noise levels at receivers by -2 dB, as wind turbines are tall and typically overlook all the surrounding landscape.
- Accounting for the valley effect by applying a +3 dB correction in situations such as that shown in Figure 4 where a significant valley exists between the wind turbine (source) and receiver.

As the proposed Swansons Lane Wind Farm is in a relatively flat area, predicted terrain effects were minimal.

Figure 4: Valley effect example (Figure 5 of the UK Institute of Acoustics guidance)



APPENDIX D NOISE CONTOUR MAP



APPENDIX E WIND TURBINE NOISE CONTROLS

Ongoing noise controls and compliance checks applying to the Swansons Lane wind farm include:

- *Repeat noise modelling prior to construction of the wind farm*

  This is required in order to verify that predicted noise levels for the final turbine selection, accounting for any minor turbine location changes (micro-siting which occurs to account for factors such as local ground conditions or fauna), remain compliant with the noise limits.

- *Preparation of a noise management plan*

  This plan must set out the noise controls that apply to the wind farm, and how the operator's noise control responsibilities will be fulfilled. This plan must be audited by an independent EPA Victoria accredited auditor.

- *Noise compliance monitoring after the wind farm begins operating*

  The monitoring must be conducted in accordance with the New Zealand Standard and the audited noise management plan. The results must be submitted to EPA Victoria.

- *Preparation of annual statements*

  These statements must document and confirm ongoing compliance with the obligations of the audited noise management plan. Each statement must be submitted to EPA Victoria.

- *Repeat noise compliance monitoring every 5 years for the lifetime of the project*

  The repeat noise monitoring must be conducted in accordance with the audited noise management plan and the results must be submitted to EPA Victoria.

In addition to the above, there is a legislated obligation under the *Environment Protection Act 2017* (EP Act) to not cause unreasonable noise. This is a particularly important obligation with respect to the ongoing maintenance of a wind farm. Specifically, irregular or atypical noises which can be caused by a turbine in need of repair or maintenance can be classified as unreasonable noise under the EP Act. Maintenance to avoid these types of situations occurring in practice is therefore required in order to comply with EP Act.

Therefore, irrespective of the clear margin of compliance indicated by the predicted noise levels, if the Swansons Lane Wind Farm is approved, the project would be subject to a comprehensive suite of noise controls which would need to be implemented and independently verified for the life of the project.