Willatook Wind Farm

Peer Review of April 2022 Environmental Noise Assessments

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Report revision	Date	Description	Author	Reviewer
0	7 March 2022	For Issue	Tom Evans	Damien van Raaphorst
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Glossary

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.
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.
Decibel (dB)	Unit of measurement used to express sound level (as dB). We typically perceive a 10 dB increase in sound as a doubling of that sound level.
dB(A)	'A' Weighted sound level in dB.
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second. The human ear responds to sound in the frequency range of 20 to 20,000 Hz.
L_{eq}	The energy averaged equivalent noise level over a measurement period.
L_{90}	Noise level exceeded for 90% of the measurement time as required under NZS 6808:2010. The L_{90} is used to assess wind farm noise, as it is less likely to be adversely affected by extraneous noise than other noise descriptors.
mm/s	Millimetres per second—units of vibration velocity.
Sound power level	Measure of acoustic energy emitted by a source, independent of distance, expressed in units of dB re 10^{-12} W.
Special audible characteristic	An audible characteristic of wind turbine noise that is not considered a normal characteristic and has the potential to increase annoyance. Special audible characteristics are defined by NZS 6808:2010 to include tonality, excessive amplitude modulation and impulsivity.
Tonal audibility ($\Delta L_{a,k}$)	A measure of tonality describing the audibility (in dB) of a tone in relation to the surrounding masking 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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1 Introduction

Resonate has been engaged by Wind Prospect to undertake a peer review of the environmental noise and vibration reports prepared as part of the Environmental Effects Statement for the Willatook Wind Farm (the Project). The proposed wind farm will consist of up to 59 wind turbines with a tip height of up to 250 metres and will be located to approximately 3 km northeast of the township of Orford in Moyne Shire.

1.1 EES scoping requirements

The *Scoping Requirements for Willatook Wind Farm Environment Effects Statement* (scoping requirements) issued by the Minister for Planning and dated August 2019 set out the requirements for the EES documentation. The following requirements are relevant to noise and vibration from the Project.

The following Draft Evaluation Objectives identified within the scoping requirements are relevant to noise and vibration from the Project:

> **Amenity.** To minimise and manage adverse air quality and noise and vibration effects on residents and local communities as far as practicable during construction, operation and decommissioning having regard to applicable limits, targets or standards.

With respect to the above Draft Evaluation Objectives, the following scoping requirements apply to the Project:

Aspect	Scoping requirements relevant to noise and vibration
Key issues	• Potential for adverse effects on noise and vibration amenity at sensitive receptors during construction, operation and decommissioning (including on-site quarry).
Existing environment	• Characterise the ambient noise environment in adjacent established residential, farming zone, commercial and open space areas and at other sensitive land use locations. • Identify sensitive receptors that may be subject to effects to amenity from the project including, but not limited to, all dwellings within 3km of wind turbines, associated infrastructure and on-site quarry.
Likely effects	• Assess the potential effects of the project on noise and vibration amenity at sensitive receptors, including information that addresses: – how the noise associated with construction of the wind farm will be managed in accordance with relevant guidelines, such as EPA Victoria's *Noise Control Guidelines Publication 1254* and *Noise from Industry in Regional Victoria Publication 1411*; and – how the operational wind farm noise will be managed in accordance with relevant guidelines, including *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria* and *NZS 6808:2010 Acoustics – Wind Farm Noise* for the turbines, and EPA Victoria's *Noise from Industry in Regional Victoria Publication 1411* for other relevant project infrastructure such as the on-site substation. • Assess the potential noise and vibration (ground and airborne) effects from the proposed on-site quarry activities on sensitive receptors in accordance with guidelines, such as *The Guidelines for Ground Vibration and Airblast Limits for Blasting in Mines and Quarries*.

Aspect	Scoping requirements relevant to noise and vibration
Design and mitigation	• Describe and evaluate both potential and proposed design responses and/or other mitigation measures (e.g. staging/scheduling of works) which could minimise noise and vibration during construction, operation and decommissioning.
Performance objectives	• Describe proposed measures to manage and monitor effects on amenity values and identify likely residual effects, including compliance with standards and proposed trigger levels for initiating contingency measures. • Describe contingency measures for responding to unexpected impacts to amenity values resulting from the project during construction, operation and decommissioning.

1.2 Reviewed document and exclusions

This Peer Review considers the environmental noise and vibration assessments prepared for the Project by Sonus, consisting of the following reports:

- Environmental Noise Assessment[1]
- Construction Noise Assessment[2].

We note that the following items have not been considered as part of this Peer Review, for the reasons detailed below:

- The Environmental Noise Assessment identifies a significant number of dwellings at which noise predictions have been carried out. This review has not considered whether all sensitive locations have been identified within three kilometres of the wind farm as required by the scoping requirements.
- Background noise levels are only summarised in the Environmental Noise Assessment, with details on the background noise monitoring presented in a separate report attached as Appendix F to the Environmental Noise Assessment. The background noise monitoring report has not been considered as part of this peer review. However, it is noted that the assessment has been conducted against the minimum application criteria of 40 dB (non-associated dwellings) and 45 dB (stakeholder dwellings). Background noise levels have not been used to justify an increase in the operational noise criteria and, therefore, do not affect the conclusions of the operational noise assessment as to whether the Project is capable of achieving compliance with the noise criteria.
- The Environmental Noise Assessment does not assess the potential impact of noise and vibration on fauna, which is a key issue identified in the scoping requirements for biodiversity and habitat. We understand that this has been addressed as part of a separate flora and fauna technical assessment, which has not been reviewed by Resonate.
- The Environmental Noise Assessment excludes the assessment of airblast and vibration from blasting associated with the proposed quarry, with this being considered as part of a separate technical assessment. Therefore, this has not been considered in this peer review.

1.3 Peer reviewer

This peer review has been undertaken by Tom Evans, who is Technical Director at Resonate. A copy of the curriculum vitae of the author of this Peer Review is provided in Appendix A.

[1] Sonus, April 2022, *Willatook Wind Farm – Environmental Noise Assessment*, S3522C30

[2] Sonus, April 2022, *Willatook Wind Farm – Construction Noise Assessment*, S3522C22

2 Review

2.1 Scoping requirements

In general, the information in the Environmental Noise Assessment and Construction Noise Assessment fulfils the scoping requirements, subject to the comments that follow within this peer review.

SUMMARY

The assessment identifies and addresses the scoping requirements.

RECOMMENDATIONS

None

2.2 Legislation, policy and guidelines

The Environmental Noise Assessment and Construction Noise Assessment adopt the following legislation, policy and guidelines for the noise and vibration assessment:

- For wind turbine noise: the *Environment Protection Amendment (Interim) Regulations 2021*, DELWP *Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria* (the Policy and Planning Guidelines) and New Zealand Standard (NZS) 6808:2010 *Acoustics – Wind farm noise*.
- For ancillary infrastructure noise: the *Environment Protection Regulations 2021* and the Environment Protection Authority (EPA) Victoria Noise Protocol. Consideration has also been given to EPA Victoria Publication 1996 *Noise guidelines: Assessing low frequency noise* and the World Health Organisation *Guidelines for Community Noise*.
- For construction noise: EPA Victoria Publication 1834 *Civil construction, building and demolition guide*.
- For construction vibration: German Standard DIN 4150-3 for the assessment of potential damage to buildings arising from vibration.

The Environmental Noise Assessment also recognises the general environmental duty that was introduced in the *Environment Protection Act 2017*. The referenced legislation, policy and guidelines are consistent with the general environmental duty.

We note that construction vibration criteria are only established for the prevention of damage to buildings. While this is a necessary consideration for construction works, these criteria do not necessarily relate to the amenity of the community as per the scoping requirements. Levels of vibration that may be compliant with the DIN 4150-3 criteria can still be readily perceived by building occupants and it would have been desirable for amenity criteria to also be adopted for the construction phase. However, while not adopting amenity criteria for construction vibration, the Environmental Noise Assessment does identify that construction vibration is not expected to be perceptible at residences. As such, it is not expected that this would have altered any conclusions of the assessment.

SUMMARY

The legislation, policy and guidelines adopted for the noise and vibration assessment are appropriate and consistent with the general environmental duty.

RECOMMENDATIONS

None

2.3 Background noise monitoring

The Environmental Noise Assessment summarises the results of background noise monitoring conducted in 2010, with details on the background noise monitoring provided in a separate report (Appendix F to the Environmental Noise Assessment) that has not been reviewed.

Noting that the background noise monitoring was conducted over 10 years ago and indicates that background noise levels are typically 35 dB L_{A90} or lower across the assessed wind speed range, the Environmental Noise Assessment takes a cautious approach to the background noise by adopting the minimum applicable base wind turbine noise limit of 40 dB L_{A90}. We agree that this cautious approach is appropriate and means that the Environmental Noise Assessment is not reliant on the background noise levels for assessing whether the Project can comply with applicable noise limits.

It is important to note that adopting a base limit of 40 dB L_{A90} for the wind farm may make it difficult to assess compliance through noise monitoring at noise-sensitive locations. The Environmental Noise Assessment notes that, should the Project proceed, additional background noise monitoring is proposed to be conducted prior to construction and this is considered an appropriate response to assist with determining the wind turbine noise contribution as part of future post-construction noise monitoring.

SUMMARY

Due to potential limitations associated with previous background noise monitoring conducted for the Project, the Environmental Noise Assessment takes an appropriately cautious approach to the wind farm noise assessment and adopts the base noise limits, meaning that the assessment of noise compliance is not reliant on the background noise.

RECOMMENDATIONS

None

2.4 Wind turbine noise

2.4.1 Noise limits

The Environmental Noise Assessment correctly identifies noise limits, as recommended by NZS 6808:2010, consisting of a base limit or, for wind speeds where background noise levels are sufficiently high, a limit of 5 dB above the background noise level. A 40 dB base limit is established for non-associated residences consistent with NZS 6808:2010 and the Policy and Planning Guidelines, and this has been adopted for the assessment as a cautious approach given the difficulties associated with conducting background noise measurements in the absence of any contribution from Macarthur Wind Farm.

No specific assessment criteria are set by NZS 6808:2010 for noise-sensitive uses of landowners located on the defined wind farm site. Generally, higher noise limits would be applicable to residences whose owners are involved with, and financially benefitting from, the Project. The Environmental Noise Assessment adopts a base limit of 45 dB L_{A90} for involved landowners consistent with the *Environment Protection Amendment (Wind Turbine Noise) Regulations 2021* and the *Environment Protection Amendment (Interim) Regulations 2021*.

SUMMARY

The wind turbine noise limits adopted are consistent with relevant Victorian legislation and guidelines, and consistent with NZS 6808:2010.

RECOMMENDATIONS

None

2.4.2 High amenity areas

NZS 6808:2010 sets a general base noise limit of 40 dB L_{A90} for non-involved residences and other noise-sensitive uses. However, in certain cases, where a 'high amenity' area is deemed to apply, then the base noise limit is reduced to 35 dB L_{A90}. The application of a 'high amenity' limit occurs, as per NZS 6808:2010, where a district plan promotes a higher degree of protection of amenity related to the sound of an area than is normal. In Victoria, guidance on the application of a 'high amenity' to wind farms is given by:

- The Cherry Tree Wind Farm VCAT determination as referenced by the Policy and Planning Guidelines.
- The Golden Plains Wind Farm Planning Panel report.

Together, these previous decisions support the Environmental Noise Assessment with respect to the Farming Zone, that includes the site and nearest noise-sensitive locations around it, not qualifying as a high amenity area as defined by NZS 6808:2010.

The Golden Plains Wind Farm Planning Panel report did, however, define Township Zones as high amenity areas and this may apply to the Township Zone in Orford that is located over 2.5 km from the nearest proposed turbine location. The Environmental Noise Assessment argues that this area does not need to be considered as it is outside the predicted 35 dB L_{A90} noise contour as per C5.3.1 of NZS 6808:2010. Given that the predicted noise levels at this area are below 30 dB L_{A90}, it is agreed that the Orford Township Zone does not need to be considered as a potential high amenity area for the Project.

SUMMARY

The Environmental Noise Assessment report does not apply the high amenity limit to the Farming Zone areas, consistent with relevant Victorian guidance and previous planning panel decisions. Predicted noise levels at the Orford Township Zone are sufficiently low that, in accordance with NZS 6808:2010, it does not need to be considered as a potential high amenity area.

RECOMMENDATIONS

None

2.4.3 Wind turbine noise assessment

A wind turbine noise assessment consists of three key elements:

- assumed wind turbine candidate models and sound power levels
- wind turbine noise predictions
- consideration of special audible characteristics.

Wind turbine sound power levels

The assessment has been conducted based on a single candidate wind turbine being a Vestas V162-6.0MW wind turbine with a maximum sound power level of 104.3 dB L_{WA}. The report notes that Vestas has indicated that these levels already include an uncertainty factor and therefore no uncertainty factor has been applied in the noise modelling.

We understand that this is a representative turbine selection and may not be the final turbine model installed at the site. The V162-6.0MW turbine is a relatively quiet turbine as, in our experience, turbines of this capacity may have sound power levels typically in the range of 104 – 108 dB with an uncertainty margin applied. Therefore, while the assessment demonstrates that the site is expected to be capable of achieving compliance with the noise limits with a turbine at the lower end of this range being selected, this will need to be reassessed for the final selected turbine and layout as per the commentary in Section 4.2.1 of Environmental Noise Assessment.

Given the above, we would recommend that a condition requiring a pre-construction noise assessment be included in any planning approval, confirming the final selected turbines and layout can achieve the relevant NZS 6808:2010 noise limits.

SUMMARY

The adopted sound power levels for the candidate turbines are at the lower end of the typical range of modern turbines in our experience. While the assessment demonstrates predicted compliance with this model, a pre-construction noise assessment will be required to demonstrate that this is still predicted for the final selected wind turbine model(s) and layout.

RECOMMENDATIONS

- A condition should be applied requiring a pre-construction noise assessment be prepared based on the final selected wind turbine model(s) and layout, that demonstrates that compliance is predicted with the NZS 6808:2010 noise limits.

Wind turbine noise prediction methodology

Sonus has adopted two different noise prediction methodologies in the Environmental Noise Assessment:

- CONCAWE[3] prediction algorithm with a ground absorption factor of 100%, receiver height of 1.5 m above ground and a weather category of 6 (worst case conditions for propagation).
- ISO 9613-2[4] implemented in general accordance with the UK IoA Good Practice Guide with the exception that no 2 dB reduction has been applied to adjust L_{eq} sound power levels to L_{90} sound power levels as would be typical in the UK.

In our experience, and considering the topography around the Project site, both methods are appropriate for the prediction of wind turbine noise from the Project and will tend to overpredict relative to downwind measured noise levels by 1 to 3 dB at the nearest noise-sensitive locations.

The Environmental Noise Assessment Report makes the statement between the two methodologies that the ISO 9613-2 method 'requires adjustments to ensure accurate results for wind farm assessments' whereas CONCAWE does not, referring to the fact that the UK IoA method applies a 3 dB correction to predicted noise levels where concave topography is detected between source and receiver. We consider this statement to be a simplification. It is well established that concave topography results in a 3 dB increase in measured wind turbine noise[5] and the UK IoA method applies this correction to obtain accurate prediction results. By contrast, CONCAWE applies no such correction and so tends to overpredict by 3 dB for sites without concave topography, while returning more accurate predictions where the concave topography exists.

Additionally, noise predictions made using the CONCAWE methodology start to attenuate with distance more rapidly than ISO 9613-2 at distances further than two kilometres from the wind farm when calculated using SoundPlan, which is the software package used by Sonus for the assessment. This is due to the CONCAWE meteorological attenuation curves only being defined to a distance of two kilometres. SoundPlan uses the equation defined by CONCAWE to replicate these curves within the software, which is well-defined to two kilometres but can lose accuracy beyond two kilometres. The effect of this can be seen in the noise contours in Appendix G with the 25 dB contour for ISO 9613-2 extending further than that for CONCAWE, even though CONCAWE predicts a larger 40 dB contour.

[3] Manning C, 1981, *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities*, CONCAWE Report 4/81.

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

[5] 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(1), pp 28 – 36.

Overall, however, both prediction methodologies are considered appropriate, and indeed conservative, for the assessment of predicted wind farm noise levels against the applicable wind farm noise limits.

SUMMARY

The prediction methodologies adopted are considered appropriate, and indeed conservative, for the assessment of predicted wind farm noise levels against the applicable wind farm noise limits.

RECOMMENDATIONS

None.

Special audible characteristics

NZS 6808:2010 requires penalties to be applied where special audible characteristics are measured or predicted to occur at a receiver. Special audible characteristics are defined by NZS 6808:2010 to include tonality, impulsiveness and amplitude modulation. Depending on the nature and frequency of the characteristic, the penalty may be up to 6 dB.

Special audible characteristics are not assessed at the pre-construction stage of a wind farm unless there is evidence that the Project would result in such characteristics at residential locations. Additionally, our experience is that special audible characteristics in wind turbine noise are relatively uncommon at residential locations. Therefore, we would not expect that the Environmental Noise Assessment would apply any penalty to wind farm noise predictions at this stage. The discussion provided in Section 4.2.3 of the Environmental Noise Assessment is appropriate for a planning stage assessment of a proposed wind farm.

In accordance with NZS 6808:2010 and the *Environment Protection Amendment (Interim) Regulations 2021*, it will be necessary for post-construction testing of special audible characteristics to be carried out to demonstrate that this assumption was correct once the wind farm is operating. If special audible characteristics are identified, and this leads to non-compliance with the noise limits, then noise reduction strategies would need to be identified and implemented to achieve compliance. The Environmental Noise Assessment identifies that such strategies could involve alterations to the turbines to remove the special audible characteristics or operations of the turbines in noise reduced modes as contingency measures.

SUMMARY

The Environmental Noise Assessment is based on the assumption that special audible characteristics will not occur at residences. We consider this a reasonable approach given the limited occurrence of such characteristics in Australia and the information available at this time.

RECOMMENDATIONS

- A suitable post-construction monitoring program will need to be implemented for the Project that includes testing for special audible characteristics.

2.4.4 Cumulative noise

The report presents an assessment of cumulative noise from Macarthur Wind Farm after determining that the risk of cumulative noise from other approved wind farms in the area leading to an exceedance of the noise limit was negligible. The assessment of cumulative noise from Macarthur Wind Farm is conservative in that it assumes that noise-sensitive locations between the two sites will be simultaneously downwind of each site. As this is not able to occur, the predicted cumulative noise levels are expected to be overestimates.

The assessment demonstrates that the two sites can operate and achieve cumulative compliance with the NZS 6808:2010 minimum noise limit of 40 dB L_{A90}, even with the conservative assumptions that underly the cumulative noise predictions. It is noted that a residence located in between the two wind farms will be downwind of a given wind farm more often, which may result in an occupant experiencing audible wind farm noise more often than they currently do from Macarthur Wind Farm on its own. However, based on the predictions in the Environmental Noise Assessment, the combined wind farm noise levels would be able to be controlled to below the minimum applicable NZS 6808:2010 noise limit of 40 dB L_{A90} under all wind directions.

SUMMARY

The Environmental Noise Assessment demonstrates that predicted cumulative noise levels from Macarthur Wind Farm and the Project comply with the applicable noise limits.

RECOMMENDATIONS

None

2.5 Ancillary infrastructure including BESS

2.5.1 Noise limits

Noise from ancillary infrastructure is not subject to the noise limits of NZS 6808:2010, and therefore has been assessed in accordance with the *Environment Protection Regulations* and EPA Victoria Noise Protocol, which is appropriate. The noise limits have been correctly determined for the nearest noise-sensitive locations to the ancillary infrastructure. Consideration has also been given to low frequency noise emissions in accordance with EPA Victoria Publication 1996.

SUMMARY

The noise limits adopted for ancillary infrastructure are correct and in accordance with the *Environment Protection Regulations* and Noise Protocol.

RECOMMENDATIONS

None.

2.5.2 Predicted noise levels and assessment

Noise levels from ancillary infrastructure have been predicted based on the CONCAWE methodology and:

- assumed transformer sound power levels based on sound power data from AS/NZS 60076.10:2009
- manufacturer data for a potential battery energy storage system (BESS)
- a cumulative assessment of noise with the Macarthur Wind Farm substation.

The predictions include consideration of a +2 dB correction for potential tonality at mains frequency harmonics, with tonal noise at these frequencies a potential feature of transformer noise when audible at a noise-sensitive location. Additionally, the sound power levels for the Tesla Megapacks provided on Page 30 indicate potential tonality, such that application of a +2 dB penalty for the ancillary infrastructure assessment is considered appropriate.

The predicted noise levels are stated for the nearest non-involved noise-sensitive location (D11) as being able to comply with the noise limits as long as a reduced sound power level specification is achieved for the Willatook Wind Farm substation and that the BESS operates at lower fan speeds at night, corresponding to lower temperatures. These proposed controls appear reasonable for achieving the required reduction in night-time noise levels.

Section 4.3.4 of the Environmental Noise Assessment also gives regard to the ancillary infrastructure noise, including quarry noise, against day and night time L_{eq} guideline values from the WHO *Guidelines for Community Noise*. The WHO *Guidelines for Community Noise* were released in 1999. Updated WHO guidelines for the European region released in 2009[6] identified an external night time noise level of 40 dB L_{night} as the lowest observed adverse effect level for night noise, where L_{night} is the long-term annual average sound level (L_{eq}) over the night time period. While this is lower than the 45 dB L_{eq} adopted in the Environmental Noise Assessment, it does not change the conclusion that the ancillary infrastructure noise of 35 dB is below the WHO night level at non-involved noise-sensitive locations.

It is noted that the Environmental Noise Assessment does not address the predicted noise levels from the substation and BESS at involved dwelling D8, but that the noise contour maps indicate noise levels marginally higher than at the stated noise levels for D11. If the predicted noise levels at D8 exceed the Noise Protocol noise limits, then this would need to be suitably managed through the agreement with that landowner.

SUMMARY

The assessment of potential noise for ancillary infrastructure is considered appropriate. The predicted noise levels at the nearest involved dwelling are not stated but appear marginally higher than at the nearest non-involved location, and this would need to be managed through the agreement with that landowner.

RECOMMENDATIONS

- A condition should be imposed requiring a pre-construction noise assessment for noise from ancillary infrastructure.
- It would be appropriate for a condition to be applied to require post-construction monitoring of the ancillary infrastructure given the predicted noise levels are close to the noise limits.

2.5.3 Cumulative noise

The Environmental Noise Assessment presents an assessment of cumulative noise between the Project's ancillary infrastructure, including the existing substation, and the approved Tarrone Gas-Fired Power Station.

The cumulative ancillary infrastructure noise assessment has been conducted on the basis that noise levels at dwellings would not be tonal in nature, due to the masking effects of the various noise sources. In our opinion, there is a residual risk of tonal noise as part of the cumulative assessment noting that:

- noise from both the BESS and substation has the potential to be tonal based on the Environmental Noise Assessment, and was assessed as such for the non-cumulative noise assessment
- the predicted noise levels from the gas-fired power station are at a similar or lower level than the Project sources such that it is unclear if any masking effect would be sufficient to address the risk of tonality.

The impact of a +2 dB tonal penalty on the cumulative noise assessment would be a marginal predicted exceedance of the night time noise limit at D11. At this stage of the Project, we do not expect it will be possible to confirm if a tonal penalty would apply to the ancillary infrastructure noise. However, if this risk remained as the design of the facility progresses, it is anticipated that reasonably practicable contingency measures would be available that could reduce the noise levels. This could include selection of quieter equipment for the BESS or transformers, or the use of physical mitigation measures such as barriers around noise-generating equipment.

[6] WHO, 2009, *Night Noise Guidelines for Europe*

Our previous recommendations requiring a pre-construction noise assessment for noise from ancillary infrastructure and post-construction noise monitoring would assist in assessing and managing this risk.

SUMMARY

The assessment of cumulative noise from ancillary infrastructure is based on the assessment that tonal noise from the BESS and substation would not be present due to masking from the other sources. However, there may be a residual risk of a tonal penalty that would affect the predicted compliance with the noise limit. It is expected that this could be resolved through reasonably practicable mitigation and management measures during detailed design.

RECOMMENDATIONS

- A condition should be imposed requiring a pre-construction noise assessment for noise from ancillary infrastructure.
- It would be appropriate for a condition to be applied to require post-construction monitoring of the ancillary infrastructure given the predicted noise levels are close to the noise limits.

2.6 Quarry noise

2.6.1 Noise limits

General noise from operations at the proposed on-site quarry, although temporary, may last for up to two years and therefore has been assessed against noise limits derived from the *Environment Protection Regulations* and Noise Protocol. This is an appropriate approach for a fixed operation that may continue for that period of time and is conservative as it represents the same assessment criteria that would apply to a permanent quarry operation.

SUMMARY

The noise limits adopted for quarry operation are correct and in accordance with the *Environment Protection Regulations and* Noise Protocol.

RECOMMENDATIONS

None.

2.6.2 Assessment

The noise assessment conducted for the quarry operations is, due to the nature of the Project at this stage, preliminary and has been based on typical plant and equipment assumed based on previous assessments at other sites. The assumed sources are considered reasonable for a typical quarry operation.

The quarry noise assessment concludes that noise from the quarry can readily comply with the most stringent night time noise limits at the nearest noise-sensitive location (D34). It is noted that the Environmental Noise Assessment does not address the predicted noise levels from the quarry at involved dwelling D375, which is substantially closer. If the predicted noise levels at D375 exceed the noise limits, then this would need to be suitably managed through the agreement with that landowner.

SUMMARY

The noise assessment for quarry operations generally appears appropriate in terms of assumed noise sources and adopted noise limits. The predicted noise levels at the nearest involved dwelling are not stated but will be higher than at the nearest non-involved location, and this may need to be managed through the agreement with that landowner if the noise levels exceed the noise limits.

RECOMMENDATIONS

None

2.7 Construction noise and vibration

2.7.1 Assessment criteria

The Environmental Noise Assessment and Construction Noise Assessment reference the following documents to establish assessment criteria for noise and vibration generated by construction works:

- EPA Victoria Publication 1834 for the assessment of construction noise.
- German Standard DIN 4150-3 for the assessment of construction vibration.

The adopted assessment criteria for construction noise are considered appropriate for an assessment at this stage of the Project.

The Construction Noise Assessment takes a risk assessment approach to potential out of hours work by assuming a typical background noise level of 30 dB L_{A90}. It is noted that EPA Victoria Publication 1834 imposes a requirement for inaudibility for certain works conducted at night, and it is likely that construction works at night may need to achieve lower noise levels than 30 dB at residential areas to ensure inaudibility during quieter periods of the night. Overall, the current assumption of 30 dB L_{A90} is considered reasonable for the purposes of the risk assessment, and it is noted that any out of hours work subject to the inaudibility requirement would need to be assessed prior to them occurring on a case-by-case basis during the construction phase.

The adopted assessment criteria for construction vibration are appropriate for assessing the risk of damage to structures, but do not assess the risk of vibration to amenity. However, despite not adopting specific amenity criteria for construction vibration, the Environmental Noise Assessment does identify that construction vibration is not expected to be perceptible at residences. As such, it is not expected that the adoption of specific amenity vibration criteria for the construction phase would have altered any conclusions of the assessment.

SUMMARY

The adopted construction noise and vibration criteria are appropriate for this stage of an assessment. While the adopted vibration criteria do not directly address potential amenity impacts from construction vibration, it is agreed that amenity impacts from general construction vibration are unlikely given the significant separation distance between residences and work areas.

RECOMMENDATIONS

None

2.7.2 Assessment

Construction noise

Given the stage that the Project is currently at, the Construction Noise Assessment is based on typical activities expected at the site. Based on our review, it is considered to be based on suitable assumptions around the likely typical worst case sound power levels from construction works that would be expected for the construction of a major wind farm facility.

The Construction Noise Assessment proposes appropriate construction noise management measures, and requires any works outside of hours that are not considered unavoidable works to meet stringent noise criteria as defined by EPA Victoria Publication 1834. Unavoidable works are defined as per EPA Victoria Publication 1834.

The management measures in the Construction Noise Assessment should be implemented throughout the construction process. It is recommended that a condition be considered that requires implementation of a Construction Noise Management Plan, or an equivalent document, during the works incorporating these management measures and any other measures required to address the risk of construction noise so far as reasonably practicable.

SUMMARY

The construction noise assessment is generally considered reasonable, including the identification of appropriate noise management measures.

RECOMMENDATIONS

- A condition should be imposed requiring a Construction Noise Management Plan (or an equivalent document) be implemented during the construction phase.

Construction vibration

A construction vibration assessment is documented in the Environmental Noise Assessment that concludes that vibration from construction works is unlikely to be perceptible at distances further than 100 m. Other than stating that the report could have considered amenity criteria for construction vibration as per our previous comments, we agree that vibration from the construction works considered within the Environmental Noise Assessment is unlikely to be perceptible at residences.

SUMMARY

The assessment of potential vibration from construction is considered appropriate given the stage of the Project. Significant disruption to sensitive land uses as a result of vibration from general construction works is not expected due to considerable setback distances from the majority of the works.

RECOMMENDATIONS

None

3 Summary

Resonate has been engaged by Wind Prospect to undertake a peer review of the environmental noise and vibration assessment prepared as part of the Environmental Effects Statement for the Willatook Wind Farm. The proposed wind farm will consist of up to 59 wind turbines with a tip height of up to 250 metres and will be located to approximately 3 km northeast of the township of Orford in Moyne Shire.

We consider that the Environmental Noise Assessment and Construction Noise Assessment prepared for the Project demonstrates that the Project is expected to be able to operate in compliance with appropriate noise and vibration criteria, subject to the incorporation of appropriate noise and vibration management measures during construction and operation.

Should the Project be approved, it would be necessary to apply conditions related to noise from the site. These conditions would need to require:

- Implementation of a Construction Noise Management Plan during the construction phase incorporating the management measures identified in the Construction Noise Assessment and any other measures required to address the risk of construction noise so far as reasonably practicable.
- An updated Pre-Construction Noise Assessment to be conducted once the final turbine type, layout and ancillary infrastructure is confirmed. The Pre-Construction Noise Assessment would need to demonstrate that the final design is capable of complying with the applicable noise limits.
- Post-construction noise monitoring to be carried out for both wind turbine and ancillary infrastructure noise.

Appendix A—CV of peer reviewer

Tom Evans

Technical Director

Qualifications

Bachelor of Engineering (Mechatronics) (First Class Honours)
Bachelor of Economics

Affiliations

Member of Australian Acoustical Society
AAS VIC Division Committee Member
Member of Victorian Planning & Environmental Law Association

Awards

2013 Australian Acoustical Society Award for Excellence in Acoustics: *Development of a method for tonality assessment at a wind farm*

Career history

Tom has over 14 years of experience in the assessment of noise and vibration on a wide range of industry sectors through the various planning, design and construction phases of projects.

During this time, Tom has earned a reputation as a specialist in wind farm noise, working on projects in all Australian States as well as in New Zealand and Asia. In addition to project work, his research papers have been presented at Australian and international conferences, as well as being referenced in publications internationally.

Tom's particular strengths are his ability to combine his strong technical understanding with excellent communication skills, as well as to understand the different technical, social and environmental opportunities and constraints on a project.

Contact details

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Project experience

Tom has experience across:

- Background noise monitoring for wind farms.
- Wind farm noise prediction and assessment.
- Wind farm noise operational assessment.
- Near field (sound power) testing.
- Tonality and amplitude modulation assessments.

Key projects that Tom has worked on include:

- Bodangora Wind Farm (NSW)
- Gunning Wind Farm (NSW)
- White Rock Wind Farm (NSW)
- Kaban Wind Farm (QLD)
- Lakeland Wind Farm (QLD)
- Mount Emerald Wind Farm (QLD)
- Brown Hill Wind Farm (SA)
- Clements Gap Wind Farm (SA)
- Hallett Hill Wind Farm (SA)
- North Brown Hill Wind Farm (SA)
- Starfish Hill Wind Farm (SA)
- The Bluff Wind Farm (SA)
- Wattle Point Wind Farm (SA)
- Willogoleche Wind Farm (SA)
- Bald Hills Wind Farm (VIC)
- Golden Plains Wind Farm (VIC)
- Inverleigh Wind Farm (VIC)
- Macarthur Wind Farm (VIC)
- Moorabool Wind Farm (VIC)
- Mount Mercer Wind Farm (VIC)
- Oaklands Hill Wind Farm (VIC)
- Portland Wind Energy Project Stage IV (VIC)
- Woolsthorpe Wind Farm (VIC)
- Yaloak South Wind Farm (VIC)
- Yambuk Wind Farm (VIC)
- Te Rere Hau Wind Farm (NZ)
- Turitea Wind Farm (NZ)
- Jeneponto Wind Farm (Indonesia)
- Burgos Wind Farm (Philippines)
- Mannar Island Wind Project (Sri Lanka)
- Tra Vinh Wind Farm (Vietnam)

Publications and Technical Papers

- 'A comparison of tonal noise regulations in Australia', Acoustics 2015, Hunter Valley, November 15-18. T. Evans and J. Cooper.
- 'Microphone wind speed limits during wind farm noise measurements', Acoustics 2015, Hunter Valley, November 15-18. J. Cooper and T. Evans.
- 'Tonal noise from wind turbines', Proceedings of 6th International Conference on Wind Turbine Noise, Glasgow, August 2015, T. Evans and J. Cooper.
- 'Comparison of infrasound measured at people's ears when walking to that measured near wind farms', Stead M, Evans T & Cooper J, 2014, *Acoustics Australia*, Vol. 42, No. 3, pp. 197-203.
- 'Analysis of wind turbine low frequency noise prediction accuracy', Internoise 2014, Melbourne, November 16-19, T. Evans, J. Cooper and V. Alamshah.
- 'Influence of non-standard atmospheric conditions on turbine noise levels near wind farms' Internoise 2014, Melbourne, November 16-19, J. Cooper and T. Evans.
- 'Low frequency noise near wind farms and in other environments', SA EPA and Resonate Acoustics, April 2013, T. Evans, J. Cooper and V. Lenchine.
- 'Infrasound levels near windfarms and in other environments', SA EPA and Resonate Acoustics, January 2013, T. Evans, J. Cooper and V. Lenchine.
- 'Effects of different meteorological conditions on wind turbine noise', Acoustics 2013, Victor Harbor, November 18-20. T. Evans and J. Cooper.
- 'Automated detection and analysis of amplitude modulation at a residence and wind turbine', Acoustics 2013, Victor Harbor, November 18-20. J. Cooper and T. Evans.
- 'Tonality assessment at a residence near a wind farm', Proceedings of 5th International Conference on Wind Turbine Noise, Denver, 28-30 August 2013, J. Cooper, T. Evans and D. Petersen
- 'Accuracy of noise predictions for wind farms', Proceedings of 5th International Conference on Wind Turbine Noise, Denver, 28-30 August 2013, J. Cooper and T. Evans
- 'Influence of wind direction on noise emission and propagation from wind turbines', Proceedings of Acoustics 2012, Fremantle, 21-23 November 2012, T. Evans and J. Cooper.
- 'Influence of upwind turbines on wind turbine sound power output', Proceedings of Acoustics 2012, Fremantle, 21-23 November 2012, J. Cooper and T. Evans.
- 'Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms', Evans T & Cooper J, 2012, *Acoustics Australia*, Vol. 40, No. 1, pp. 28-36.
- 'Comparison of compliance results obtained from the various wind farm standards used in Australia', Cooper J, Evans T & Najera L, 2012, *Acoustics Australia*, Vol. 40, No. 1, pp. 37-44.
- 'Effect of a 35 dB(A) minimum criterion on a wind farm development', Cook A, Evans T & Brown R, 2012, *Acoustics Australia*, Vol. 40, No. 2, pp. 144-146.