Appendix N. Noise and vibration
N.2 Noise peer review
Document Information

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<td>Client</td>
<td>WestWind Energy Pty Ltd</td>
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<td>Report title</td>
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Reviewed by Jon Cooper

Revision Table

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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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3 Summary
1 Introduction

Resonate has been engaged by WestWind Energy Pty Ltd (WestWind) to undertake a peer review of the environmental noise and vibration assessment prepared as part of the Environmental Effects Statement for the Golden Plains Wind Farm (the Project). The proposed wind farm will consist of up to 228 wind turbines with a tip height of up to 230 metres and will be located to the west, south and southeast of Rokewood in Golden Plains Shire.

1.1 EES scoping requirements

The Scoping Requirements for the Golden Plains Wind Farm Project (scoping requirements) issued by the Minister for Planning and dated December 2017 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:

- **Biodiversity.** To avoid, minimise or offset potential adverse effects on native vegetation, habitat, listed threatened species and ecological communities, migratory species, and other protected flora and fauna.

- **Community amenity, roads and transport.** To manage potential adverse effects for the community, businesses and land uses with regard to construction noise, vibration, dust, traffic and transport and operational turbine noise, electromagnetic interference and aviation safety.

With respect to the above Draft Evaluation Objectives, the following key issues apply to the Project:

- **Biodiversity**
  
  Potential indirect habitat loss or degradation resulting from other effects of ground disturbance such as edge effects, surface hydrological changes, groundwater changes, dust and noise on listed values.

- **Community amenity, roads and transport**
  
  Managing loss of amenity during construction through generation of noise, vibration, dust and lighting changes.

  Managing loss of amenity during operations through generation of noise generated by wind turbines.

1.2 Reviewed document and exclusions

This Peer Review considers the environmental noise and vibration assessment prepared for the Project by Marshall Day Acoustics (Noise and Vibration Assessment Report\(^1\)). The Noise and Vibration Assessment Report provides information on the existing noise environment, establishes noise and vibration assessment criteria for the Project and provides predictions and assessment of noise and vibration from construction works and quarry, and operational noise from wind turbine operation and ancillary infrastructure.

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

- The Noise and Vibration Assessment Report states that a total of 220 buildings have been identified by WestWind within three kilometres of the wind farm, of which 137 are non-involved noise-sensitive locations and 45 are involved residential locations. This review has not considered whether all sensitive locations have been identified, although it is noted that the zone of three kilometres for the identification of sensitive land uses is considered appropriate for the assessment of noise and vibration from the site against the relevant assessment criteria within Victoria.

• The Noise and Vibration Assessment Report summarises the results of background (pre-construction) noise monitoring conducted at locations around the site but the technical details regarding this monitoring are summarised in a separate report. This separate report has not been reviewed as it was noted that the Project was not reliant on background noise levels in order for predicted noise levels to achieve compliance with the relevant noise criteria.
• The Noise and Vibration Assessment Report refers to the planning assessment presented in the EES in considering whether more stringent high amenity limits for wind turbine noise should apply. We have not reviewed this planning assessment.
• The Noise and Vibration Assessment Report does not assess the potential impact of noise on fauna, which is a key issue identified in the scoping requirements. We understand that this has been addressed as part of a separate flora and fauna technical assessment, which has not been reviewed by Resonate.

1.3 Peer reviewer

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

2.1 Wind turbine noise

2.1.1 Assessment criteria


The noise criteria (or limit) recommended by NZS 6808:2010 consists 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. The establishment of the base limit is dependent on whether the receiver is involved with the Project and the land zoning.

Involved landowners

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 criteria would be applicable to residences whose owners are involved with, and financially benefitting from, the Project. The Victorian Wind Energy Guidelines recommend a reference noise level of 45 dB(A), including for any residences of involved landowners outside the site boundary, which has been adopted for context within the Noise and Vibration Assessment Report.

SUMMARY

The reference noise level of 45 dB(A) adopted for the residences of involved (or stakeholder) residences is considered appropriate. It is noted that noise levels from the wind farm at involved residences would need to be managed in an agreement with the relevant landowner.

RECOMMENDATIONS

None.

High amenity areas

NZS 6808:2010 sets a general base noise limit of 40 dB(A) 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(A). 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. The Project is adjacent to residences within a Farming Zone, a Township Zone and a Low Density Residential Zone.

The Noise and Vibration Assessment Report refers to the planning assessment presented in the EES, which we understand has determined that the ‘high amenity’ limit is not applicable to the Project and surrounding areas.

We have not reviewed the planning assessment but note that the application of the ‘high amenity’ limits to a wind farm project in Victoria is a planning matter, as it requires interpretation of the New Zealand planning system with respect to the Victorian system. Therefore, it is appropriate that the application of the ‘high amenity’ limit be considered through the planning assessment. It is also consistent with our previous experience that the high amenity limits would not apply in areas such as this.
SUMMARY
The Noise and Vibration Assessment Report does not apply the 'high amenity' limit to residences around the Project site based on the planning assessment conducted for the EES.

RECOMMENDATIONS
None.

Non-involved landowners
Given that the 'high amenity' limit does not apply, the Noise and Vibration Assessment Report applies the following criteria for wind farm noise to non-involved noise-sensitive uses:

- 40 dB(A) or
- background noise level plus 5 dB, whichever is the greater with wind speed.

These criteria have been applied to non-involved residences, one school and one child care centre. The criteria have not been applied to a variety of land uses including sheds, petrol stations, a church, businesses, a health facility and community halls. NZS 6808:2010 advises that these would not be considered noise-sensitive land uses.

The adopted criteria are considered appropriate and consistent with NZS 6808:2010, the Victorian Wind Energy Guidelines and the EES scoping requirements.

SUMMARY
The adopted criteria are considered appropriate and consistent with NZS 6808:2010, the Victorian Wind Energy Guidelines and the EES scoping requirements.

RECOMMENDATIONS
None.

2.1.2 Wind turbine noise assessment
The wind turbine noise assessment documented within the Noise and Vibration Assessment Report consists of three key elements:

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

WTG sound power levels
The assessment has conducted based on two potential candidate wind turbines:

- Senvion 3.6M140 with a maximum sound power level of 105 dB(A)
- Vestas V150-4.2MW with a maximum sound power level of 105.9 dB(A).

Both sound power levels include a 1 dB uncertainty factor to account for potential uncertainties in the actual sound power level of installed WTGs, which is in accordance with good practice for wind turbine noise assessments.

We note that the Noise and Vibration Assessment Report states that WTGs with a capacity of 3 to 5 MW will be installed at the site, but that the assessment has been based only on WTGs with a maximum rated power output of 4.2 MW. WTGs with rated power output above this have not been assessed, although the Report notes that WTGs with higher capacities will not necessarily have higher sound power levels.
We concur that it is not necessarily the case that WTGs with a rated power higher than 4.2 MW will also have a higher sound power level output. For example, GE recently released information on a 4.8 MW WTG with a stated mean sound power level of 104 dB(A).\(^2\)

Additionally, we note that a pre-development assessment confirming the final selected WTGs can achieve the relevant NZS 6808:2010 noise criteria would need to be submitted in line with the recommended Environmental Performance Requirements (EPRs) included in the Noise and Vibration Assessment Report.

### SUMMARY

The adopted sound power levels for the candidate WTGs are considered typical of WTGs with a rated power output of 3 to 5 MW and include a 1 dB uncertainty factor. An EPR is recommended within the Report that will require assessment of the final selected WTGs against the NZS 6808:2010 noise criteria.

### RECOMMENDATIONS

None.

### Wind Turbine Noise Prediction Methodology

The noise prediction methodology adopted by Marshall Day Acoustics is based on the following:

- Sound power levels as discussed above.
- Hub heights of 130 m (Senvion 3.6M140), 115 m and 155 m (both Vestas V150-4.2MW).
- ISO 9613-2\(^3\) prediction algorithm as implemented in SoundPLAN Version 7.4 environmental noise prediction software.
- Topographical information for the site obtained from VicMap (10 m height contours).
- Topographic shielding limited to 2 dB with shielding evaluated based on the WTG source being located at tip, rather than hub, height.
- Ground absorption factor of 50%.
- Receiver height of 1.5 m above ground.
- A temperature of 10ºC and relative humidity of 70%.

The prediction methodology described is consistent with the findings of a previous study conducted of operating sites in Australia\(^4\), which identified the methodology provided accurate predictions for sites with topography such as that present around the Golden Plains Wind Farm site. The methodology is also largely consistent with the UK Institute of Acoustics (IoA) Good Practice Guide\(^5\) for wind turbine noise with the exception that:

- The IoA Good Practice Guide recommends adoption of a 4 m receiver height instead of a 1.5 m receiver height. In practice, this increases predicted noise levels by approximately 1.5 dB.
- The IoA Good Practice Guide states that a -2 dB correction can be applied to the sound power levels to adjust them from L\(_{eq}\) to L\(_{90}\). This has not been done in the assessment documented in the Acoustic Report.

Given the above, and noting the two deviations from the Good Practice Guide will effectively balance out, we consider the prediction methodology to be appropriate and consistent with good practice in Australia. The predictions will be representative of downwind noise levels, with wind farm noise levels at residences expected to be lower during periods of upwind and crosswind conditions.

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SUMMARY
The prediction methodology adopted in the Noise and Vibration Assessment Report is appropriate and consistent with good practice in Australia.

RECOMMENDATIONS
None.

Predicted wind turbine noise levels and assessment

The predictions presented in the Noise and Vibration Assessment Report demonstrates that:

- predicted noise levels at all non-involved sensitive receivers are 39 dB(A) or lower, which is lower than the base noise limit of 40 dB(A)
- predicted noise levels at most involved residences are 45 dB(A) or lower, with up to four stakeholder receivers having predicted noise levels exceeding the 45.0 dB(A) reference level depending on the WTG model and hub height considered. The highest predicted noise level at any stakeholder residence is 47 dB(A).

Resonate has conducted comparative noise predictions for the Project based on the Vestas V150-4.2MW WTG with a hub height of 115 m, which corresponded to the highest predicted noise levels presented in the Noise and Vibration Assessment Report. Using the same inputs as Marshall Day Acoustics, our predicted noise levels were within 0.1 dB of Marshall Day’s predictions for those receivers with a predicted noise level of 35 dB(A) or greater, indicating a very high level of agreement between the predictions.

For those involved (stakeholder) receivers where the predicted noise level exceeds the reference level of 45 dB(A), the Noise and Vibration Assessment Report recommends that the agreement with those stakeholders would need to reflect this to allow an exceedance of 45 dB(A).

We understand that the four involved stakeholder residences at which predicted noise levels exceed 45.0 dB(A) are located within the nominated wind farm site boundary, and note that NZS 6808:2010 only establishes noise limits for locations outside of the wind farm site. Additionally, the model Planning Permit conditions in the Victorian Wind Energy Guidelines state that no specific limits would apply for locations where a relevant agreement is in place between the wind farm proponent and the landowners.

Generally, we are of the opinion it would be desirable for wind farm noise levels at all stakeholder residences to comply with the reference level of 45 dB(A). The predicted exceedances of the 45.0 dB(A) reference level are small, ranging from 0.1 to 1.6 dB, and therefore this may be achievable as part of the final wind farm design and with improvements in WTG sound power levels prior to the final WTG model selection. However, we note that the approach suggested by the Noise and Vibration Assessment Report is consistent with current practice within Victoria where it is not possible for the wind farm noise levels to achieve 45 dB(A) at involved residences.

SUMMARY
The predictions are considered accurate based on the documented inputs and the assessment appropriate and in accordance with NZS 6808:2010 and the Victorian Wind Energy Guidelines.

RECOMMENDATIONS
None.
Consideration of high amenity limit

Although the planning assessment has deemed that the high amenity limit from NZS 6808:2010 does not apply to this Project, Section 7.5.1 of the Noise and Vibration Assessment Report also details an assessment of predicted noise levels by zone, indicating that predicted wind turbine noise levels at up to 52 residences in the Township Zone exceed 35 dB(A) for the maximum sound power level of the Vestas V150-4.2MW with 115 m hub height.

The Report argues that NZS 6808:2010 does not generally apply the ‘high amenity’ limit at wind speeds above 6 m/s and, for wind speeds below the 6 m/s threshold, the predicted noise levels at all receivers in the Township Zone are below 35 dB(A). The Report therefore concludes that, even if the ‘high amenity’ base limit of 35 dB(A) were to apply, predicted noise levels from the site would achieve compliance with the relevant limit.

With respect to the above, we note that while NZS 6808:2010 does state that 6 m/s could be a suitable wind speed threshold for the application of a ‘high amenity’ limit, it also recommends that justification be provided for the adopted threshold. This is not provided within the Noise and Vibration Assessment Report as the assessment is informative only and the ‘high amenity’ limit has not been deemed to be applicable to the Project. Should it later be determined by a relevant authority that the ‘high amenity’ limit may be applicable to some areas, then further consideration of the appropriate wind speed threshold would be required.

SUMMARY
The indicative assessment against the ‘high amenity’ limit is based on the default wind speed from NZS 6808:2010. Should a detailed assessment against the ‘high amenity’ limits later be required by a relevant authority, then the adopted wind speed threshold would need to be justified.

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. Therefore, the Noise and Vibration Assessment Report does not apply a penalty to the predicted wind farm noise levels, making the assumption that special audible characteristics would not occur at neighbouring residential locations.

To support this, the Noise and Vibration Assessment Report identifies that available information on the candidate WTGs indicates that penalisable tones are not present in the near field for those turbines.

Overall, we agree that it is not possible to undertake a detailed assessment of special audible characteristics at the pre-construction stage of the wind farm and note that the Noise and Vibration Assessment Report has considered the information available at the time of the assessment. Given that special audible characteristics have only been identified at operating wind farms in Australia in limited cases, it is reasonable to assume that no penalties would apply to Golden Plains Wind Farm based on the information available at the time of the assessment.

In accordance with NZS 6808:2010, 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 assessment criteria, then Section 7.10 of the Noise and Vibration Assessment Report identifies noise reduction strategies that could be implemented to achieve this.
SUMMARY
The noise and vibration 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 that includes testing for special audible characteristics. It is envisaged this would be defined by the operational noise management plan required to be submitted by the recommended EPR for Risk N006.
2.2 Ancillary noise

Ancillary noise includes noise from ancillary infrastructure associated with the wind farm, predominantly power transformers.

2.2.1 Assessment criteria

Noise from ancillary infrastructure is not subject to the noise criteria of NZS 6808:2010, and therefore has been assessed in accordance with the EPA NIRV.

The Noise and Vibration Assessment Report correctly identifies the following noise assessment criteria for ancillary infrastructure:

- Day: 45 dB(A)
- Evening: 39 dB(A)
- Night: 34 dB(A).

**SUMMARY**

The assessment criteria adopted for ancillary infrastructure are correct and in accordance with the EPA NIRV.

**RECOMMENDATIONS**

None.

2.2.2 Predicted noise levels and assessment

Noise levels from ancillary infrastructure have been based on assumed transformer sound power levels, derived from Australian Standard AS 60087-10:2009 based on the transformer rating, and using the ISO 9613-2 prediction methodology. The predictions include a +2 dB correction for potential tonality at 100 Hz, with tonal noise at this frequency a common feature of transformer noise where it controls the ambient noise environment.

The predicted noise levels at the nearest noise sensitive receivers are shown, with the highest predicted noise levels being:

- 32 dB(A) at R20 – a: a non-involved residence near the proposed terminal station
- 33 dB(A) at W21 – b (H): an involved residence near the proposed collector station 4.

These levels are marginally compliant with the most stringent night time assessment criterion of 34 dB(A) and the Noise and Vibration Assessment Report therefore notes that environmental noise will be a relevant design consideration for ancillary infrastructure.

Generally, the assessment of ancillary infrastructure noise is considered appropriate, but we note that the +2 dB correction applied to transformer noise assumes that the low frequency transformer tonality is just detectable. While this may be the case, it is also possible that transformer noise will be clearly audible when background noise levels are low and the tonal penalty could increase to +5 dB. In this case, there is the potential for transformer noise to be non-compliant with the NIRV night time noise criterion.

We note that it is likely that any minor exceedance will be able to be addressed during detailed design of the ancillary infrastructure for the site. As per Section 8.4 of the Noise and Vibration Assessment Report, the predictions are based on standard transformer sound power levels with no enclosures or barriers. With the selection of quieter transformers and/or enclosures/barriers around the transformers, it is expected that compliance would be able to be achieved with the night time noise limit even with the application of a higher tonal penalty.
SUMMARY
The assessment of potential noise for ancillary infrastructure is generally considered appropriate but we note that it is based on tonal noise from the transformers not being clearly perceptible at residences. The Noise and Vibration Assessment Report details appropriate mitigation measures that can be applied to address this risk during detailed design.

RECOMMENDATIONS
The noise from ancillary infrastructure will need to be assessed and addressed during detailed design, and should be considered as part of any post-construction noise testing. The EPR proposed to address Risk N005 is considered sufficient to fulfil this recommendation.
2.3 Construction noise and vibration

This Section considers the assessment of construction noise and vibration from general construction works and construction traffic. Our review of the assessment for quarry operations is detailed in Section 2.4.

2.3.1 Assessment criteria

General construction works

The Noise and Vibration Assessment Report references the following documents to establish assessment criteria for noise and vibration generated by construction works:

- Environment Protection Authority (EPA) Publication 1254 Noise Control Guidelines (Noise Control Guidelines) for the assessment of construction noise.
- Department of Economic Development, Jobs, Transports and Resources (DEDJTR) Ground Vibration and Airblast Limits for Blasting in Mines and Quarries (DEDJTR Guidelines)

The adopted assessment criteria for construction noise and vibration are considered appropriate for the Project.

The Report notes that the Noise Control Guidelines primarily aim to protect residential premises but that other noise-sensitive premises may also require consideration.

As part of recent major infrastructure projects in Victoria, such as the Melbourne Metro Rail Project (MMRP), it was identified in the Environmental Performance Requirements that additional noise criteria should be established for other noise-sensitive land uses. With respect to the Project, it is recommended that consideration be given to the adoption of noise and vibration criteria for the school and child care facility in line with the MMRP EPRs.

**SUMMARY**
The noise criteria adopted for construction noise and vibration (including blasting) are appropriate.

**RECOMMENDATIONS**
Construction noise criteria for the school and child care centre should be considered in line with the approach to construction noise applied to other major recent projects in Victoria. These could be included in the Construction Noise and Vibration Management Plan (CNVMP) required by the recommended EPR to address Risk N002.

Construction traffic

No specific assessment criteria have been established for construction traffic noise on local roads. As per the discussion in the Noise and Vibration Assessment Report, this is generally not objectively assessed in Victoria.

No vibration criteria have been discussed for construction traffic on local roads. The ‘intermittent’ vibration assessment criteria for general construction works can also be applied to construction traffic.

**SUMMARY**
No specific noise criteria have been adopted for construction traffic on local roads which is in accordance with normal practice in Victoria.

**RECOMMENDATIONS**
Consideration could be given to applying the ‘intermittent’ vibration criteria from the NSW Vibration Guideline to construction traffic. These could be included in the CNVMP required by the recommended EPR to address Risk N002.
2.3.2 Assessment

Construction noise

Given the stage of the Project, the construction noise assessment is indicative only. 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 Noise and Vibration Assessment Report includes a recommendation to restrict works to normal working hours unless works are unavoidable, and this is considered appropriate where noise from construction works may exceed the Evening and Night time noise criteria set by the Noise Control Guidelines.

| SUMMARY |
|------------------|--------------------------------------------------|
| The assessment of potential noise from construction works is considered appropriate given the stage of the Project. The recommendation to restrict works to normal working hours (unless unavoidable) is supported for those cases where noise levels from works may exceed the Evening and Night time noise criteria set by the Noise Control Guidelines. |

| RECOMMENDATIONS |
|------------------|--------------------------------------------------|
| None |

Construction vibration

A construction vibration assessment is documented in Section 9.6 of the Noise and Vibration Assessment Report.

Due to the current stage of the Project, the assessment is preliminary only, but the typical vibration levels appear consistent with what would be expected for vibration-intensive works that may occur on the site.

Generally, it is not considered that construction vibration from the Project will involve significant disruption to sensitive land uses due to the considerable separation distances to the most vibration-intensive activities. The minimum safe working distances for vibration-intensive plant, referenced from the RMS Construction Noise and Vibration Guideline, are illustrative, showing that human disturbance would not be expected at distances further than 100 m from the works.

| SUMMARY |
|------------------|--------------------------------------------------|
| The assessment of potential noise from construction vibration 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 |

Blasting

It is noted that blasting design information is not available at this stage of the Project, and it is not certain that blasting would be required for the excavation on site.

Should blasting be required, then a blast plan would need to be implemented, setting out the control measures to be implemented to achieve the DEDJTR Guidelines. This may include controls on charge sizes, delays and depths. If necessary, trial blasts could be undertaken to confirm the propagation of airblast and ground vibration across the site.
SUMMARY
Information on blasting is not available at this stage of the Project and it is not confirmed that blasting would be required for the excavation on site.

RECOMMENDATIONS
None
2.4 Quarry noise, airblast and vibration

A temporary quarry is proposed as part of the Project, to be located centrally adjacent to Meadows Road and north of the Ledwells Road intersection.

2.4.1 Assessment criteria

General noise from quarry operations, although temporary, may last for up to four years and therefore has been assessed against assessment criteria derived from the EPA NIRV. 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.

The Noise and Vibration Assessment Report correctly identifies the following noise assessment criteria for the quarry:

- Day: 46 dB(A)
- Evening: 41 dB(A)
- Night: 36 dB(A).

Blasting may also occur at the quarry and has the potential to generate both airblast and ground vibration. The Noise and Vibration Assessment Report adopts the airblast and vibration limits from the DEDJTR Guidelines.

**SUMMARY**

The assessment criteria adopted for quarry operations are generally correct and in accordance with the EPA NIRV. The airblast and ground vibration limits from the DEDJTR Guidelines are also correctly identified.

**RECOMMENDATIONS**

None

2.4.2 Assessment

**Quarry noise**

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 a simplified terrain profile and a sensitivity analysis of screening between major noise sources and surrounding residential locations. The assumed plant and associated sound power levels are considered appropriate for quarry operations in our experience.

Predicted noise levels are presented for the four nearest residences, which are all involved with the Project, with predicted noise levels at these locations ranging from 40 to 47 dB(A). As the quarry will only operate during the daytime period, it is stated that predicted noise levels only exceed the daytime NIRV criterion of 46 dB(A) at one location.

Given the above, the Noise and Vibration Assessment Report notes that:

- A detailed assessment should be undertaken as part of a Quarry Work Plan when additional information on the quarry design and plant selection is available. This may result in changes to predicted noise levels at neighbouring residences.
- If it is still not possible to achieve compliance with the NIRV criteria at stakeholder residences, then an extended agreement should be considered with these landowners to allow temporary exceedances of the NIRV criteria due to quarry operations. It is noted that the NIRV are recommended levels rather than mandatory levels.

We consider the above approach appropriate on the basis that the quarry site is well removed from all residences that are not involved with the Project and as the predicted noise levels only marginally exceed the NIRV criteria at one
involved residence. It is recommended that the Quarry Work Plan should detail all reasonable and feasible noise management measures to achieve the NIRV criteria and, only if the criteria are not able to be achieved after the application of reasonable and feasible measures, should an extended agreement with any affected landowners be considered.

| SUMMARY |
| The noise assessment for quarry operations generally appears appropriate given the preliminary nature of information available on the quarry design at this stage. |

| RECOMMENDATIONS |
| As per the recommended EPR to address Risk N004, a detailed Quarry Work Plan should be required to be submitted once further information on the quarry design and operation is available. This should include identification of all reasonable and feasible noise mitigation measures, prior to considering extended agreements with involved landowners where the NIRV criteria are not able to be reasonably achieved at involved landowner residences. |

### Airblast and ground vibration

No specific assessment of airblast or ground vibration is detailed within the Noise and Vibration Assessment Report but it is noted that, given the distance of approximately 750 m to the nearest residences, compliance is expected to be achievable with the airblast and vibration criteria.

At this stage of the Project, we agree that it is not possible to provide detailed predictions of airblast or ground vibration from quarry operations and that compliance is expected to be achievable across a distance of 750 m. The Quarry Work Plan will need to include a Blast Management Plan that details:

- indicative predictions of airblast and ground vibration based on nominated locations, charge sizes and delays
- a proposed monitoring regime for blasting to confirm compliance, including trial blasting where there is a risk that the DEDJTR Guidelines limits may be approached or exceeded.

| SUMMARY |
| No detailed assessment of airblast and ground vibration from quarry operations has been undertaken. However, given the distance of 750 m to the nearest residences it is expected that the DEDJTR Guidelines limits would be achievable with appropriate blast design. |

| RECOMMENDATIONS |
| As per the recommended EPR to address Risk N004, a Blast Management Plan should be included as part of the Quarry Work Plan detailing indicative predictions of airblast and ground vibration based on blast design parameters and a monitoring regime to be implemented during blasting at the site. |
2.5 **Recommended EPRs**

Section 11.0 of the Noise and Vibration Assessment Report details recommended Environmental Performance Requirements (EPRs) that have been developed to address the potential noise and vibration risks associated with the Project.

A summary of the EPRs and any comments / recommendations is provided in Table 1.

**Table 1  Comments on proposed EPRs**

<table>
<thead>
<tr>
<th>EPR recommended in Noise and Vibration Assessment Report</th>
<th>Our comments / recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offsite vehicle movements are to be addressed in the construction noise management plan (see recommended performance requirement for on-site construction traffic and works), detailing proposed routing, timing and operating procedures to reduce noise along local roads.</td>
<td>This EPR is supported.</td>
</tr>
<tr>
<td>Before development starts, a construction noise and vibration management plan is to be prepared for endorsement by the Responsible Authority. The plan is to address the effects of construction noise related to on-site activities and off-site traffic movements. The construction noise and vibration management plan is to provide a clear overview of the proposed construction program and demonstrate how the proposed mitigation measures are compliant with the requirements defined by the Victorian Noise Control Guidelines (EPA Publication 1254). This shall include a schedule of noise emission data for the major plant items selected for construction of the project, and a comparison of the data with the noise emission ranges set out in AS 2436:2010. The plan is to clearly define all unavoidable works and low-noise managed-impact works which may occur outside of normal working hours, such as out of hours deliveries or turbine installation activities that are subject to weather constraints. The plan is to describe the proposed scheduling of any out of hours works, and provide evidence to support that low-noise managed-impact works meet the criteria defined in EPA Publication 1254. The plan shall also identify the specific activities which warrant notification of neighbouring residents in advance of the work occurring, such as unavoidable works outside of normal working hours, and activities with the potential to give rise perceptible vibration at neighbouring locations (e.g. access track construction near to houses). All temporary concrete batching plants are to be designed and operated in accordance with the general management measures in EPA Publication 628 Environmental Guidelines for the Concrete Batching Industry.</td>
<td>This EPR is supported.</td>
</tr>
<tr>
<td><strong>EPR recommended in Noise and Vibration Assessment Report</strong></td>
<td><strong>Our comments / recommendations</strong></td>
</tr>
<tr>
<td>------------------------------------------------------------</td>
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</tr>
<tr>
<td>If blasting is proposed to be undertaken on site as part of construction of the wind farm, a blasting plan is to be prepared in accordance with the requirements of the <em>Dangerous Goods (Explosives) Regulations</em> 2011. The blasting plan is to address a range of considerations relating to safety and protection of the surrounding environment. The blasting plan is to document the measures that will be implemented to manage and monitor noise and vibration levels at sensitive sites in accordance with AS 2187-2:2006 and the DEDJTR Environmental Guidelines. For the purpose of this requirement, a ‘sensitive site’ is defined in the DEDJTR Environmental Guidelines as ‘any land within 10 metres of a residence, hospital, school, or other premises in which people could reasonably expected to be free from undue annoyance and nuisance caused by blasting’.</td>
<td>This EPR is supported.</td>
</tr>
<tr>
<td>Before development starts, a Quarry Work Plan is to be prepared in consultation with DEDJTR and endorsed as part of the Work Authority required under the <em>Mineral Resources (Sustainable Development) Act</em> 1990. The Quarry Work Plan shall document all reasonable and practicable measures that will be implemented for the purpose of achieving the recommended maximum noise levels determined in accordance with NIRV, including working hours, equipment noise controls and perimeter screening. The Quarry Work Plan shall also include a blasting plan prepared in accordance with the requirements of the <em>Dangerous Goods (Explosives) Regulations</em> 2011. The blasting plan is address a range of considerations relating to safety and protection of the surrounding environment. With respect to noise and vibration at sensitive locations where people reside, the blasting plan is to document the measures that will be implemented to manage and monitor noise and vibration levels in accordance with AS 2187-2:2006 and the DEDJTR Environmental Guidelines. For the purpose of this requirement, a ‘sensitive site’ is defined in the DEDJTR Environmental Guidelines as ‘any land within 10 metres of a residence, hospital, school, or other premises in which people could reasonably expected to be free from undue annoyance and nuisance caused by blasting’.</td>
<td>This EPR is supported. Consideration could be given to the specific inclusion of ‘airblast’ in the EPR with respect to the blasting plan. However, we note that airblast would be required to be considered to address both AS 2187-2 and the DEDJTR Guidelines.</td>
</tr>
<tr>
<td>Before development starts, a pre-development noise assessment is to be submitted to the responsible authority demonstrating that power transmission infrastructure associated with the wind farm is expected to achieve compliance with the recommended levels determined in accordance with NIRV. Before the wind farm’s power transmission infrastructure commences operation, an operational noise management plan is to be prepared for endorsement by the responsible authority. The operational noise management plan shall identify receiver locations around the terminal station and collector stations where compliance testing is warranted (i.e. receiver locations where the predicted effective noise levels presented in the predevelopment noise assessment are approaching the NIRV recommended noise levels), the procedures and timing for the testing, and the procedures that would be used to investigate any suspected compliance breaches.</td>
<td>This EPR is supported.</td>
</tr>
</tbody>
</table>
Before development starts, a pre-development noise assessment is to be submitted to the responsible authority demonstrating that the wind farm is expected to achieve compliance with the operational noise requirements established in accordance with NZS 6808:2010. The pre-development noise assessment shall be based on the final wind farm layout, representative noise emission data for the final selected turbine(s) for the Project and the location of all noise sensitive receiver locations around the wind farm (existing or approved noise sensitive receiver locations at the date of the wind farm’s approval). The predevelopment assessment shall identify all stakeholder locations where noise agreements have been established. The pre-development noise assessment shall be prepared in accordance with the assessment and documentation requirements of NZS 6808:2010.

Before development starts, an operational noise management plan is to be prepared for endorsement by the responsible authority.

The operational noise management plan shall contain details of the procedures and timing of compliance testing to be carried out when the wind farm commences operation, and the procedures that would be used to investigate any suspected compliance breaches. The operational noise management plan shall include data describing the trend of wind speeds and wind directions at the site throughout the year, and shall describe how the post-construction noise compliance testing will be scheduled to account for periods when the test locations are most likely to be downwind of the wind farm. Due to the size of the Project and the potential time between commencement of operation of the first turbines, and commencement of operation of the last turbines, the testing plan will document how noise compliance testing is to be staged to provide the earliest verification of compliance. The noise management plan shall also document a schedule of sound power level testing which will be undertaken to verify that the emissions of the installed turbine are consistent with the findings presented in the pre-development noise assessment.

Before development starts, a complaint investigation and response plan is to be prepared, including details of how complaints are recorded, managed and evaluated in order to determine whether compliance investigation studies are required.

The construction noise and vibration management plan will also address the effects of noise and vibration during decommissioning activities.

A permit condition specifying a requirement for the construction noise management plan to detail the procedures that would equally apply to the decommissioning of the project.

This EPR is supported.

Consideration could be given to including specific reference to operational testing for special audible characteristics in the operational noise management plan. However, we note that this is a requirement of NZS 6808:2010 and will therefore need to be addressed.

This EPR is supported.

This EPR is supported.

This EPR is supported.
3 Summary

Resonate has been engaged by WestWind Energy Pty Ltd (WestWind) to undertake a peer review of the environmental noise and vibration assessment prepared as part of the Environmental Effects Statement for the Golden Plains Wind Farm. The proposed wind farm will consist of up to 228 wind turbines with a tip height of up to 230 metres and will be located to the west, south and southeast of Rokewood in Golden Plains Shire.

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

To address potential risks associated with noise and vibration, the Noise and Vibration Assessment Report recommends EPRs that should apply to the Project. We consider these EPRs appropriate.

Recommendations have been made within this peer review regarding both the Noise and Vibration Assessment Report as follows:

Operational wind turbine noise

- A suitable post-construction monitoring program will need to be implemented that includes testing for special audible characteristics. It is envisaged this would be defined by the operational noise management plan required to be submitted by the recommended EPR for Risk N006.

Ancillary noise

- The noise from ancillary infrastructure will need to be assessed and addressed during detailed design, and should be considered as part of any post-construction noise testing. The EPR proposed to address Risk N005 is considered sufficient to fulfil this recommendation.

Construction noise and vibration

- Construction noise criteria for the school and child care centre should be considered in line with the approach to construction noise applied to other major recent projects in Victoria. These could be included in the CNVMP required by the recommended EPR to address Risk N002.
- Consideration could be given to applying the ‘intermittent’ vibration criteria from the NSW Vibration Guideline to construction traffic. These could be included in the CNVMP required by the recommended EPR to address Risk N002.

Quarry noise, airblast and vibration

- As per the recommended EPR to address Risk N004, a detailed Quarry Work Plan should be required to be submitted once further information on the quarry design and operation is available. This should include identification of all reasonable and feasible noise mitigation measures, prior to considering extended agreements with involved landowners where the NIRV criteria are not able to be reasonably achieved at involved landowner residences.
- As per the recommended EPR to address Risk N004, a Blast Management Plan should be included as part of the Quarry Work Plan detailing indicative predictions of airblast and ground vibration based on blast design parameters and a monitoring regime to be implemented during blasting at the site.
Appendix A—CV of peer reviewer
Tom Evans
Associate Director – Acoustics

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

Awards
2013 Australian Acoustical Society Award for Excellence in Acoustics
2011 SA Engineering Excellence Awards – Commendation for Northern Expressway (Acoustics)

Affiliations
Member of Australian Acoustical Society
AAS VIC Division Committee Member

Career history
Tom’s expertise in the assessment of noise and vibration on a wide range of projects has been called upon by prestigious clients both within Australia and internationally to provide expert advice and service to the environmental, architectural, buildings, wind energy, transport and industrial sectors. He is a prolific author of technical papers on the topic of wind farm noise and was awarded the 2013 Australian Acoustical Society Excellence for work developing a tonality assessment methodology for wind farms. 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. In addition to providing advice on developments across various market sectors, he has been involved in the development of noise and vibration regulations for Local and State Government.

Project experience

Wind Farms
- Macarthur Wind Farm (VIC)
- Oaklands Hill Wind Farm (VIC)
- Mount Mercer Wind Farm (VIC)
- Bald Hills Wind Farm (VIC)
- Portland Wind Energy Project Stage IV (VIC)
- Inverleigh Wind Farm (VIC)
- Naroghid Wind Farm (VIC)
- Woolsthorpe Wind Farm (VIC)
- Yaloak South Wind Farm (VIC)
- Lal Lal Wind Farm (VIC)
- Mortlake South Wind Farm Peer Review (VIC)
- Moorabool Wind Farm Peer Review (VIC)
- Clements Gap Wind Farm (SA)
- Hallett Hill Wind Farm (SA)
- North Brown Hill Wind Farm (SA)
- The Bluff Wind Farm (SA)
- Wattle Point Wind Farm (SA)
- Bodangora Wind Farm (NSW)
- Gunning Wind Farm (NSW)
- White Rock Wind Farm (NSW)
- Coopers Gap Wind Farm (QLD)
- Lakeland Wind Farm (QLD)
- Flat Rocks Wind Farm (WA)
- Warradarge Wind Farm (WA)
- Te Rere Hau Wind Farm (NZ)
- Burgos Wind Farm (Philippines)
- Mannar Island Wind Project (Sri Lanka)
- Jeneponto Wind Farm (Indonesia)
- Zephyr Wind Farm (Pakistan)
- SA EPA Infrasound and Low Frequency Noise Studies (SA)

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e tom.evans@resonate-consultants.com