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August 2007

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Resonate

Wombelano Wind Farm

Environmental Noise Assessment

M200708RP1 Revision B

Friday, 18 December 2020

Document Information

Project	Wombelano Wind Farm
Client	Wind Projects Australia
Report title	Environmental Noise Assessment
Project Number	M200708

Revision Table

Report revision	Date	Description	Author	Reviewer
0	16 November 2020	For Issue	Tom Evans	Damien van Raaphorst
A	16 December 2020	Updated Issue	Tom Evans	Damien van Raaphorst
B	18 December 2020	Amended Turbine Numbering	Tom Evans	Damien van Raaphorst

Glossary

Amplitude modulation	The variation in level of noise over time. With regards to wind turbine noise, amplitude modulation is the regular variation in aerodynamic noise which occurs at the blade pass frequency. Wind turbine noise is generally considered to contain a normal level of amplitude modulation as a fundamental characteristic, e.g. the blade swish noise, but excessive amplitude modulation has been identified in limited cases.
A-weighting	A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies.
dB	Decibel—a unit of measurement used to express sound level. It is based on a logarithmic scale which means a sound that is 3 dB higher has twice as much energy. We typically perceive a 10 dB increase in sound as a doubling of that sound level.
DELWP	Department of Environment, Land, Water and Planning.
L_{A90}	A-weighted noise level exceeded for 90% of the measurement time as required under NZS 6808:2010. The L_{A90} is used to assess wind farm and background noise, as it is less likely to be adversely affected by extraneous noise than other noise descriptors.
NZS 6808:2010	New Zealand Standard 6808:2010 *Acoustics – Wind farm noise*.
Special audible characteristic	A characteristic of wind farm noise that has the potential to increase annoyance above an equivalent noise level that does not contain the characteristic. Special audible characteristics are defined by NZS 6808:2010 to include tonality, amplitude modulation and impulsivity, and attract penalties if detected in wind farm noise.
Tonality	A characteristic of a noise where there is a distinctly higher level over a relatively narrow frequency range. Examples include the reversing signal on a truck or the low frequency hum of a transformer. A noise exhibiting tonality is subjectively more annoying than a non-tonal noise at the same level.

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Executive summary

Wind Projects Australia Project 1 (the Proponent) is proposing to develop the Wombelano Wind Farm, approximately 21 kilometres east of Edenhope in Western Victoria. The wind farm will consist of up to seven wind turbines, with a hub height of approximately 149 m above ground level (AGL).

This report presents a pre-construction noise assessment for the proposed Wombelano Wind Farm against the requirements of the Department of Environment, Land, Water and Planning (DELWP) *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria* (Wind Farm Guidelines, March 2019).

In accordance with the Wind Farm Guidelines, wind farm noise levels have been predicted and compared against the relevant noise limits as specified by New Zealand Standard 6808:2010 *Acoustics – Wind Farm Noise* (NZS 6808:2010). With no noise-sensitive locations located within the predicted 35 dB L_{A90} contour from the site, no background noise monitoring has been conducted and, therefore, this assessment has been conducted against the minimum applicable noise limits of 40 dB L_{A90} for non-involved landowners.

Predictions were carried out for the Wombelano Wind Farm based on an industry standard wind farm noise prediction methodology, the typical candidate wind turbine model for the site (Vestas V162-6.0MW) and the proposed layout. The predicted noise levels for the maximum sound power level of the typical candidate turbines at the Wombelano Wind Farm are compliant with the NZS 6808:2010 minimum possible noise limits at all nearby noise-sensitive locations. The highest predicted noise level at any noise-sensitive location is 33 dB L_{A90}.

Noise from the proposed substation and transformer for the site was also predicted and found to comply with the relevant noise limits, determined in accordance with the Environment Protection Authority (EPA) Guidelines *Noise from Industry in Regional Victoria* (NIRV Guidelines). The predicted transformer noise levels were significantly lower than the applicable night noise levels at the nearest noise-sensitive locations.

This pre-construction assessment indicates that noise emissions from the Wombelano Wind Farm are expected to be compliant with the requirements of the Wind Farm Guidelines and NZS 6808:2010 based on the proposed layout and typical candidate wind turbine model. It is recommended that:

- Post-construction noise monitoring be undertaken at R1 and R12 at a minimum, representing the two residences with predicted wind farm noise levels above 30 dB L_{A90}. The post-construction noise monitoring procedure should be established in a Noise Management Plan developed in accordance with the requirements of the Wind Farm Guidelines and NZS 6808:2010.
- The wind turbine procurement process should consider the sound power levels of the selected model. A clause should be included in the procurement contract such that the wind turbines do not produce audible tones that would attract a penalty at neighbouring residences.

1 Introduction

Wind Projects Australia Project 1 (the Proponent) is proposing to develop the Wombelano Wind Farm, approximately 21 kilometres east of Edenhope in Western Victoria. The wind farm will consist of up to seven wind turbines, with a hub height of approximately 149 m above ground level (AGL).

This report presents a pre-construction noise assessment for the proposed Wombelano Wind Farm against the requirements of the Department of Environment, Land, Water and Planning (DELWP) *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria* (Wind Farm Guidelines, March 2019). The report:

- establishes applicable noise limits for wind turbine noise and substation noise
- presents predicted noise levels for the wind turbines and substation
- assesses whether the wind farm is capable of complying with the applicable noise limits.

2 Project description

2.1 Site description

Wombelano Wind Farm will be located in West Wimmera Shire, approximately 21 kilometres east of the township of Edenhope. The site will consist of up to seven wind turbines, with a hub height of approximately 149 m AGL and is located in a Farming Zone as defined by the West Wimmera Planning Scheme. The surrounding area is also a Farming Zone.

The Proponent has advised of 64 residences around the site, which includes residences over 15 km from the nearest turbines. One residence (denoted R6) is an involved landowner but does not have a specific noise agreement in place and has therefore been assessed to the same noise limits as all other residences.

The proposed wind turbines and substation, nearest residences and planning zones are shown on Figure 1. Coordinates of the turbines, substation and residences are included in Appendix A.

2.2 Wind turbine model

We understand that the precise turbine model to be installed at Wombelano Wind Farm will be selected via a competitive tendering process following the completion of the planning application process. At this stage, the Proponent has advised that the assessment should be carried out on the basis of a Vestas V162-6.0MW wind turbine, which has a capacity of 6.0 MW, a rotor diameter of 162 m and is considered typical of the turbines that could be installed at the site.

The overall sound power levels and corresponding octave band spectra of the V162-6.0MW have been based on the manufacturer-specified sound power levels provided via the Proponent.[1] A 1 dB uncertainty factor has been added to the manufacturer-specified levels.

The overall sound power levels, following the addition of the 1 dB uncertainty factor, are shown with integer hub height wind speeds in Table 1.

Table 1 Vestas V162-6.0MW turbine sound power levels with wind speed

WTG	Sound power level in dB L_{WA} for hub height wind speed in m/s							
	3	4	5	6	7	8	9	≥10
V162-6.0MW-STE	94.9	95.1	95.3	97.2	100.2	103.0	105.1	105.3

The octave band sound power level spectra for the Vestas V162-6.0MW turbine are presented in Table 2 for a wind speed of 10 m/s. This wind speed has been selected as it corresponds to the lowest wind speed at which the maximum overall sound power level of 105.3 dB L_{WA} is specified.

Table 2 Vestas V162-6.0MW turbine sound power level spectra

Hub height wind speed	Sound power level in dB L_{WA} at octave band centre frequency in Hz									Overall
m/s	31.5	63	125	250	500	1000	2000	4000	8000	dB L_{WA}
10	76.2	86.6	94.1	98.7	100.4	99.3	95.2	88.3	78.5	105.3

[1] Vestas Wind Systems A/S, 10 June 2020, *Third octave noise emission – EnVentus™ V162-6.0MW*, Doc. No.: 0095-3732_00

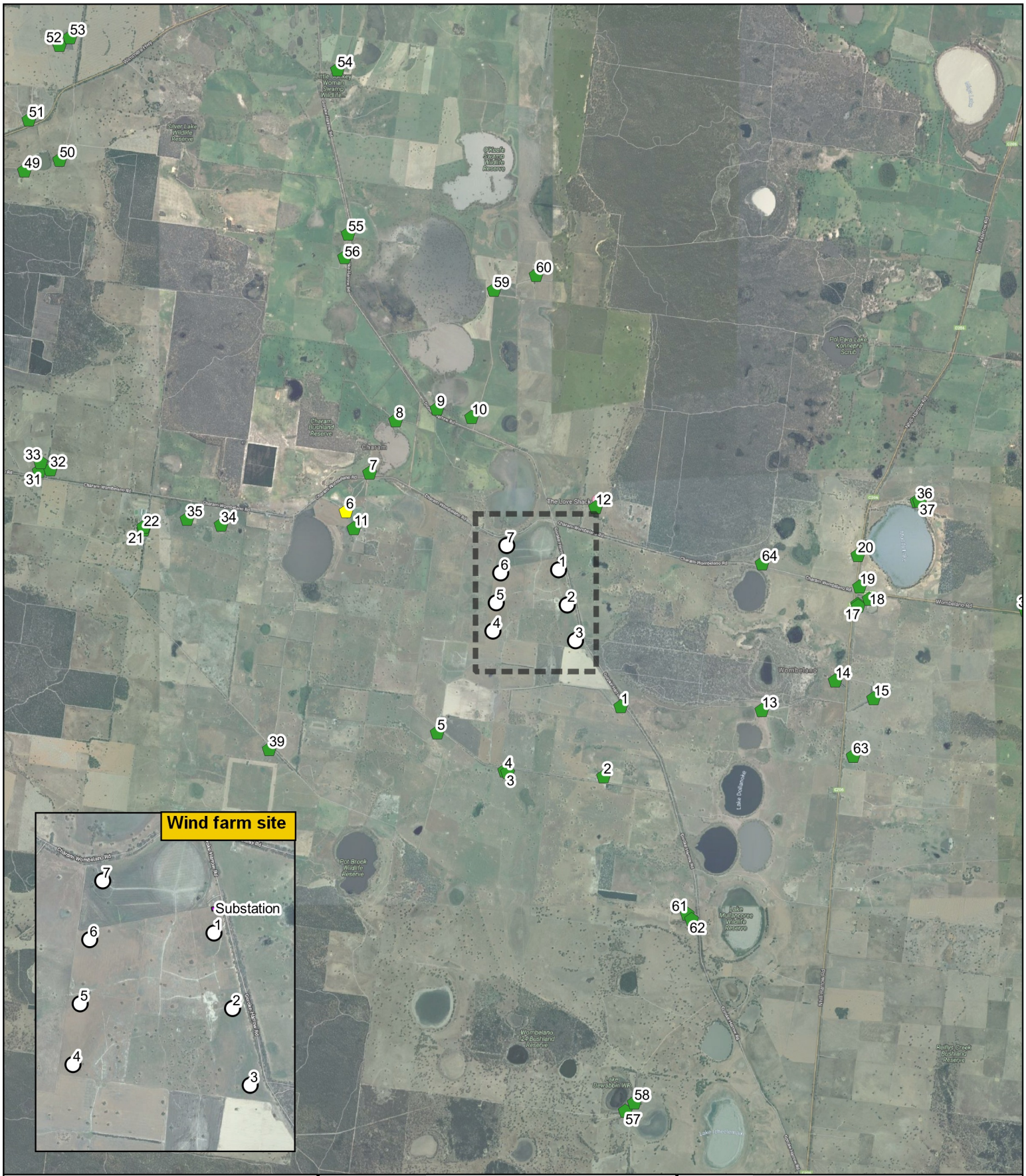

FIGURE 1: Wombelano Wind Farm Site Map

Legend

- Wind turbine
- Substation

Noise-sensitive land use

- Involved
- Non-Involved

0 1,000 2,000 3,000 m

Datum WGS 84, Projection UTM ZONE 54S

PROJECT NUMBER	M200708
DRAWN BY	TRE
DATE ISSUED	December 2020
CLIENT	Wind Projects Australia

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3 Noise limits

3.1 Wind farm noise limits

3.1.1 Wind Farm Guidelines

The DELWP Wind Farm Guidelines are the relevant planning guidelines for wind farms in Victoria and state that, with respect to operational noise:

> A wind energy facility must comply with the noise limits in the New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (the Standard).

The Wind Farm Guidelines also require that wind farm noise compliance be demonstrated by post-construction testing of the wind farm noise levels in accordance with NZS 6808:2010.

3.1.2 West Wimmera Planning Scheme

Clause 52.32 of the West Wimmera Planning Scheme addresses wind energy facilities such as the proposed Wombelano Wind Farm. In particular, Clause 52.32-6 states that the responsible authority should consider:

- The Wind Farm Guidelines
- NZS 6808:2010

3.1.3 NZS 6808:2010

NZS 6808:2010 of the Standard defines acceptable limits for wind farm noise at noise sensitive locations (residences) as:

- For most locations:
  - a base noise limit of 40 dB L_{A90} or
  - the background noise level plus 5 dB

  whichever is the greater for each hub height wind speed.
- For locations in High Amenity areas:
  - a base noise limit of 35 dB L_{A90} or
  - the background noise level plus 5 dB

  whichever is the greater for each hub height wind speed.

3.1.4 High Amenity areas

With respect to High Amenity areas, the definition of High Amenity areas is relevant to the New Zealand planning system and not directly translatable to Victorian planning schemes. However, the approach of the Victorian Civil and Administrative Tribunal (VCAT) in their determination on the Cherry Tree Wind Farm was that areas allocated for farming use would not be considered to be High Amenity. The Wind Farm Guidelines reference the Cherry Tree Wind Farm decision with respect to High Amenity areas.

Further Victorian guidance was provided by the Planning Panel for the Golden Plains Wind Farm, who deemed that noise-sensitive land uses located in a Township Zone and Low Density Residential Zone should be deemed High Amenity, but that those noise-sensitive land uses in Farming Zones were not High Amenity areas for the purposes of NZS 6808:2010.

As shown in Figure 1, the West Wimmera Planning Scheme defines the area in which the Wombelano Wind Farm and nearest noise sensitive receivers are located as a Farming Zone and therefore, based on the previous VCAT decision, the High Amenity condition is not considered applicable to this site.

3.1.5 Involved landowners

The NZS 6808:2010 base limit of 40 dB is not applicable to landowners involved with the wind farm that have a commercial agreement allowing a higher noise limit. It has been normal practice in Victoria for involved landowners that have a commercial agreement with the wind farm to accept a base noise limit of 45 dB L_{A90}, and this is recommended by the Wind Farm Guidelines.

At this stage, we understand that no specific noise agreement is in place with the involved residence relevant to the Wombelano Wind Farm and we have therefore retained the NZS 6808:2010 noise limit of 40 dB L_{A90} for this involved landowner.

3.1.6 Wind farm noise limit summary

Based on NZS 6808:2010 and the West Wimmera Planning Scheme, this assessment has been conducted against the following noise limits:

- Non-involved noise-sensitive land uses:
  - a base noise limit of 40 dB L_{A90} or
  - the background noise level plus 5 dB

  whichever is the greater for each hub height wind speed.

As no background noise monitoring has been conducted at this stage, this assessment has been conducted against the minimum applicable NZS 6808:2010 noise limit of 40 dB L_{A90} for noise-sensitive land uses.

3.2 Substation noise limits

The proposed substation as part of the Wombelano Wind Farm will also need to comply with relevant environmental noise limits.

Substation noise is not assessed under NZS 6808:2010 but is assessed in regional Victoria using the Environment Protection Authority (EPA) Guidelines *Noise from Industry in Regional Victoria* (NIRV Guidelines). The NIRV Guidelines are applicable to noise from facilities such as substations, but specifically excludes the assessment of wind turbines at wind energy facilities.

Noise limits are defined by the NIRV Guidelines based on the zoning of the source and receptor. Background noise levels may also be measured to determine if a higher noise limit is applicable, but this has not been considered in this assessment. For a utility source, such as a transformer, and receptor both located in the same Farming Zone, the applicable noise limits are as defined in Table 3.

Table 3 NIRV noise limits

Receiver	**Applicable noise limit for time of day, dB $L_{Aeq,30min}$**		
	Day **7 am – 6 pm Mon – Fri** **7 am – 1 pm Sat**	**Evening** **6 pm – 10 pm any day** **1 pm – 6 pm Sat** **7 am – 10 pm Sun**	**Night** **10 pm – 7 am any day**
All receivers	45	39	34

As the substation will operate 24 hours per day, noise levels will need to comply with the more stringent night time noise limit at surrounding receptors.

It is noted that, from 1 July 2021, the NIRV Guidelines will be replaced by the new EPA 1826.2 *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (Noise Protocol). However, the Noise Protocol will adopt the same approach to the determination of noise limits for the substation as is currently applied in the NIRV Guidelines and, therefore, the noise limits in Table 3 will remain applicable after 1 July 2021.

4 Noise assessment

4.1 Wind farm noise assessment

4.1.1 Noise prediction methodology

To predict wind farm noise levels from Wombelano Wind Farm, an environmental noise model has been developed in SoundPlan version 8.2 environmental noise prediction software. The noise model implements the ISO 9613-2:1996[2] prediction algorithm. In accordance with standard prediction procedures for wind farm noise, predictions have been undertaken on the basis of the following parameters:

- Turbine and residence locations as per the coordinates detailed in Appendix A.
- Topographical contours sourced from VicPlan. A topographic map is included as Figure B1 in Appendix B.
- Ground absorption factor of 50% representing mixed reflective and absorptive ground. This corresponds to a value of G = 0.5 in accordance with ISO 9613-2:1996.
- Turbine hub height of 149 m with rotor diameter of 162 m and sound power levels as per Table 1.
- Receiver height of 1.5 m above ground.
- Temperature of 10˚C and relative humidity of 70%.
- +3 dB applied to the predicted noise level from any turbine where concave topography observed as per the UK Institute of Acoustics *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (Good Practice Guide) definition.
- Topographical shielding limited to 2 dB.

The air absorption values from ISO 9613-2:1996 have been adopted. Air absorption is dependent on the assumed temperature and humidity and therefore the relevant air absorption values for this assessment are shown in Table 4.

Table 4 Adopted air absorption values

Conditions	Atmospheric attenuation in dB/km for octave band centre frequency in Hz							
	63	125	250	500	1000	2000	4000	8000
Temperature 10˚C Rel humidity 70%	0.1	0.4	1.0	1.9	3.7	9.7	32.8	117

This prediction methodology is in accordance with that recommended by the UK Institute of Acoustics Good Practice Guide with the exceptions that:

- The Good Practice Guide recommends a receiver height of 4 m above ground rather than 1.5 m above ground. A receiver height of 4 m above ground would increase predicted noise levels by approximately 1.5 dB.
- The Good Practice Guide recommends that 2 dB be subtracted from predicted noise levels to adjust predicted L_{eq} noise levels to the assessed L_{90} noise levels. This has not been adopted for this assessment.

Given that the above two changes effectively negate each other, the predicted noise levels using the adopted methodology are considered to be consistent with the UK Institute of Acoustics Good Practice Guide. It is also noted that this methodology has been shown to accurately predicted downwind noise levels for Australian sites with sloping or relatively flat topography.[3]

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[2] International Standard ISO 9613-2, 1996, *Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation*

[3] Evans T & Cooper J, 2012, *Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms*, Acoustics Australia, vol. 40, no. 1, pp 28-36.

4.1.2 Predicted wind farm noise levels

The highest predicted wind farm noise levels occur at a hub height wind speed of 10 m/s and above. These levels are compared to the minimum applicable noise limits in Table 5. At lower wind speeds, the predicted wind farm noise levels are lower.

Table 5 Highest predicted wind farm noise levels

Receiver	Involved	Minimum applicable noise limit, dB L_{A90}	Highest predicted wind farm noise level, dB L_{A90}	Compliance predicted?
R1	No	40	31	✓
R2	No	40	26	✓
R3	No	40	27	✓
R4	No	40	27	✓
R5	No	40	28	✓
R6	Yes[1]	40	26	✓
R7	No	40	26	✓
R8	No	40	25	✓
R9	No	40	25	✓
R10	No	40	27	✓
R11	No	40	27	✓
R12	No	40	33	✓
R13	No	40	22	✓
R14	No	40	20	✓
R15	No	40	18	✓
R16	No	40	19	✓
R17	No	40	19	✓
R18	No	40	19	✓
R19	No	40	19	✓
R20	No	40	19	✓
R21	No	40	17	✓
R22	No	40	17	✓
R23	No	40	11	✓
R24	No	40	11	✓
R25	No	40	5	✓
R26	No	40	5	✓
R27	No	40	7	✓
R28	No	40	7	✓

Receiver	Involved	Minimum applicable noise limit, dB L_{A90}	Highest predicted wind farm noise level, dB L_{A90}	Compliance predicted?
R29	No	40	5	✓
R30	No	40	6	✓
R31	No	40	14	✓
R32	No	40	14	✓
R33	No	40	14	✓
R34	No	40	20	✓
R35	No	40	18	✓
R36	No	40	17	✓
R37	No	40	17	✓
R38	No	40	14	✓
R39	No	40	20	✓
R40	No	40	8	✓
R41	No	40	7	✓
R42	No	40	8	✓
R43	No	40	8	✓
R44	No	40	7	✓
R45	No	40	7	✓
R46	No	40	7	✓
R47	No	40	7	✓
R48	No	40	8	✓
R49	No	40	10	✓
R50	No	40	11	✓
R51	No	40	10	✓
R52	No	40	9	✓
R53	No	40	9	✓
R54	No	40	12	✓
R55	No	40	17	✓
R56	No	40	17	✓
R57	No	40	13	✓
R58	No	40	13	✓
R59	No	40	20	✓
R60	No	40	19	✓

Receiver	Involved	Minimum applicable noise limit, dB L_{A90}	Highest predicted wind farm noise level, dB L_{A90}	Compliance predicted?
R61	No	40	18	✓
R62	No	40	18	✓
R63	No	40	18	✓
R64	No	40	22	✓

(1) While the receiver is involved with the Project, it is understood that no formal noise agreement is in place and, therefore, the noise levels have been assessed against the NZS 6808:2010 noise limits.

The wind farm noise predictions in Table 5 are representative of the expected wind farm noise levels when each receiver is downwind of the nearest turbines. Under other wind directions, where the receiver is upwind or crosswind of the wind farm, wind farm noise levels would be lower than indicated in Table 5.

The predictions demonstrate that the Wombelano Wind Farm is expected to be compliant with the NZS 6808:2010 minimum applicable noise limits and the operational noise requirements of the Wind Farm Guidelines. The highest predicted noise level at any noise-sensitive land use is 33 dB L_{A90} at R12 and the predicted noise levels at all but R1 and R12 are below 30 dB L_{A90}.

A noise contour map for a wind speed of 10 m/s at hub height is included as Figure B2 in Appendix B. Uncertainty in the predicted noise levels is discussed in Appendix C.

4.1.3 Special audible characteristics

NZS 6808:2010 requires that a penalty be applied to the measured wind farm noise level if tonality, excessive amplitude modulation and/or impulsivity is detected at a receiver. A maximum penalty of 6 dB is applicable depending on the extent of any special audible characteristics at the receiver location.

The predictions in Table 5 are based on no special audible characteristics that would attract a penalty being detected at the residences surrounding the site. It is not possible to assess special audible characteristics in detail at the pre-construction stage but, in our experience, it is reasonable to assume that no characteristics would be present that would attract a penalty. It is also noted that that, regardless of the application of a special audible characteristic penalty, predicted Wombelano Wind Farm noise levels would remain below the minimum applicable noise levels.

In order to provide assurance regarding special audible characteristics at noise-sensitive land use locations, recommendations are provided in Section 5 regarding procurement of turbines and post-construction monitoring.

4.1.4 Micro-siting

It is common for some turbine locations to move by a relatively small degree during detailed design, a practice called micro-siting. The Wind Farm Guidelines recommended standard Planning Permit conditions include a micro-siting allowance of up to 100 m from the locations proposed during the planning stage assessment. From the perspective of a residence, micro-siting changes do not normally change wind farm noise levels because most turbine positions only move to a small degree, if at all, and, of those that do, some may move closer while others move further away.

In the highly unlikely event that all turbines at Wombelano Wind Farm were to move closer to the nearest residence, R12, by the maximum 100 m, the predicted noise level at the dwelling would increase by 1 dB, to 34 dB L_{A90}, remaining readily compliant with the minimum applicable noise limit of 40 dB L_{A90}.

4.2 Substation noise assessment

4.2.1 Noise prediction methodology

The same environmental noise model as for the wind farm noise assessment was used for the substation assessment. Based on advice from the Proponent, the substation is to be located as shown on Figure 1 and at the coordinates listed in Appendix A.

We understand that a transformer rated no higher than 50 MVA is expected to be used in the substation. The octave band sound power level of the transformer has been determined in accordance with Australian/New Zealand Standard AS/NZS 60076.10:2009 *Power Transformers Part 10 Determination of sound levels* and is shown in Table 6.

Table 6 Assumed 50 MVA transformer sound power levels

Transformer	Sound power level in dB L_{WA} at octave band centre frequency in Hz									Overall
	31.5	63	125	250	500	1000	2000	4000	8000	dB L_{WA}
50 MVA	64.1	68.9	76.9	84.4	86.8	79.0	76.2	69.0	64.9	89.8

The ISO 9613-2 prediction algorithm was used. ISO 9613-2 advises that the application of this algorithm results in predicted noise levels representative of downwind propagation to receivers or propagation under a well-developed moderate ground-based temperature inversion. The same air and ground absorption parameters have been adopted as detailed in Section 4.1

The transformer was modelled at a height of 4 m above ground level and a 5 dB penalty was applied to the predicted noise levels to account for potential audible tonality, although this is considered unlikely given the distance between the substation and nearest noise-sensitive land uses.

4.2.2 Predicted substation noise levels

The substation is over one kilometre from the nearest residence (R12). The highest predicted substation noise level at any receiver location is 21 dB L_{Aeq} at R12, including any potential tonality penalty. On this basis, it is expected that the substation and transformer will be able to easily operate in compliance with the NIRV night noise limits.

As discussed in Appendix C, ISO 9613-2 advises a typical prediction accuracy of ±3 dB at distances of up to 1 km. Given the significant margin between the predicted noise level and the NIRV night limit, this is not expected to impact on compliance.

4.3 Requirements checklist

A checklist identifying the relevant requirements of the Planning Scheme, Wind Farm Guidelines and NZS 6808:2010 for pre-construction noise assessments is included in Appendix D. The checklist also identifies where, within this report, each requirement has been addressed.

5 Recommendations

5.1 Noise monitoring

Clause 7.1.4 of NZS 6808:2010 states that background noise monitoring should be conducted at non-involved locations within the 35 dB L_{A90} contour. As shown in Appendix B, no noise-sensitive locations have been identified within the 35 dB contour, with the highest predicted noise level at any location being 33 dB L_{A90}. Therefore, no background noise monitoring needs to be conducted under NZS 6808:2010.

Under the Wind Farm Guidelines, however, it will be necessary for a Noise Management Plan to be developed after planning approval has been received, detailing how post-construction noise measurements are to be implemented. Based on the predicted noise levels from the wind farm, it is recommended that post-construction noise monitoring be carried out at R1 and R12, which are the only locations with predicted wind farm noise levels above 30 dB L_{A90}.

Given the relatively low predicted wind farm noise levels at R1 and R12, this post-construction noise monitoring may consist of:

- Noise monitoring at the residence or an appropriate intermediate location for a period of at least 10 days as per the normal requirements of NZS 6808:2010. It should be noted that, in general, it is advisable to have conducted background noise monitoring prior to undertaking measurements at a residence or intermediate location to assist in determining the contribution of wind farm noise to the operational measurements. This background noise monitoring may be conducted post-approval, however, given the background noise levels are not required for assessing compliance of predicted noise levels with the noise limits.
- Attended on/off testing as per Section 7.7 of NZS 6808:2010.

The noise monitoring procedure would need to be documented in a Noise Management Plan as per the requirements of the Wind Farm Guidelines.

5.2 Wind turbine selection

If a different wind turbine type is selected to the to the Vestas V162-6.0MW with a sound power level higher than 105.3 dB L_{WA}, then an updated pre-construction noise assessment should be undertaken to assess compliance with the relevant noise limits.

It is noted that higher sound power levels would not necessarily mean non-compliance. Typical modern wind turbines have sound power levels in the range of 104 to 107 dB L_{WA} and predicted wind farm noise levels are at least 7 dB below the relevant noise limits at all receivers with the current WTG selection.

It is also recommended that a contractual clause be included in the procurement contract to ensure the selected turbines do not produce tonal audibility that would attract a penalty at residential locations when assessed in accordance with NZS 6808:2010.

6 Conclusion

This report presents an environmental noise assessment of the proposed Wombelano Wind Farm in accordance with the Wind Farm Guidelines and NZS 6808:2010.

Based on the proposed wind turbine model, wind farm layout and the minimum applicable NZS 6808:2010 limits for the wind farm, noise levels from the Wombelano Wind Farm are predicted to be compliant with the requirements of NZS 6808:2010.

Substation noise levels are also predicted to comply with the relevant environmental noise limits as defined by the NIRV Guidelines.

Appendix A—Turbine and receiver coordinates

Table A1 Proposed Wombelano Wind Farm turbine coordinates in UTM WGS84 Zone 54S

Turbine	Easting	Northing
1	548723	5904928
2	548871	5904327
3	549012	5903716
4	547600	5903881
5	547657	5904365
6	547733	5904876
7	547837	5905344

Table A2 Proposed Wombelano Wind Farm substation coordinates in UTM WGS84 Zone 54S

Item	Easting	Northing
Substation	548734	5905121

Table A3 Wombelano Wind Farm noise sensitive receiver locations in UTM WGS84 Zone 54S

Receiver	Involved	Easting	Northing	Nearest turbine	Horizontal distance to nearest turbine, m
R1	No	549787	5902587	4	1369
R2	No	549492	5901389	4	2376
R3	No	547851	5901463	6	2431
R4	No	547803	5901488	6	2402
R5	No	546649	5902140	6	1984
R6	Yes	545089	5905922	5	2808
R7	No	545493	5906581	5	2651
R8	No	545939	5907476	5	2855
R9	No	546645	5907676	5	2620
R10	No	547237	5907533	5	2269
R11	No	545224	5905632	7	2621
R12	No	549356	5905990	1	1237
R13	No	552199	5902521	4	3403
R14	No	553453	5903028	4	4494
R15	No	554109	5902724	4	5193
R16	No	553837	5904335	4	4865
R17	No	553846	5904306	4	4869

Receiver	Involved	Easting	Northing	Nearest turbine	Horizontal distance to nearest turbine, m
R18	No	554034	5904425	4	5072
R19	No	553869	5904635	4	4943
R20	No	553840	5905172	2	5041
R21	No	541628	5905610	7	6150
R22	No	541630	5905657	7	6153
R23	No	537715	5903825	6	9885
R24	No	537807	5903871	6	9793
R25	No	531479	5904131	6	16122
R26	No	531154	5904702	6	16467
R27	No	534343	5899895	6	13843
R28	No	534273	5900541	6	13739
R29	No	530860	5900959	6	16993
R30	No	532392	5900924	6	15493
R31	No	539843	5906611	7	8079
R32	No	540033	5906637	7	7899
R33	No	539867	5906759	7	8088
R34	No	542953	5905692	7	4850
R35	No	542371	5905791	7	5440
R36	No	554851	5906097	2	6237
R37	No	554897	5906096	2	6280
R38	No	556712	5904237	4	7718
R39	No	543775	5901855	6	4328
R40	No	535294	5906875	7	12598
R41	No	533174	5906739	3	14677
R42	No	534991	5907979	5	13113
R43	No	535568	5909584	5	12981
R44	No	535341	5911142	5	13776
R45	No	535415	5911015	5	13655
R46	No	535215	5911075	5	13862
R47	No	535289	5911154	5	13828
R48	No	535648	5909746	5	12960
R49	No	539591	5911746	5	10439

Receiver	Involved	Easting	Northing	Nearest turbine	Horizontal distance to nearest turbine, m
R50	No	540192	5911930	5	10090
R51	No	539667	5912617	5	10938
R52	No	540190	5913893	5	11470
R53	No	540369	5914024	5	11451
R54	No	544943	5913472	5	8628
R55	No	545127	5910666	5	5972
R56	No	545064	5910267	5	5650
R57	No	549863	5895671	4	8090
R58	No	550018	5895813	4	7967
R59	No	547619	5909707	5	4369
R60	No	548339	5909961	5	4645
R61	No	550922	5899041	4	5050
R62	No	550997	5898946	4	5166
R63	No	553760	5901739	4	5144
R64	No	552200	5905027	2	3402

Appendix B—Topographic and noise contour maps

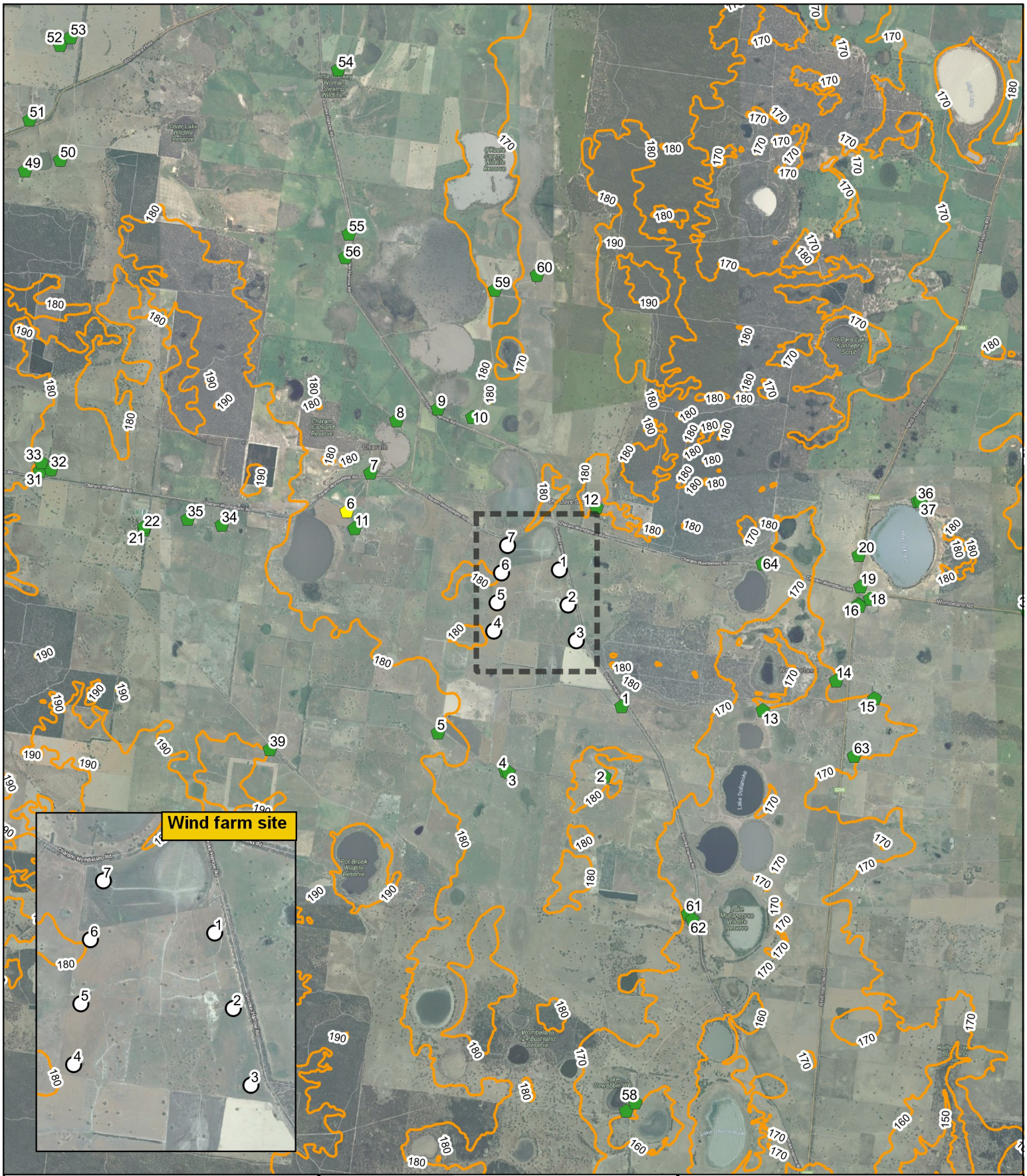


FIGURE B1: Wombelano Wind Farm Topographic Map

Legend

- Wind turbine
- 10 m elevation line

Noise-sensitive land use

- Involved
- Non-Involved

0 1,000 2,000 3,000 m

Datum WGS 84, Projection UTM ZONE 54S

PROJECT NUMBER	M200708
DRAWN BY	TRE
DATE ISSUED	December 2020
CLIENT	Wind Projects Australia

Resonate

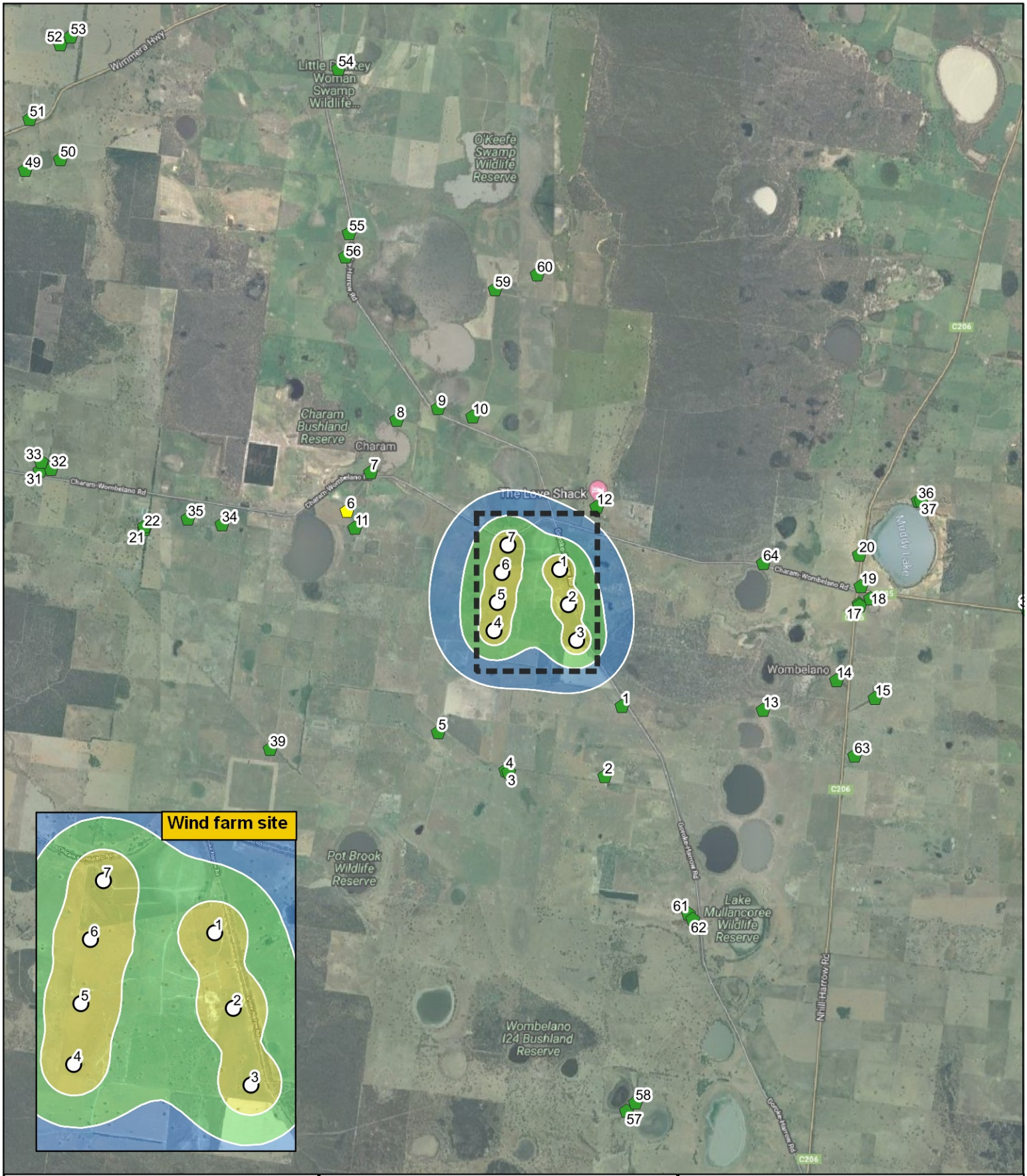


FIGURE B2: Wombelano Wind Farm Noise Contour Map

PROJECT NUMBER	M200708
DRAWN BY	TRE
DATE ISSUED	December 2020
CLIENT	Wind Projects Australia

○ Wind turbine

Noise-sensitive land use

- Involved
- Non-Involved

Predicted noise level

- 35-40 dB LA90
- 40-45 dB LA90
- >45 dB LA90

0 1,000 2,000 3,000 m

Datum WGS 84, Projection UTM ZONE 54S

Resonate

Appendix C—Noise prediction uncertainty

Appendix C of NZS 6808:2010 recommends that an assessment of uncertainty be included in an assessment conducted under the Standard. The discussion in NZS 6808:2010 relates to measurement uncertainty, which is not relevant to this assessment. With regards to uncertainty at the design stage, Appendix C of NZS 6808:2010 states that compliance with the wind farm noise limits is assessed on the basis of the predicted wind farm noise level, regardless of the uncertainty. However, some discussion the uncertainty associated with the predicted noise levels can be provided at the design stage.

Uncertainty in the predicted wind farm noise levels are a result of two main factors:

- uncertainty inherent in the prediction methodology
- uncertainty in the assumed sound power levels of the turbines.

Uncertainty in other inputs, such as the position of turbiens and the location of residences, may also exist but are likely to have an insignificant impact on the prediction uncertainty as small changes in position do not result in any noticeable change in predicted noise levels when the distance between source and receiver is over 2 km.

Uncertainty in predictions

For the prediction methodology adopted, ISO 9613-2:1996 provides a discussion on uncertainty and advises a typical accuracy of overall A-weighted noise levels of ±3 dB at distances of up to 1 km from the source. It does not advise on the accuracy of predictions at distances further than this.

Given that the nearest non-involved residences are slightly further than 1 km from the nearest turbines, this suggests that an accuracy in the order of ±3 dB could be expected for the wind farm noise predictions. However, it should also be noted that the ISO 9613-2 statement of accuracy is based on sources that are located less than 30 m above ground. As turbines are located much higher above ground than normal noise sources, there is less potential for the uncertainties associated with ground attenuation effects and topographic shielding to reduce the prediction accuracy for wind turbine noise.

In considering the above, it should be noted that the ISO 9613-2 accuracy in the order of ±3 dB is applicable to individual predictions – that is, the predicted wind farm noise level for a particular 10-minute period. Given the use of NZS 6808:2010, the following factors reduce the uncertainty of wind farm noise predictions or tend the predictions towards conservatism thereby reducing the likelihood of any under-prediction:

- NZS 6808:2010 requires that wind farm noise levels are assessed based on a large number of 10-minute data points (at least 1440 data points) that are correlated with wind speed, with an average noise level determined for each wind speed. In practice, this reduces the uncertainty associated with predictions due to the large number of data points that would be collected and averaged during any measurement campaign. A study performed on Australian wind farms that examined the difference between predicted noise levels using ISO 9613-2 and measured downwind noise levels in general accordance with NZS 6808:2010 found that the predictions were within ±1 dB for sloping or relatively flat sites when appropriate prediction parameters were used.[4]
- The predictions are based on downwind conditions – that is, where the residence is downwind of the nearest turbines. NZS 6808:2010 does not specifically require the assessment to be carried out for downwind conditions and so, if compliance measurements include periods where there are some crosswind or upwind conditions, then the measured noise level would be lower. This increases the conservatism of the predictions.

[4] Evans T & Cooper J, 2012, *Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms*, Acoustics Australia, vol. 40, no. 1, pp 28-36.

Uncertainty in sound power levels

Sound power levels of wind turbines are quantified in accordance with measurement standard IEC 61400-11 Edition 3.0 *Wind turbines – Part 11: Acoustic noise measurement techniques* (IEC 61400-11). The measurement process includes quantification of the uncertainty in the sound power level at each wind speed as documented in IEC 61400-11.

The sound power level provided by Vestas for their candidate turbine does specify if it includes an allowance for measurement uncertainty. As a cautious approach, a 1 dB adjustment has been applied to increase the sound power levels for the Vestas turbines and is considered appropriate to address uncertainty in the wind turbine sound power levels for this assessment.

Summary

Given the methods by which wind turbine noise is measured in Victoria and previous assessments of wind turbine noise modelling accuracy, the uncertainty associated with the predicted noise levels is considered small. Conservative assumptions in the prediction methodology are likely to offset any uncertainty, resulting in over prediction of noise levels at residences.

It is noted that Appendix C of NZS 6808:2010 states that compliance with the wind farm noise limits is assessed on the basis of the predicted wind farm noise level, regardless of the uncertainty.

Appendix D—Requirements checklist

Document	Relevant requirement for pre-construction noise assessment	Where addressed in this report
West Wimmera Planning Scheme Clause 52.32	A pre-construction (predictive) noise assessment report demonstrating that the proposal can comply with the New Zealand Standard NZS6808:2010, Acoustics – Wind Farm Noise, including an assessment of whether a high amenity noise limit is applicable under Section 5.3 of the Standard.	This Report. High Amenity is addressed in Section 3.1.
Victorian *Development of Wind Energy Facilities in Victoria – Policy and Planning Guidelines*, March 2019 Section 5.1.2(a) Noise	A wind energy facility must comply with the noise limits recommended for in the New Zealand Standard NZS 6808:2010 Acoustics – Wind Farm Noise (the Standard).	Noise limits stated in Section 3.1. Compliance with limits assessed in Section 4.1.
	The Standard specifies a general 40 decibel limit (40 dB $L_{A90(10min)}$) for wind energy facility sound levels outdoors at noise sensitive locations, or that the sound level should not exceed the background sound level by more than five decibels (referred to as 'background sound level +5 dB'), whichever is the greater.	Limits stated in Section 3.1.4.
	A 45-decibel limit is recommended for stakeholder dwellings. A stakeholder dwelling is one on the wind energy facility site, or one that has an agreement with the wind energy facility to exceed the noise limit.	Limits stated in Section 3.1.5.
	Under section 5.3 of the Standard, a 'high amenity noise limit' of 35 decibels applies in special circumstances. All wind energy facility applications must be assessed using Section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in clause C5.3.1 of the Standard. Guidance can be found on this issue in the VCAT determination for the Cherry Tree Wind Farm.	High Amenity is assessed in Section 3.1.4.

Document	Relevant requirement for pre-construction noise assessment	Where addressed in this report
Victorian *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria*, January 2016 Section 5.1.2(a) Noise	These assessments must be undertaken by an acoustic engineer. The wind energy facility operator must provide the responsible authority with an assessment by an appropriately qualified and experienced acoustician that demonstrates whether the facility is compliant with the noise standard. The acoustician must be able to demonstrate to the responsible authority appropriate qualifications and experience to carry out the task. Measurement and compliance assessment methods are set out in the Standard.	This Report has been authored and reviewed by qualified, experienced acoustic consultants. The primary author Tom Evans is a Member of the Australian Acoustical Society and has over 14 years of experience in the assessment of wind farm noise.
New Zealand Standard NZS 6808:2010 *Acoustics – Wind farm noise* Section 8 Documentation Section 8.1 Predictions	Any report of wind farm sound level predictions in accordance with this Standard shall refer to this Standard and provide the following:	NZS 6808:2010 referenced throughout this report, with noise limits included in Section 3.1.
	• A map showing the topography (contour lines) in the vicinity of the wind farm, the position of the wind turbines, and noise sensitive locations;	Appendix B Figure B1
	• Noise sensitive locations for which wind farm sound levels are calculated;	Section 2.1 Figure 1 and Appendix A
	• Wind turbine sound power levels;	Section 2.2
	• The make and model of the wind turbines;	Section 2.2
	• The hub-height of the wind turbines;	Section 2.2
	• Distance of noise sensitive locations from the wind turbines;	Appendix A
	• Calculation procedure used;	Section 4.1
	• Meteorological conditions assumed;	Section 4.1
	• Air absorption parameters used;	Section 4.1 Table 4
	• Ground attenuation parameters used;	Section 4.1
	• Topography/screening assumed; and	Section 4.1
	• Predicted far-field wind farm sound levels.	Section 4.1 Table 5

Restricted
Document no 0095-3732_00

Third octave noise emission

EnVentus™ V162-6.0MW

Abstract

This document serves as a paper behind the General Specification.

The document describes the measured/estimated third octave spectra for noise levels according to the General Specification.

The document is a living document and will be updated regularly.

When new measurements exist, the document might be updated.

Contents

1. Introduction

The purpose of this document is to present the expected third octave noise spectra for the V162 EnVentus™ turbine when operated in the PO6000 mode.

Test results for this turbine are not yet available, so data are based on test results from turbines with rotors that are as close as possible in size the V162. All results are thus based upon internal measurement results obtained on V136 turbines.

2. Method

2.1 Procedure

During measurements, a very large number of correlated values for noise emission spectra and turbine operating parameters are identified.

From these a relation between noise emission within each 1/3 octave band, wind speed and operational conditions are extracted. By combination of these extracted values and the actual turbine operation and rotor size, an estimate of the actual 1/3 octave performance is obtained.

The frequency content is limited to the frequency range 6.3 Hz to 10 kHz to secure that measurement system limitations are not influencing the findings. The stated spectral values are thus representative for the expected noise emission from the turbine at each wind speed.

The method is verified as giving results corresponding to direct measured values.

The reported wind speed range cover hub height wind speeds from 3 to 20 m/s. Extrapolations outside this wind speed range is not possible due to limitations in the measured input data.

The stated values do not in any way enable issuing guarantees.

2.2 Physical environment

The results are valid for the downwind reference position as defined according to IEC 61400-11 Ed.3.

Applicable environmental conditions are thus corresponding to the standardized requirements as described directly and indirectly in IEC 61400-11.

These can be interpreted as air density 1.225 kg/m^3, yaw errors below +/- 15 deg. and vertical inflow angles below +/- 10 deg. Blade condition is clean and undamaged.

3. Results

3.1 Results V162 PO6000

Frequency	Hub height wind speeds [m/s]																	
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s	14 m/s	15 m/s	16 m/s	17 m/s	18 m/s	19 m/s	20 m/s
6.3 Hz	20.4	22.0	21.6	22.9	26.1	29.2	31.5	32.0	32.5	32.5	31.9	31.0	30.1	29.2	28.1	27.0	25.5	23.9
8 Hz	26.9	28.5	28.2	29.6	32.8	35.8	38.1	38.6	39.0	38.9	38.3	37.5	36.6	35.8	34.8	33.7	32.3	30.7
10 Hz	32.7	34.2	34.1	35.5	38.6	41.7	43.9	44.4	44.8	44.6	44.1	43.3	42.4	41.7	40.6	39.7	38.3	36.9
12.5 Hz	38.2	39.7	39.6	41.1	44.2	47.2	49.5	49.9	50.2	50.0	49.5	48.7	47.9	47.2	46.2	45.3	44.1	42.7
16 Hz	43.9	45.3	45.3	46.9	50.0	52.9	55.2	55.6	55.8	55.6	55.1	54.4	53.6	53.0	52.1	51.2	50.0	48.8
20 Hz	48.8	50.1	50.2	51.8	54.9	57.8	60.0	60.4	60.6	60.4	59.9	59.2	58.5	57.8	57.0	56.2	55.1	53.9
25 Hz	53.3	54.6	54.7	56.4	59.4	62.4	64.6	64.9	65.1	64.8	64.3	63.7	63.0	62.4	61.6	60.9	59.9	58.8
31.5 Hz	57.6	58.9	59.1	60.8	63.8	66.7	68.9	69.2	69.4	69.1	68.6	68.0	67.4	66.9	66.1	65.4	64.5	63.5
40 Hz	61.8	63.0	63.3	65.0	68.0	70.9	73.1	73.3	73.4	73.2	72.7	72.2	71.6	71.1	70.4	69.8	68.9	68.0
50 Hz	65.4	66.5	66.8	68.5	71.6	74.4	76.6	76.9	76.9	76.7	76.2	75.7	75.2	74.7	74.1	73.5	72.8	71.9
63 Hz	68.8	69.8	70.1	71.9	74.9	77.8	79.9	80.2	80.2	80.0	79.6	79.1	78.6	78.2	77.6	77.1	76.4	75.6
80 Hz	71.9	72.9	73.2	75.0	78.0	80.9	83.0	83.2	83.2	83.0	82.6	82.2	81.8	81.4	80.9	80.4	79.8	79.1
100 Hz	74.5	75.4	75.8	77.6	80.6	83.4	85.6	85.8	85.8	85.5	85.2	84.8	84.4	84.1	83.6	83.2	82.7	82.1
125 Hz	76.8	77.6	78.0	79.9	82.9	85.7	87.8	88.0	88.0	87.8	87.5	87.1	86.8	86.5	86.1	85.7	85.2	84.7
160 Hz	79.0	79.7	80.1	82.0	85.0	87.8	89.9	90.1	90.1	89.9	89.6	89.3	89.0	88.8	88.4	88.1	87.7	87.3
200 Hz	80.7	81.3	81.7	83.6	86.6	89.4	91.5	91.7	91.6	91.4	91.2	91.0	90.7	90.5	90.2	90.0	89.6	89.2
250 Hz	82.0	82.6	82.9	84.8	87.8	90.6	92.7	92.9	92.8	92.7	92.5	92.3	92.1	91.9	91.7	91.5	91.2	90.9
315 Hz	83.1	83.6	83.9	85.8	88.8	91.6	93.7	93.9	93.8	93.7	93.5	93.4	93.2	93.1	93.0	92.8	92.6	92.3
400 Hz	83.8	84.2	84.5	86.4	89.4	92.2	94.3	94.5	94.4	94.3	94.3	94.2	94.1	94.0	93.9	93.8	93.6	93.4
500 Hz	84.2	84.5	84.8	86.7	89.7	92.5	94.6	94.7	94.7	94.7	94.6	94.6	94.5	94.5	94.4	94.4	94.3	94.2
630 Hz	84.3	84.5	84.7	86.6	89.6	92.4	94.5	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.6	94.6
800 Hz	84.0	84.1	84.3	86.2	89.2	92.0	94.1	94.3	94.3	94.3	94.4	94.4	94.5	94.5	94.6	94.6	94.7	94.7
1 kHz	83.5	83.4	83.5	85.4	88.4	91.2	93.3	93.5	93.6	93.7	93.8	93.9	94.0	94.1	94.2	94.3	94.4	94.5
1.25 kHz	82.6	82.4	82.5	84.4	87.4	90.2	92.3	92.5	92.6	92.7	92.9	93.0	93.2	93.3	93.5	93.6	93.8	93.9
1.6 kHz	81.2	81.0	80.9	82.8	85.8	88.6	90.8	91.0	91.1	91.3	91.5	91.8	92.0	92.1	92.3	92.5	92.7	93.0
2 kHz	79.7	79.3	79.2	81.1	84.1	86.9	89.0	89.3	89.4	89.7	90.0	90.3	90.5	90.7	91.0	91.2	91.5	91.8
2.5 kHz	77.9	77.4	77.1	79.0	82.0	84.9	87.0	87.2	87.4	87.8	88.1	88.5	88.8	89.0	89.3	89.6	89.9	90.3
3.15 kHz	75.7	75.0	74.7	76.5	79.6	82.4	84.6	84.8	85.0	85.5	85.9	86.3	86.7	87.0	87.3	87.6	88.0	88.4
4 kHz	73.0	72.2	71.8	73.6	76.6	79.5	81.7	82.0	82.2	82.7	83.2	83.7	84.1	84.5	84.9	85.2	85.7	86.1
5 kHz	70.2	69.3	68.7	70.5	73.6	76.5	78.7	79.0	79.3	79.9	80.4	81.0	81.4	81.8	82.3	82.7	83.2	83.7
6.3 kHz	67.0	65.9	65.2	67.0	70.1	73.0	75.2	75.5	75.9	76.6	77.2	77.8	78.3	78.7	79.3	79.7	80.2	80.8
8 kHz	63.3	62.1	61.3	63.0	66.1	69.1	71.3	71.6	72.1	72.8	73.5	74.2	74.8	75.2	75.8	76.3	76.9	77.5
10 kHz	59.6	58.2	57.2	58.9	62.1	65.0	67.3	67.6	68.2	69.0	69.8	70.5	71.1	71.6	72.3	72.8	73.4	74.1
A-wgt	93.9	94.1	94.3	96.2	99.2	102.0	104.1	104.3	104.3	104.3	104.3	104.3	104.3	104.3	104.3	104.3	104.3	104.3

Table 1: V162-PO6000, expected 1/3 octave band performance

(Blades with serrated trailing edges)

Frequency	Hub height wind speeds [m/s]																	
	3 m/s	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s	14 m/s	15 m/s	16 m/s	17 m/s	18 m/s	19 m/s	20 m/s
6.3 Hz	15.5	14.8	14.8	16.8	19.8	22.6	24.7	24.9	24.9	25.2	25.6	26.1	26.6	27.0	27.5	28.0	28.6	29.3
8 Hz	22.7	22.0	22.0	24.1	27.1	30.0	32.1	32.2	32.2	32.5	33.0	33.4	33.9	34.3	34.8	35.3	35.9	36.5
10 Hz	29.2	28.5	28.5	30.6	33.6	36.5	38.6	38.8	38.8	39.1	39.5	39.9	40.4	40.8	41.3	41.7	42.3	42.9
12.5 Hz	35.2	34.6	34.6	36.7	39.8	42.6	44.8	44.9	44.9	45.2	45.6	46.1	46.5	46.9	47.4	47.8	48.4	48.9
16 Hz	41.6	41.0	41.0	43.1	46.2	49.0	51.2	51.4	51.4	51.6	52.0	52.5	52.9	53.2	53.7	54.1	54.7	55.2
20 Hz	46.9	46.4	46.4	48.5	51.6	54.5	56.7	56.8	56.8	57.1	57.5	57.9	58.3	58.6	59.1	59.5	60.0	60.5
25 Hz	52.0	51.4	51.5	53.6	56.7	59.6	61.8	61.9	62.0	62.2	62.6	63.0	63.3	63.7	64.1	64.5	65.0	65.5
31.5 Hz	56.8	56.3	56.4	58.5	61.6	64.5	66.7	66.9	66.9	67.1	67.5	67.8	68.2	68.5	68.9	69.3	69.8	70.2
40 Hz	61.5	61.0	61.1	63.2	66.3	69.2	71.4	71.6	71.6	71.8	72.2	72.5	72.9	73.2	73.5	73.9	74.3	74.7
50 Hz	65.5	65.1	65.1	67.2	70.4	73.3	75.5	75.7	75.7	75.9	76.2	76.5	76.8	77.1	77.5	77.8	78.2	78.6
63 Hz	69.2	68.9	68.9	71.1	74.2	77.1	79.3	79.5	79.5	79.7	80.0	80.3	80.6	80.8	81.2	81.5	81.8	82.2
80 Hz	72.8	72.5	72.5	74.6	77.8	80.7	82.9	83.1	83.1	83.3	83.5	83.8	84.1	84.3	84.6	84.9	85.2	85.6
100 Hz	75.7	75.5	75.5	77.6	80.8	83.7	85.9	86.1	86.1	86.2	86.5	86.7	87.0	87.2	87.5	87.7	88.0	88.3
125 Hz	78.3	78.1	78.2	80.3	83.4	86.4	88.5	88.7	88.7	88.9	89.1	89.3	89.5	89.7	90.0	90.2	90.5	90.7
160 Hz	80.8	80.7	80.8	82.9	86.0	88.9	91.1	91.3	91.3	91.4	91.6	91.8	92.0	92.1	92.3	92.5	92.8	93.0
200 Hz	82.8	82.6	82.8	84.8	87.9	90.8	93.0	93.2	93.2	93.3	93.5	93.6	93.8	93.9	94.1	94.3	94.5	94.6
250 Hz	84.3	84.3	84.4	86.4	89.5	92.4	94.6	94.8	94.8	94.9	95.0	95.1	95.3	95.4	95.5	95.7	95.8	96.0
315 Hz	85.6	85.6	85.8	87.8	90.9	93.7	95.9	96.1	96.1	96.1	96.2	96.4	96.5	96.5	96.6	96.7	96.8	96.9
400 Hz	86.5	86.6	86.8	88.8	91.8	94.7	96.8	97.0	97.0	97.1	97.1	97.2	97.3	97.3	97.4	97.5	97.5	97.6
500 Hz	87.1	87.2	87.4	89.3	92.4	95.2	97.3	97.5	97.5	97.6	97.6	97.6	97.7	97.7	97.7	97.8	97.8	97.8
630 Hz	87.3	87.5	87.7	89.6	92.6	95.4	97.5	97.7	97.7	97.7	97.7	97.7	97.7	97.7	97.7	97.7	97.7	97.6
800 Hz	87.1	87.4	87.6	89.5	92.4	95.2	97.3	97.5	97.5	97.5	97.5	97.4	97.4	97.4	97.3	97.2	97.2	97.1
1 kHz	86.6	86.9	87.1	89.0	92.0	94.7	96.8	97.0	97.0	97.0	96.9	96.8	96.7	96.7	96.6	96.5	96.3	96.2
1.25 kHz	85.8	86.1	86.4	88.2	91.1	93.9	95.9	96.1	96.1	96.1	96.0	95.8	95.7	95.6	95.5	95.3	95.2	95.0
1.6 kHz	84.4	84.9	85.1	86.9	89.8	92.5	94.5	94.8	94.7	94.7	94.5	94.4	94.2	94.0	93.9	93.7	93.5	93.2
2 kHz	82.9	83.4	83.7	85.4	88.3	90.9	93.0	93.2	93.2	93.0	92.9	92.6	92.4	92.3	92.0	91.8	91.5	91.3
2.5 kHz	81.0	81.6	81.9	83.6	86.4	89.0	91.0	91.2	91.2	91.1	90.8	90.6	90.3	90.1	89.8	89.6	89.3	88.9
3.15 kHz	78.7	79.4	79.7	81.3	84.1	86.7	88.6	88.8	88.8	88.7	88.4	88.1	87.8	87.6	87.2	86.9	86.5	86.2
4 kHz	75.9	76.7	77.0	78.6	81.3	83.9	85.8	86.0	86.0	85.8	85.5	85.2	84.8	84.5	84.1	83.7	83.3	82.9
5 kHz	73.0	73.8	74.2	75.7	78.4	80.9	82.8	83.0	83.0	82.8	82.4	82.0	81.6	81.3	80.9	80.4	80.0	79.5
6.3 kHz	69.6	70.5	70.9	72.4	75.0	77.5	79.3	79.5	79.5	79.3	78.9	78.4	78.0	77.6	77.1	76.6	76.1	75.6
8 kHz	65.8	66.7	67.1	68.6	71.1	73.5	75.4	75.6	75.6	75.3	74.8	74.3	73.8	73.4	72.9	72.3	71.7	71.2
10 kHz	61.8	62.9	63.3	64.6	67.1	69.5	71.3	71.5	71.5	71.2	70.7	70.1	69.6	69.1	68.5	67.9	67.3	66.7
A-wgt	96.7	96.9	97.1	99.0	102.0	104.8	106.9	107.1	107.1	107.1	107.1	107.1	107.1	107.1	107.1	107.1	107.1	107.1

Table 2: V162-PO6000-0S, expected 1/3 octave band performance

(Blades without serrated trailing edges)

4. Limitations

The values as stated in the present document are to be regarded as “best estimates” for the octave band performance for the turbine. The values are to be regarded as informative and cannot in any way be used as guaranteed for any projects.

The complete document can be handed out as pdf and must always be referred to using the complete document DMS number.

5. Recalculation to 10 m wind speeds

In case 10 m height wind speed references are required, recalculation of the stated values can be made using the following procedure:

1. The stated hub height wind speeds are recalculated to 10 m reference height.
2. Integer 10 m height wind speed related sound power levels are calculated using linear interpolation between the nearest non-integer values.

Recalculation is made using procedures as defined in IEC 61400-11 ed.3. Appendix D.

REGISTER SEARCH STATEMENT (Title Search) Transfer of Land Act 1958

VOLUME 09388 FOLIO 180

Security no : 124070112102W
Produced 30/01/2018 10:00 am

CROWN GRANT

LAND DESCRIPTION

Crown Allotment 48A Parish of Wombelano.

REGISTERED PROPRIETOR

Estate Fee Simple
TENANTS IN COMMON
As to 1 of a total of 2 equal undivided shares
Sole Proprietor
[redacted]
As to 1 of a total of 2 equal undivided shares
Sole Proprietor
[redacted]

ENCUMBRANCES, CAVEATS AND NOTICES

[redacted]

[redacted]

Any crown grant reservations exceptions conditions limitations and powers noted on the plan or imaged folio set out under DIAGRAM LOCATION below. For details of any other encumbrances see the plan or imaged folio set out under DIAGRAM LOCATION below.

DIAGRAM LOCATION

SEE TP311100A FOR FURTHER DETAILS AND BOUNDARIES

ACTIVITY IN THE LAST 125 DAYS

NIL

----------END OF REGISTER SEARCH STATEMENT----------

Additional information: (not part of the Register Search Statement)

Street Address: CHARAM-WOMBELANO ROAD WOMBELANO VIC 3409

ADMINISTRATIVE NOTICES

NIL

eCT Control 03500L BENDIGO AND ADELAIDE BANK LTD - SAFE CUSTODY
Effective from
21/07/2017

DOCUMENT END

Property Report from www.land.vic.gov.au on 20 March 2018 02:07 PM

Address: CHARAM-WOMBELANO ROAD WOMBELANO 3409
Crown Description: Allot. 48A PARISH OF WOMBELANO
Standard Parcel Identifier (SPI): 48A\PP3858
Local Government (Council): WEST WIMMERA **Council Property Number:** 1027465
Directory Reference: VicRoads 54 A2

This property is in a designated bushfire prone area.
Special bushfire construction requirements apply. Planning provisions may apply.

Further information about the building control system and building in bushfire prone areas can be found in the Building Commission section of the Victorian Building Authority website www.vba.vic.gov.au

State Electorates

Legislative Council: WESTERN VICTORIA
Legislative Assembly: LOWAN

Utilities

Regional Urban Water Business: Grampians Region Water
Rural Water Business: Grampians Wimmera-Mallee Rural Water
Melbourne Water: outside drainage boundary
Power Distributor: POWERCOR (Information about choosing an electricity retailer)

Planning Zone Summary

Planning Zone: FARMING ZONE (FZ)
SCHEDULE TO THE FARMING ZONE (FZ)
Planning Overlays: BUSHFIRE MANAGEMENT OVERLAY (BMO)
ENVIRONMENTAL SIGNIFICANCE OVERLAY (ESO)
ENVIRONMENTAL SIGNIFICANCE OVERLAY - SCHEDULE 2 (ESO2)
Areas of Aboriginal Cultural Heritage Sensitivity:
This property is within, or affected by, one or more areas of cultural heritage sensitivity

Planning information continued on next page

Land.vic.gov.au

Planning scheme data last updated on 14 March 2018.

A **planning scheme** sets out policies and requirements for the use, development and protection of land. This report provides information about the zone and overlay provisions that apply to the selected land. Information about the State, local, particular and general provisions of the local planning scheme that may affect the use of this land can be obtained by contacting the local council or by visiting Planning Schemes Online

This report is NOT a **Planning Certificate** issued pursuant to Section 199 of the Planning & Environment Act 1987. It does not include information about exhibited planning scheme amendments, or zonings that may abut the land. To obtain a Planning Certificate go to Titles and Property Certificates

The Planning Property Report includes separate maps of zones and overlays

For details of surrounding properties, use this service to get the Reports for properties of interest

To view planning zones, overlay and heritage information in an interactive format visit Planning Maps Online

For other information about planning in Victoria visit www.planning.vic.gov.au

Areas of Aboriginal Cultural Heritage Sensitivity

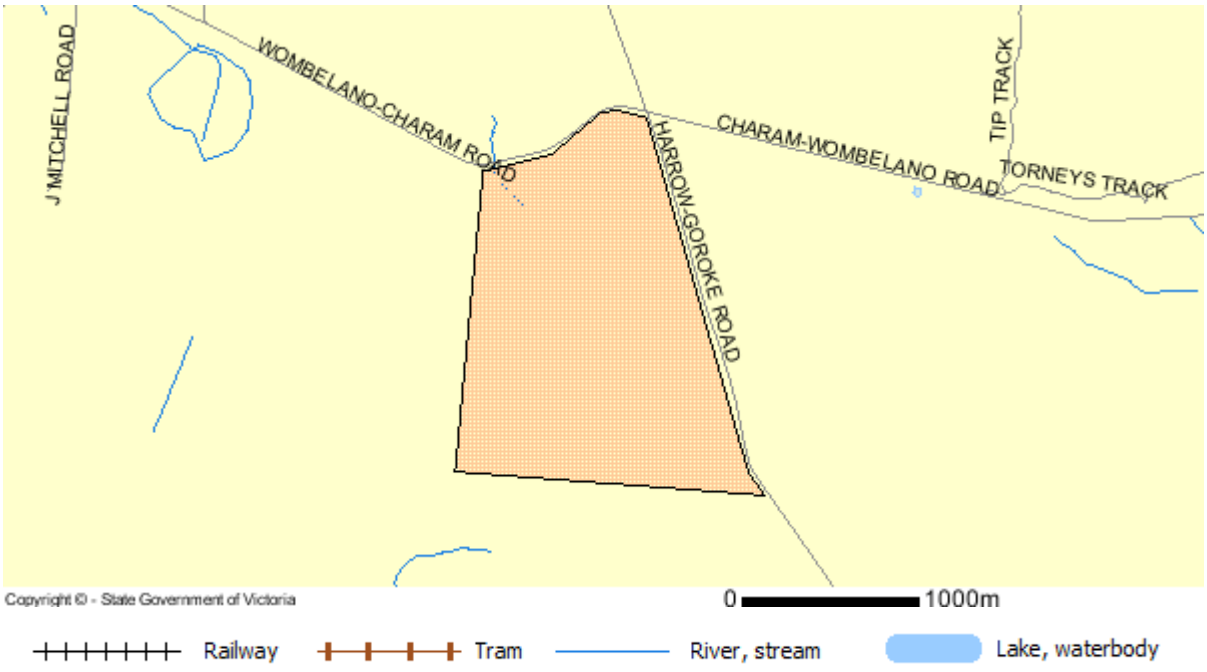
The data provides indicative information about the location and extent of areas of Aboriginal cultural heritage sensitivity and is provided to assist with the decisions about the potential need to prepare a Cultural Heritage Management Plan in relation to proposed activities on this property.

For further information about whether a Cultural Heritage Management Plan is required go to Aboriginal Heritage Planning Tool

To find out if your property has any recorded Aboriginal cultural heritage places, such as scarred trees, occupation sites or places of burial, you can request information from the Victorian Aboriginal Heritage Register.

Find out more about the Victorian Aboriginal Heritage Register

Area Map



Department of Environment, Land, Water and Planning

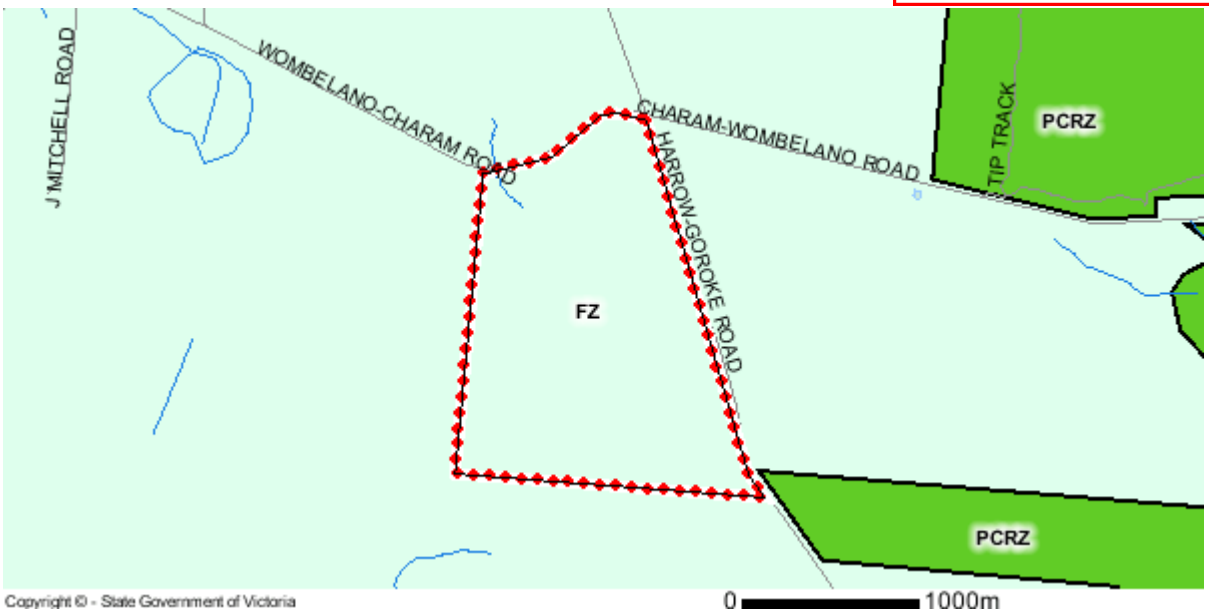
Planning Property Report

from www.planning.vic.gov.au on 20 March 2018 02:09 PM

Address: CHARAM-WOMBELANO ROAD WOMBELANO 3409
Crown Description: Allot. 48A PARISH OF WOMBELANO
Local Government (Council): WEST WIMMERA **Council Property Number:** 1027465
Directory Reference: VicRoads 54 A2

Planning Zone

FARMING ZONE (FZ)
SCHEDULE TO THE FARMING ZONE (FZ)



Note: labels for zones may appear outside the actual zone - please compare the labels with the legend.

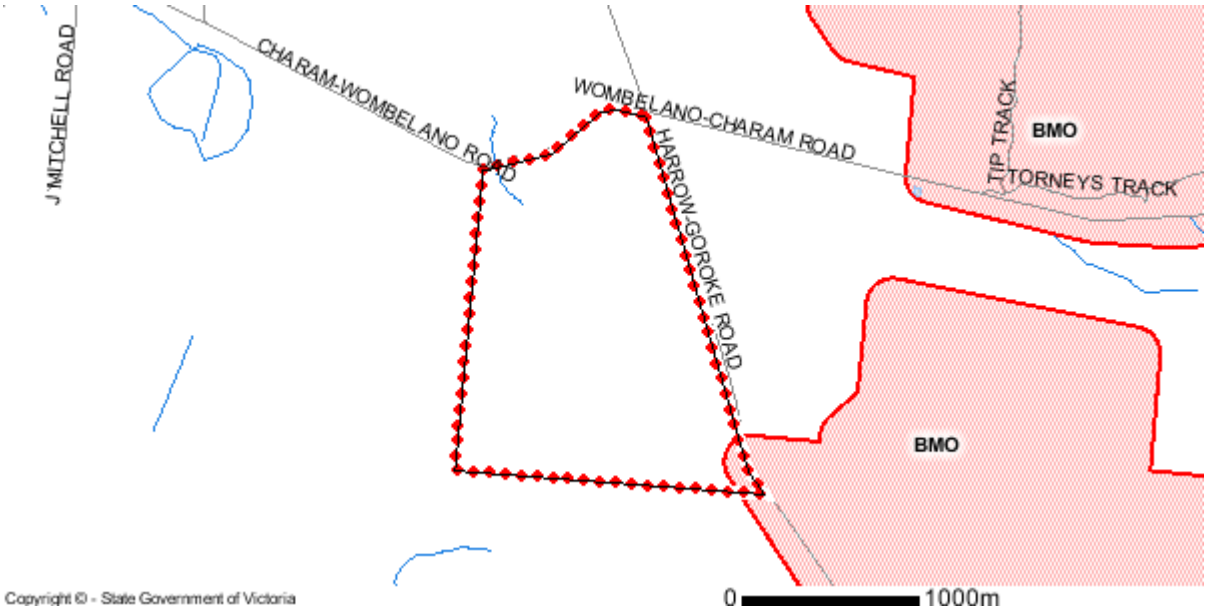
Zones Legend

- ACZ - Activity Centre
- B1Z - Commercial 1
- B2Z - Commercial 1
- B3Z - Commercial 2
- B4Z - Commercial 2
- B5Z - Commercial 1
- C1Z - Commercial 1
- C2Z - Commercial 2
- CA - Commonwealth Land
- CCZ - Capital City
- CDZ - Comprehensive Development
- DZ - Dockland
- ERZ - Environmental Rural
- FZ - Farming
- GRZ - General Residential
- GWAZ - Green Wedge A
- GWZ - Green Wedge
- IN1Z - Industrial 1
- IN2Z - Industrial 2
- IN3Z - Industrial 3
- LDRZ - Low Density Residential
- MUZ - Mixed Use
- NRZ - Neighbourhood Residential
- PCRZ - Public Conservation & Resource
- PDZ - Priority Development
- PPRZ - Public Park & Recreation
- PUZ1 - Public Use - Service & Utility
- PUZ2 - Public Use - Education
- PUZ3 - Public Use - Health Community
- PUZ4 - Public Use - Transport
- PUZ5 - Public Use - Cemetery/Crematorium
- PUZ6 - Public Use - Local Government
- PUZ7 - Public Use - Other Public Use
- PZ - Port
- R1Z - General Residential
- R2Z - General Residential
- R3Z - General Residential
- RAZ - Rural Activity
- RCZ - Rural Conservation
- RDZ1 - Road - Category 1
- RDZ2 - Road - Category 2
- RGZ - Residential Growth
- RLZ - Rural Living
- RUZ - Rural
- SUZ - Special Use
- TZ - Township
- UFZ - Urban Floodway
- UGZ - Urban Growth
- Urban Growth Boundary

Railway | Tram | River, stream | Lake, waterbody

Planning Overlays

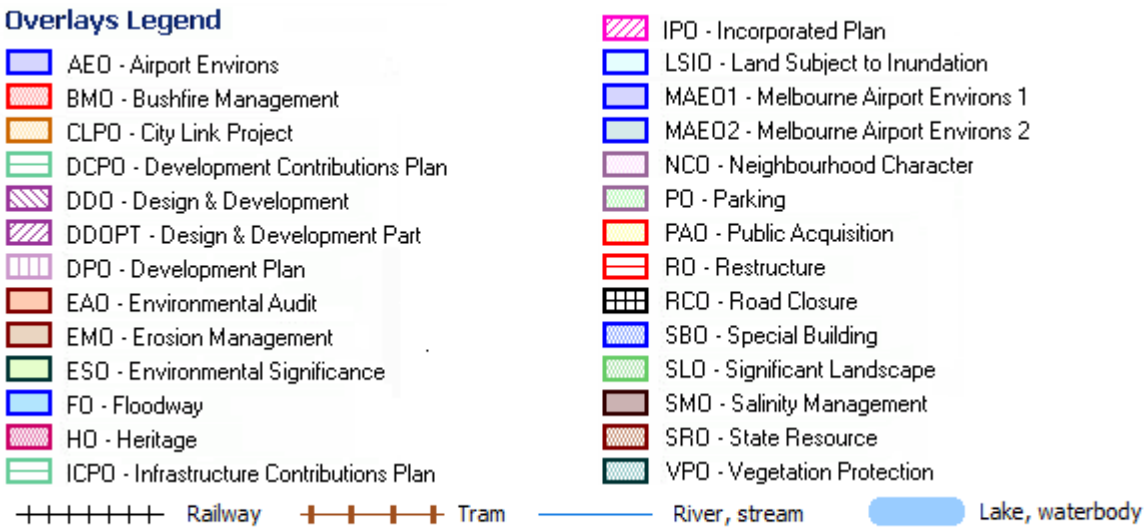
BUSHFIRE MANAGEMENT OVERLAY (BMO)



ENVIRONMENTAL SIGNIFICANCE OVERLAY (ESO)

ENVIRONMENTAL SIGNIFICANCE OVERLAY - SCHEDULE 2 (ESO2)

Planning Overlays Legend



Note: due to overlaps some colours on the maps may not match those in the legend.

Areas of Aboriginal Cultural Heritage Sensitivity

This property is within, or is affected by, one or more areas of cultural heritage sensitivity as described in the Aboriginal Heritage Regulations 2007.

The data provides indicative information about the location and extent of areas of Aboriginal cultural heritage sensitivity and is provided to assist with the decisions about the potential need to prepare a Cultural Heritage Management Plan in relation to proposed activities on this property.

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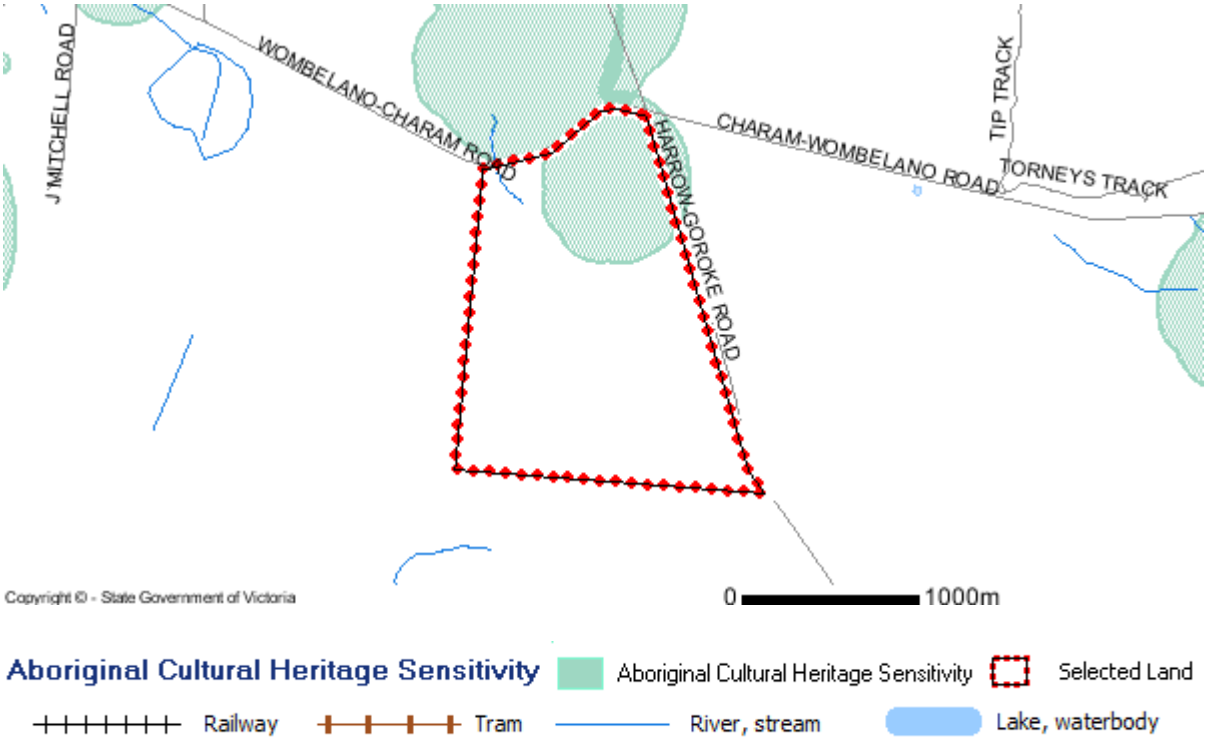

Further Planning Information

Planning scheme data last updated on 14 March 2018.

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