In the matter of the
Lal Lal Wind Farm Amendment Application

Planning Panels Victoria

Proponent: West Wind Energy Pty Ltd

Expert Witness Statement of
Christophe Frederic Delaire

Expert of West Wind Energy Pty Ltd

1 Name and address

CHRISTOPHE FREDERIC DELAIRE

Associate

Marshall Day Acoustics Pty Ltd

6 Gipps Street, Collingwood.

Victoria 3066

2 Area of expertise

For over 14 years I have worked in the field of acoustics and noise control. I have a special interest in environmental noise and have gained extensive experience in the noise assessment of wind farms since 2005.

I am a member of the Australian Acoustical Society (MAAS) and the Association of Australian Acoustical Consultants (AAAC) Wind Farm Subcommittee.

My qualifications and experience are detailed in Annexure A.

I am sufficiently expert to make this statement because I have been involved in environmental noise impact assessments for major environmental projects such as power stations, wind farms and other industrial plants.

My experience extends to all aspects of wind farm noise, including predictions, background noise monitoring and post-construction noise monitoring. This is demonstrated by my involvement in over fifty (50) projects across Australia, providing expert witness evidence for eleven (11) Victorian wind farms and presentation of multiple papers at international conferences.

3 Scope

3.1 Instructions

The Lal Lal Wind Farm has been approved for development with planning permit PL-SP/05/0461 having been issued in April 2009 (the Planning Permit).

Marshall Day Acoustics Pty Ltd (MDA) was commissioned by West Wind Energy Pty Ltd (West Wind) to prepare a noise assessment for the Lal Lal Wind Farm in accordance with the New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010), as required by the Victorian Government's *Policy and planning guidelines for development of wind energy facilities in Victoria* (Victorian Guidelines).

The noise assessment was undertaken in accordance with the June 2015 version of the Victorian Guidelines, with findings presented in the MDA report Rp002 2015386ML *Lal Lal Wind Farm - NZS 6808:2010 Noise Assessment* dated 11 September 2015 (the MDA Report).

The MDA Report was exhibited as Annex E of the *Lal Lal Wind Farm Planning Amendment* report dated October 2015.

Following the issue of the MDA Report, a revised noise assessment for the Lal Lal Wind Farm has been undertaken considering the following:

- The January 2016 version of the Victorian Guidelines
- An amended turbine layout
- Additional candidate turbine models
- An additional participating landholder property

The revised noise assessment is detailed in the MDA letter 001 2016307ML dated 12 August 2016 (the Revised Noise Assessment).

I adopt the MDA Report and Revised Noise Assessment as the basis for my expert witness statement and evidence.

I have been instructed by Herbert Smith Freehills (HSF) on behalf of West Wind Energy Pty Ltd (West Wind) to prepare a witness statement and give expert evidence at the panel hearing based on the findings of the revised noise assessment.

This statement provides a summary of the revised noise assessment for the amended turbine layout and selection, together with a response to key submissions raising issues relating to noise.

3.2 Reports reviewed to prepare initial study or statement

The documents I have reviewed and referenced in the MDA Report, Revised Noise Assessment and this statement are listed in Annexure B.

3.3 Persons assisting with this work

My colleagues Justin Adcock, Daniel Griffin and Alex Morabito have assisted with the review of calculations, reporting and this statement of evidence.

4 Revised noise assessment

The revised noise assessment for the variation to the amendment application for the Lal Lal Wind Farm presented in the Revised Noise Assessment and summarised herein considers the following changes from the MDA Report:

- Amendments to the Victorian Guidelines dated January 2016
- An amended sixty (60) wind turbine layout, with the following modifications:
    - Relocation of one (1) turbine (ESWT02 by 150 m)
    - Removal of one (1) turbine (YSWT37)
    - Reinstatement of one (1) turbine (YSWT31)
- Additional participating landholder property (J17ab)
- Consideration of two (2) additional candidate turbine models, the Senvion 3.4M122 and Senvion 3.4M140
- New octave band sound power data, provided by Senvion, for the candidate 3.2M114 turbine model

The methodology used for the Revised Noise assessment is consistent with that detailed in the MDA Report.

4.1 Noise criteria

4.1.1 NZS 6808:2010

At the time of approval of the Lal Lal Wind Farm, wind farm noise was assessed in accordance the New Zealand Standard 6808:1998 *Acoustics – The assessment and measurement of sound from wind turbine generators* (NZS 6808:1998). Condition 37 of the planning permit requires that compliance with the NZS 6808:1998 criteria be achieved at *any dwelling existing on land in the vicinity of the proposed wind energy facility as at the date of the issue of this permit*.

The assessment of operational wind farm noise detailed in the MDA Report was undertaken in accordance with NZS 6808:2010 as detailed in the Victorian Guidelines, dated June 2015, applicable at the time of preparing the assessment.

Since the preparation of the MDA Report, the Victorian Guidelines were revised in January 2016. This latest version includes additional guidance regarding the application of the high amenity area noise limits.

The Revised Noise Assessment of operational wind farm noise has been undertaken in accordance with NZS 6808:2010 as detailed in the latest version of the Victorian Guidelines.

In accordance with NZS 6808:2010, the operational noise from turbines at noise sensitive locations should not exceed 40 dB L_{A90} or the background noise (L_{A90}) by more than 5 dB, whichever is the greater.

Although background noise levels were measured in the vicinity of the proposed wind farm in 2009, as a conservative approach, the NZS 6808:2010 base noise limit of 40 dB L_{A90} has been used at all wind speeds for all noise sensitive locations.

4.1.2 High amenity

Section 5.3.1 of NZS 6808:2010 states that the base noise limit of 40 dB L_{A90} is *appropriate for protection of sleep, health, and amenity of residents at most noise sensitive locations*. It goes on to note that high amenity areas may require additional consideration:

> […] *In special circumstances at some noise sensitive locations a more stringent noise limit may be justified to afford a greater degree of protection of amenity during evening and night-time. A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area, for example where evening and night-time noise limits in the plan for general sound sources are more stringent than 40 dB $L_{Aeq(15\ min)}$ or 40 dBA L_{10}. A high amenity noise limit should not be applied in any location where background sound levels, assessed in accordance with section 7, are already affected by other specific sources, such as road traffic sound.*

Section 5.3 of NZS 6808:2010 provides details of high amenity noise limits that apply to residential properties that are deemed to be located within a high amenity area as defined in Sections 5.3.1 and 5.3.2 of the standard. The high amenity limit specifies that wind farm noise levels (L_{A90}) during evening and night-time periods should not exceed the background noise level (L_{A90}) by more than 5 dB or 35 dB L_{A90}, whichever is the greater, for wind speeds below 6 m/s at hub height. High amenity noise limits are not applicable during the daytime period.

In Section 5.1.2.a, the Victorian Guidelines states the following:

> *Under section 5.3 of the Standard, a 'high amenity noise limit' of 35 decibels applies in special circumstances. All wind farm applications must be assessed using section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in clause C5.3.1 of the Standard. Guidance can be found on this issue in the VCAT determination for the Cherry Tree Wind Farm.*

The definition of a high amenity area provided in NZS 6808:2010 is specific to New Zealand planning legislation and guidelines. A degree of interpretation is therefore required when determining how to apply the concept of high amenity in Victoria. As recommended in the Victorian Guidelines, it is therefore appropriate to follow the guidance detailed in the Cherry Tree Wind Farm Pty Ltd v Mitchell Shire Council decisions[1].

Paragraph 53 of the Cherry Tree Wind Farm Decision states the following:

> *The Tribunal does not accept that the permit conditions need to refer to the High Amenity Area provisions of the New Zealand standard because it has not been established that any such area could reasonably be identified within the environs of this wind energy facility.* […]

[1] Mitchell Shire Council interim decision dated 4 April 2013 (the Cherry Tree Wind Farm Interim Decision) and Mitchell Shire Council decision dated 27 November 2013 (the Cherry Tree Wind Farm Decision)

Further justification for the above statement was provided in Paragraphs 107 to 109 of the Cherry Tree Wind Farm Interim Decision:

> *107. We were invited by the respondents to treat the subject land and the locality as a high amenity area. This invitation meets with the immediate conundrum that the language of the standard is not translatable to the Victorian planning framework. The "plan" referred to in section 5.3 is a plan as defined by the Resources Management Act of New Zealand. Section 43AA of that Act defines "plan" to mean "a regional plan or a district plan". No such animals exist under the Victorian legislation.*
>
> *108. Applying the standard mutatis mutandis to the Victorian experience we treat the plan referred to in the standard as a planning scheme approved under the Planning and Environment Act 1987. The Mitchell Planning Scheme does not anywhere expressly or by implication "promote a higher degree of protection of amenity related to the sound environment of a particular area". Approaching the matter by a process of elimination it can be seen with certainty that the controls contained within the Farming zone, which includes most of the locality, do not answer this description. The purpose of the Farming zone is to encourage agricultural use, which is not an inherently quiet land use. In fact reference to the zone purposes confirms that agricultural use is to be preferred to residential use if there is potential conflict between the two.*
>
> *109. Accordingly the Tribunal concludes that the subject land and its locality is not capable of designation as a high amenity area because it does not possess the necessary characteristics of such an area as specified in the NZ standard.*

As detailed in Paragraph 108, for the land surrounding the wind farm to be considered a high amenity area, the zoning of the land must be identified in the relevant planning scheme as *promoting a higher degree of protection of amenity related to the sound environment*.

The area surrounding the proposed wind farm is zoned Farming Zone.

The *Moorabool Planning Scheme* dated 14 July 2016 does not specify the Farming Zone as promoting a higher degree of protection of amenity related to the sound environment.

Following guidance from the VCAT determination for the Cherry Tree Wind Farm, as required by the latest version of the Victorian Guidelines, the high amenity noise limit detailed in NZS 6808:2010 is therefore not considered to be applicable for residential properties in the vicinity of the Lal Lal Wind Farm.

4.1.3 Participating landholder properties

For participating landholder properties, the proposed planning permit conditions[2] specify the following:

> *Any dwelling may be exempt from [complying with the noise limits detailed in Condition 23]. This exemption will be given effect through a written agreement with the landowner of the dwelling and evidence of the agreement must be provided to the satisfaction of the Minister for Planning.*

WestWind has advised that agreements have been signed between WestWind and all participating landowners. While these dwellings are therefore exempt from noise limits according to proposed Condition 23 of the Planning Permit, a recommended base noise limit of 45 dB L_{A90} is referenced in this noise assessment for participating landholder properties. This base noise limit is provided for informative purposes and is consistent with recommendations from the final report by *The European Working Group on Noise from Wind Turbines* (ETSU-R-97) which is commonly referenced for wind farms in Victoria and Australia.

[2] Submitted with the amendment application dated October 2015

4.2 Site layout

The wind farm is located on land in Yendon and Elaine, Victoria and is proposed to comprise of sixty (60) turbines in two (2) sections:

- Elaine: Twenty-two (22) turbines
- Yendon: Thirty-eight (38) turbines

Noise compliance in accordance with NZS 6808:21010 has been assessed for the following three (3) candidate turbine models:

- Senvion 3.2M114 with a 114 m rotor diameter and 104 m hub height
- Senvion 3.2M122 with a 122 m rotor diameter and 100 m hub height
- Senvion 3.4M140 with a 140 m rotor diameter and 91 m hub height

In accordance with the existing Planning Permit, the assessed receivers comprise sensitive locations that existed before the date of issue of the existing Planning Permit. As detailed in NZS 6808:2010, noise sensitive receiver locations include residential dwellings, temporary accommodation and educational facilities.

Residential dwellings are separately considered according to whether or not they are participating in the development of the proposed wind farm, by way of land ownership or formal agreement with the developer.

West Wind has identified twenty (20) residential properties, existing before the date of issue of the existing Planning Permit, in the vicinity of the proposed wind farm, including seven (7) participating landholder properties.

The amended layout is presented in Annexure C together with the assessed residential properties.

4.3 Predicted noise levels

Noise from the Lal Lal Wind Farm has been predicted using ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation* (ISO 9613-2:1996) as implemented in version 7.4 of SoundPLAN.

The following key details are noted:

- Turbine hub height: As detailed in Section 4.2 above
- Receiver heights: 1.5 m
- Ground characterisation: G = 0.5
- Atmospheric conditions: T = 10°C and RH = 70 %
- Terrain elevation sourced from VicMap downloaded in July 2016.

Predicted noise levels for each of the three (3) candidate turbine models, corresponding to the wind speeds which give rise to the highest noise emissions (sound power levels) of each turbine, are provided in Tables 4 and 5 for the residential properties located in the vicinity of the Elaine and Yendon sections, respectively.

Table 4: Highest predicted noise levels – Elaine Section - dB L_{A90}

Receiver	Applicable base noise limit	Senvion 3.2M114	Senvion 3.4M122	Senvion 3.4M140
H18aa	40	38.7	39.0	38.6
J17aa (P)	45	45.0	45.3	44.9
J17ab (P)	45	40.5	40.8	40.3
K15aa	40	36.6	36.9	36.4
L17aa (P)	45	44.3	44.6	44.1
L17ab (P)	45	43.2	43.5	43.0
L18aa	40	36.7	37.0	36.6
L19ab	40	33.8	34.1	33.6
M18ab	40	34.3	34.6	34.1
M19aa	40	33.6	33.9	33.4

(P) Participating landholder property

Table 5: Highest predicted noise levels – Yendon Section – dB L_{A90}

Receiver	Applicable base noise limit	Senvion 3.2M114	Senvion 3.4M122	Senvion 3.4M140
J31aa (P)	45	38.7	39.0	38.5
K31aa (P)	45	40.8	41.1	40.6
K31ab (P)	45	40.1	40.4	39.9
K34aa	40	39.4	39.8	39.3
M29aa	40	39.5	39.8	39.3
N31aa	40	38.2	38.5	38.0
N31ab	40	39.7	40.0	39.6
N32aa	40	37.7	38.0	37.5
N32ab	40	36.8	37.1	36.6
N32ac	40	36.6	37.0	36.5

(P) Participating landholder property

The following can be seen from Tables 4 and 5:

- Senvion 3.2M114:

  Predicted noise levels from the Lal Lal Wind Farm comply with the applicable base noise limits at all assessed properties.

- Senvion 3.4M122:

  Predicted noise levels from the Lal Lal Wind Farm comply with the applicable base noise limits at all assessed neighbouring properties (those not participating with the project).

  Predicted noise levels from the Lal Lal Wind Farm marginally exceed the applicable base noise limit at one (1) of the assessed participating landholder properties (J17aa) by 0.3 dB.

  I have been advised that an agreement is in place with this participating landholder to allow this marginal exceedance with the recommended ETSU-R-97 base noise limit.

- Senvion 3.4M140:

  Predicted noise levels from the Lal Lal Wind Farm comply with the applicable base noise limits at all assessed properties.

  It should be noted that, as sound power level data for the 3.4M140 is based on a turbine with serrated blades, the predicted noise levels for this turbine model are subject to greater uncertainty tolerances. However, based on advice received from Senvion the spectral content assumptions for this turbine model are expected to provide conservative results.

4.4 Comments on Amended Conditions

I have reviewed the proposed amendments to the existing planning permit conditions submitted with the amendment application on 15 August 2016 and provide the following comments:

- The proposed changes to the permit conditions are based on the example conditions provided in Attachment B *Example permit conditions to be applied as appropriate* of the Victorian Guidelines.
- The proposed conditions are generally consistent with the existing conditions with changes addressing the changes in the version of NZS 6808 and removing overly prescriptive conditions relating the assessment of measured noise levels that were not in accordance with the requirements of NZS 6808.
- Condition 22 – Construction noise

  The condition currently proposes that the assessment of noise from construction activities should be in accordance with the Interim Guidelines for Control of Noise from Industry in Country Victoria, N3/89. This document has now been superseded by the Victorian EPA publication 1411 *Noise from industry in regional Victoria - Recommended maximum noise levels from commerce, industry and trade premises in regional Victoria* (NIRV) which specifically excludes the assessment of construction noise.

  It is my opinion that Condition 22 should reference the Victorian EPA publication 1254 *Noise Control Guidelines* dated October 2008.
- Condition 23 – Wind farm noise criteria

  The criteria set out in Condition 23 are acceptable and consistent with the requirements of NZS 6808:2010.
- Condition 24 – Noise compliance testing plan

  It is my opinion that the requirements set out in Condition 24 are acceptable.
- Conditions 25 and 26 – Noise complaints evaluation

  The Noise Complaint Investigation and Response Plan required by Condition 26 would include the procedure to practically implement the requirements of Condition 25.

  It is my opinion that the requirements set out in Conditions 25 and 26 are acceptable.
- Noise from associated infrastructure

  It is my opinion that an additional condition should be considered specifying that noise from infrastructure associated with the wind farm, such as the substation, should comply with the recommended levels detailed in NIRV.

4.5 Response to peer review

A peer review of the MDA Report and Revised Noise Assessment has been undertaken by Arup. Their findings are detailed in report No. 25305/R01 *Lal Lal Wind Farm Noise Impact Assessment – Peer Review* dated 19 October 2016 (the Arup Peer Review Report), attached in Appendix G..

The Arup Peer Review Report makes the following concluding statement:

> *In my opinion, the conclusion that the noise levels from the proposed wind farm will generally meet the requirements of NZS 6808:2010 at non-participating receivers appears to be reasonable.*

Notwithstanding the above, several remarks regarding certain aspects of the noise assessment have been made. My response is provided in Table 6 below.

Table 6: Response to peer review remarks

Issue raised	Comment
the assessment does not appear to provide an integer wind speed assessment (ie tabulated receiver noise levels at integer wind speeds other than the 95% or worst-case). This would not change the outcomes of the assessment, but is required by NZS 6808-2010	Although the provision of predicted noise levels at integer wind speeds is a requirement of the South Australian EPA Wind Farm Guidelines, it is not a requirement of NZS 6808:2010. Predicted noise levels using data for the integer wind speed with the highest sound power levels for each turbine model comply with the base noise limit of 40 dB L_{A90} at all noise assessed neighbouring properties. Therefore compliance with NZS 6808:2010 is achieved irrespective of the assessed wind speed.
there does not appear to be any assessment of; • *noise impacts from construction,* • *noise from transformers, substations and fixed equipment against SEPP N1 or NIRV,* • *discharge noise and aeolian tones from transmission lines.* *These are not required to be assessed under NZS 6808-2010, and are typically less critical than noise from the wind turbines themselves. Nevertheless, it is good practice for wind farm noise assessments to include at least a brief assessment of these noise sources to confirm that they will comply with the relevant requirements.*	My instructions were to assess noise from the proposed wind farm in accordance with NZS 6808:2010. Unlike other jurisdictions like New South Wales, it is not common practice in Victoria to assess the potential noise impact from construction and associated infrastructure (e.g. transformers and transmission lines) during the planning application stage of a wind farm. This is generally due to these matters representing low risk considerations for wind farm development which can be adequately managed with appropriate planning conditions. As discussed in Section 4.4 above, Condition 22 of the proposed planning permit specifies requirements to address the potential impact of construction noise. As also discussed in Section 4.4 above, an additional condition should be considered specifying that noise from infrastructure associated with the wind farm, such as the substation, should comply with the recommended levels detailed in NIRV. As detailed in the Arup Peer Review Report, it is also my understanding that the assessment of transmission lines is not included as part of this planning application.

4.6 Conclusion

This revised noise assessment has demonstrated that predicted wind farm noise levels for two (2) of the candidate turbines, the 3.0M114 and 3.4M140, are able to comply with applicable noise limits at all assessed residential properties.

For the remaining candidate turbine considered as part of this assessment, the 3.4M122, predicted wind farm noise levels comply with applicable noise limits at all receiver locations with the exception of the participating landholder dwelling J17aa, where wind farm noise levels are predicted to marginally exceed the recommended base noise limit by 0.3 dB.

I have been advised that an agreement is in place with this participating landholder to allow this marginal exceedance with the recommended ETSU-R-97 base noise limit.

These results are considered to demonstrate the viability of the proposed wind farm to satisfy the acoustic requirements of the Victorian Government's Policy and planning guidelines for development of wind energy facilities in Victoria.

The results do however indicate that noise will be a factor to consider in selecting the final turbine design and specification for the site. Revised noise modelling will be required during the turbine procurement phase, and should be based on direct measurement data for octave band sound power levels and tonality.

5 Response to key submissions

I have reviewed key submissions that raise issues relating to noise. The key issues and my response are provided in Table 6.

Table 6: Response to key submissions

Issue raised	Comment
Independent noise monitoring	Condition 24 of the proposed permit conditions requires for a Noise Compliance Testing Plan (NCTP) to *be prepared by a suitably qualified expert to the satisfaction of the Minister for Planning*. The NCTP would detail the methodology proposed to undertake the post-construction noise monitoring to demonstrate compliance with Condition 23, following the requirements of the planning permit and all relevant noise standards and guidelines. As discussed in Section 4.4 above, the proposed Condition 24 is based on the example conditions provided in the Victorian Guidelines.
Complaint resolution	Conditions 25 and 26 of the proposed permit conditions require for a Noise Complaint Investigation and Response Plan to be prepared to the satisfaction of the Minister for Planning. This document would detail the procedure for addressing potential noise related complaints. As discussed in Section 4.4 above, the proposed Conditions 25 and 26 are based on the example conditions provided in the Victorian Guidelines.

Issue raised	Comment
Amplitude modulation	Comment CB3.1 of NZS 6808:2010 states that, *by the very nature of wind turbine blades passing in front of a support tower, some amplitude modulation will always be present in the sound of a rotating wind turbine*. Amplitude modulation is a fundamental characteristic of wind turbine noise and is a characteristic which is taken into account in the objective criteria specifically developed for wind farms. Therefore the penalty for special audible characteristics does not apply to amplitude modulation that is a normal feature of a correctly functioning wind turbine. A higher than usual level of amplitude modulation has been reported to occur for brief periods at a small number of wind farm sites in other countries which lead to significant research by Renewable UK and others. The UK Institute of Acoustics (UK IOA) established a working group to investigate amplitude modulation. The aim of the group is to review the available evidence, and to produce guidance on the technical aspects for the assessment of amplitude modulation in wind turbine noise. In August 2016, the group published a final report presenting a proposed method for measuring and rating amplitude modulation in wind turbine noise. It should be noted that this report does not provide discussion of acceptable levels of amplitude modulation to address potential adverse community response. Notwithstanding the above, as discussed in Section 4.4, the proposed permit conditions for the project require compliance monitoring in accordance with NZS 6808:2010, which includes requirements to evaluate the presence of Special Audible Characteristics, including amplitude modulation.
Infrasound	Section 5.5.1 of NZS 6808:2010 states that *although wind turbines may produce some sound at (ultrasound and infrasound) frequencies considered to be outside the normal range of human hearing these components will be well below the threshold of human perception.* Additional information is provided in Annexure D
Low Frequency Noise	Section 5.5.1 of NZS 6808:2010 states that *claims have been made that low frequency sound and vibration from wind turbines have caused illness and other adverse physiological effects among a very few people worldwide living near wind farms. The paucity of evidence does not justify at this stage, any attempt to set a precautionary limit more stringent than those recommended.* Additional information is provided in Annexure D
Health	Health related issues are outside of my area of expertise. However, the consensus advice from publications of government and peak health bodies in relation to the health effects of wind farms is that there is no reliable evidence to support a relationship between wind farm noise and direct adverse effects on human health. Furthermore, the Standard notes that the consensus view of the committee responsible for the development of NZS 6808:2010, including New Zealand representatives from the Ministry of Health and Institute of Environmental Health, was that the Standard provides a reasonable way of protecting health and amenity at nearby noise sensitive locations, without unreasonably restricting the development of wind farms. Additional information is provided in Annexure D

Issue raised	Comment
Findings of the Acoustic Group report titled *The results of an acoustic testing program Cape Bridgewater Wind Farm* dated 26 November 2014	As a member of the Association of Australian Acoustical Consultants (AAAC) Wind Farm Subcommittee, I was involved in the preparation of a review of the Acoustic Group report which was presented at the recent Senate Select Committee on Wind Turbines. The review provides the following conclusions: • The level of infrasound measured is similar to the level previously measured by others • The claimed "pattern" between high severity sensation and modes of operation is not based on a statistical analysis and ignores contradictory occurrences • The hypothesis that there is a link between "sensations" and infrasound is based on excluding data that do not support the hypothesis. A copy of the AAAC Review is provided in Annexure E. The Acoustic Group report was commissioned in response to ongoing concerns from six (6) local residents in the vicinity of the Cape Bridgewater Wind Farm, but did not assess whether the wind farm complied with its planning approval requirements. The findings of this report are specific to the experience of these residents during the study and the noise environment at their dwellings. I endorse the AAAC Review and, considering that the Acoustic Group report does not present any new credible scientific evidence, it is my opinion that it is not relevant to the noise and vibration assessment of the proposed Lal Lal Wind Farm. It should be noted that the Joint Statement issued by the Acoustic Group and Pacific Hydro on 16 February 2015 states that *the report does not recommend or justify a change in regulations*.
Findings of the MDA report review commissioned by the Lal Lal Environment Protection Association Inc, prepared by L Huson & Associates Pty Ltd and dated December 2015 (the Huson Review Report)	The findings of my review of the Huson Review Report are presented in MDA letter 004 2015386ML dated 13 April 2016, attached in Annexure F.

6 Declaration

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Planning Panel.

Signed …….

Dated 31 October 2016

Annexure A – Qualifications

Qualifications

M.Eng – Masters' Degree in Engineering (French Equivalent), France 2001

Professional associations

MAAS – Member of the Australian Acoustical Society

Employment history and achievements

2002- Present	Associate
	Marshall Day Acoustics Pty Ltd, Melbourne, Australia.
	Consultants in acoustics and noise control.
	Responsibilities include consulting work in industrial noise control, environmental noise impact (including wind farms) and architectural sound insulation.
	Noise impact assessments of Victorian wind farm developments at Bald Hills, Berrimal, Berrybank, Challicum Hills, Chepstowe, Coonooer Bridge, Crowlands, Ferguson, Hawkesdale, Kiata, Lal Lal, Hepburn, Maroona, Moorabool, Mortlake, Mt Gellibrand, Mt Mercer, Newfield, Oakland Hill, Penshurst, Portland, Ryan Corner, Sidonia Hills, Stockyard Hill, Timboon West, Waubra, Winchelsea, Wonthaggi and Yaloak South.
2001	Vacation Employment
	Marshall Day Acoustics Pty Ltd, Melbourne, Australia

Annexure B – Reports reviewed to prepare initial study or statement

I have reviewed the following documents that are referenced in the study:

- New Zealand Standard 6808:1998 *Acoustics – The assessment and measurement of sound from wind turbine generators* (NZS 6808:1998)
- New Zealand Standard 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010)
- Victorian Government's Policy and planning guidelines for development of wind energy facilities in Victoria dated January 2016 (the Victorian Guidelines)
- UK Institute of Acoustics *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* (IOA GPG) dated May 2013
- Final report by *The European Working Group on Noise from Wind Turbines* (ETSU-R-97)
- Victoria Planning Provisions Practice Note prepared by the Department of Sustainability and Environment titled *Applying the rural zones* and dated March 2007
- ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation* (ISO9613-2:1996)
- Institute Of Acoustics *IOA Noise Working Group (Wind Turbine Noise)- Amplitude Modulation Working Group Final Report - A Method for Rating Amplitude Modulation in Wind Turbine Noise* dated 9 Aug 2016 Version 1 (http://ioa.org.uk/sites/default/files/AMWG%20Final%20Report-09-08-2016_1.pdf)

Annexure C – Amended turbine layout

Table C1: Turbine Coordinates – MGA94 Zone 55

Turbine	Easting	Northing	Turbine	Easting	Northing
ESWT01	233500	5817822	YSWT10	236427	5832689
ESWT02	233853	5818217	YSWT11	236867	5832295
ESWT03	234084	5817161	YSWT12	237362	5832449
ESWT04	234351	5817454	YSWT13	237778	5832435
ESWT05	234648	5817731	YSWT14	237722	5831876
ESWT06	235025	5817868	YSWT15	237577	5831353
ESWT07	236483	5818385	YSWT16	238492	5832517
ESWT08	236876	5818621	YSWT17	238291	5832052
ESWT10	234095	5815947	YSWT18	238663	5831739
ESWT11	234393	5816255	YSWT19	238151	5831503
ESWT12	234695	5816555	YSWT20	237011	5830822
ESWT13	234986	5816872	YSWT21	236257	5830315
ESWT14	234746	5815979	YSWT22	236743	5830314
ESWT15	235337	5816007	YSWT23	236485	5829872
ESWT16	236903	5817482	YSWT24	236209	5829620
ESWT17	236754	5816449	YSWT25	237009	5829643
ESWT18	237003	5816752	YSWT26	235970	5829179
ESWT19	237212	5817071	YSWT27	236860	5829275
ESWT20	237353	5817401	YSWT28	235956	5828763
ESWT21	237579	5817722	YSWT29	236585	5828803
ESWT23	233785	5815068	YSWT30	237553	5830953
ESWT24	233936	5815414	YSWT31	237935	5831086
YSWT01	235749	5834082	YSWT32	239265	5831110
YSWT02	236335	5834001	YSWT33	237473	5830494
YSWT03	237834	5834197	YSWT34	238063	5830698
YSWT05	237479	5833611	YSWT35	238489	5830840
YSWT06	237872	5833859	YSWT36	239624	5830764
YSWT07	236389	5833239	YSWT38	239378	5830392
YSWT08	236950	5833099	YSWT39	240083	5830399
YSWT09	237383	5833222	YSWT40	239743	5830020

Table C1: Receiver Coordinates – MGA94 Zone 55

Property	Easting	Northing	Distance to nearest turbine (m)	Nearest turbine
Elaine Section				
H18aa	233189	5818529	740	ESWT02
J17aa (P)	235026	5817386	492	ESWT06
J17ab (P)	235924	5817263	1,008	ESWT16
K15aa	236990	5815534	950	ESWT17
L17aa (P)	237170	5817965	486	ESWT21
L17ab (P)	237848	5817275	520	ESWT20
L18aa	237913	5818705	1,043	ESWT21
L19ab	237955	5819290	1,273	ESWT08
M18ab	238248	5818860	1,324	ESWT21
M19aa	238239	5819045	1,431	ESWT08
Yendon Section				
J31aa (P)	235760	5831259	1,071	YSWT21
K31aa (P)	236084	5831076	787	YSWT21
K31ab (P)	236079	5831300	1,006	YSWT21
K34aa	236991	5834590	887	YSWT02
M29aa	238304	5829565	1,163	YSWT34
N31aa	239957	5831913	1,065	YSWT32
N31ab	239974	5831555	843	YSWT32
N32aa	239820	5832252	1,269	YSWT18
N32ab	239795	5832616	1,310	YSWT16
N32ac	239798	5832667	1,318	YSWT16

(P) Participating landholder property

Annexure D – Additional information in response to key submissions

Effects of Wind Farm Noise

Sound is an important feature of the environment in which we live; it provides information about our surroundings and is a key influence on our overall perception of amenity and environmental quality. Sound is therefore an environmental quality that must be considered as part of any proposal to develop new infrastructure that could influence the sound environment of neighbouring communities.

Excessive or unwanted sound is commonly referred to as noise and can have a range of effects on people, depending on a range of physical and contextual factors. The Guidelines for Community Noise 1999 prepared by the World Health Organisation (WHO) provides a health-based framework of guideline limits and values to address the broad definition of health given as:

> *A state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity*

This broad definition means that effects ranging from community annoyance, sleep disturbance and speech interference, through to direct physiological impacts such as hearing damage, are all identified as potential health considerations. An important aspect of this range of considerations is that some effects will be highly dependent on the listener's perception and attitude to the noise in question, such as annoyance, while other effects are primarily related to the level of sound and the direct physiological risks these may represent, such as hearing damage.

Environmental noise policies, including those applied to wind farms, establish objective noise criteria to address these health considerations. In particular, environmental noise policies define criteria which are chosen to prevent direct physiological risks of sound, and minimise as far as practically possible adverse health considerations such as annoyance and sleep disturbance.

Practically minimising the risks of noise effects related to annoyance and sleep disturbance requires the potential range of responses to sound to be considered. In this respect, it is important to note that individual attitudes and reactions to sound are highly variable, and will depend on a complex set of acoustic and non-acoustic factors. These include the level and character of the sound in question, the time of day the sound occurs, the regularity of the sound, the environment in which the sound is heard, the individuals hearing acuity, and an individual's personal opinion and perception of the sound source or development in question. The latter will in turn depend on other complicating factors such as visual impressions of the source in question and the perceived community benefit, or otherwise, of the source in question.

Due to the complexity and range of potential responses to sound, it is not possible to define limits that will guarantee an audible sound will be acceptable to all individuals; this will always be a matter of personal judgement for each individual. Further, it is usually not feasible or practical to design new development or infrastructure to inaudible noise levels. As a result, minimising the risks of noise effects involves setting criteria which prevents the majority of people from being disturbed. This requires regulatory authorities to strike a balance between amenity and development, setting noise limits which are as stringent as can be practically achieved without preventing new development.

This type of approach to noise policy was outlined by the Victorian Department of Health in their 2013 publication on wind farm sound and health which states:

> *Noise standards are used not only for environmental noise (such as wind farms and traffic noise) but also for industry and even household appliances.*
>
> *Noise standards are set to protect the majority of people from annoyance. The wide individual variation in response to noise makes it unrealistic to set standards that will protect everyone from annoyance. A minority of people may still experience annoyance even at sound levels that meet the standard. This is the case not only for wind farms, but for all sources of noise.*

The subject of health effects related to operational wind farms in Australia has been extensively considered by the Commonwealth Government's National Health and Medical Research Council (NHMRC) and the Australian Medical Association; in particular, the NHMRC has undertaken and coordinated a systematic review of evidence related to wind farms and health. The research reviews[3] and public statements[4, 5] produced by these peak health bodies support that, as with any audible sound, wind farm noise can represent a potential source of annoyance or sleep disturbance for some individuals. Their findings did however indicate that there was no reliable evidence to support a relationship between wind farm noise and direct adverse effects on human health.

These findings lend support to the suitability of the wind farm noise controls applied in Victoria, which are intended to provide reasonable protection of health and amenity at noise sensitive locations. This is consistent with the objectives of NZS 6808:2010. Importantly, the Standard notes that the consensus view of the committee responsible for the development of NZS 6808:2010, including New Zealand representatives from the Ministry of Health and Institute of Environmental Health, was that the Standard provides a reasonable way of protecting health and amenity at nearby noise sensitive locations, without unreasonable restricting the development of wind farm.

Low frequency noise and infrasound

The limits adopted for the assessment of operational noise from wind farms represent relatively low levels which have been specified in recognition of the quieter rural environments in which wind farms are normally located.

However, consistent with noise policies applied to other forms of development, the criteria are not intended to restrict wind farm noise to inaudible levels. Accordingly, a wind farm which achieves compliance with the criteria may still be audible at surrounding receiver locations on some occasions; this will depend on a range of factors such as the time of day, the speed and direction of the wind, the proximity to turbines, the extent of vegetation around the dwelling, and the degree to which the dwelling is sheltered from prevailing wind conditions. Irrespective of the relatively low levels which operational wind farm noise is restricted to, an individual's judgement of the audible noise from a wind farm is highly subjective and will be influenced by a range of contextual factors.

The subject of wind farm noise and its characteristics has attracted considerable attention. Specific attention has been directed to alleged matters relating to low frequency sound as well as infrasound and vibration. Low frequency sounds are generally regarded as sounds above 20 Hz and extending upwards into the range of 100-200 Hz. The definition of infrasound often varies in different jurisdictions, but is generally accepted to refer to frequencies of sound which lie below 20 Hz. While 20 Hz is commonly cited as the lower bound of audibility, frequencies below 20 Hz can still be audible, provided that the level of the sound is sufficiently high to exceed the threshold of audibility at those frequencies.

In common with many other sources of noise, wind turbines emit infrasound, low frequency sound and ground vibrations. However, what is often overlooked is that these types of sound and vibration are a feature of the everyday environment in which we live and arise from a wide range of natural sources such as the wind and the ocean to man-made sources such as domestic appliances, transportation and agricultural equipment. The important point in relation to wind turbines is that the levels of these types of emissions are low and therefore, in many cases, cannot generally be reliably measured amidst normal background levels.

NZS 6808:2010 provides specific advice concerning infrasound at Section 5.5 noting:

> *Although wind turbines may produce some sound at (ultrasound and infrasound) frequencies outside the normal range of human hearing these components will be well below the threshold of human perception.*
>
> *Claims have been made that low frequency sound and vibration from wind turbines have cause illness and other adverse physiological effects among a very few people worldwide living near wind farms. The paucity of evidence does not justify at this stage, any attempt to set a precautionary limit more stringent than those recommend* [in the Standard].

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[3] *Systematic review of the human health effects of wind* farms 2013, Adelaide University, commissioned by the NMRC
[4] NHMRC Statement: *Evidence on Wind Farms and Human Health* 2015, National Health and Medical Research Council
[5] AMA Position Statement – *Wind Farms and Health* 2014, Australian Medical Association

These types of emissions have been the subject of considerable misrepresentation in media commentary. Notably, the work of Dr Geoff Leventhall, a prominent UK consultant in the field of acoustics and vibration, and researcher in the field of low frequency noise is often cited in some documents which continue to claim concerns about infrasound and low frequency noise from wind turbines. However, Dr Leventhall has regularly made clear statements to assert that there is no significant infrasound from current designs of wind turbines and very little low frequency sound, neither of which are anywhere near the sorts of levels which would represent a direct health risk for neighbouring residents of modern wind farms. An example such publication, co-authored by Dr Leventhall, was published in the UK Institute of Acoustics Bulletin in March 2009[6]. This publication was prepared as an agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed by local councils and community groups campaigning against wind farm developments. The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern.

On the subject of infrasound and low frequency noise, the article notes:

> *Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles. Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view.*
>
> *A Portuguese group has been researching 'Vibro-acoustic Disease' (VAD) for about 25 years. Their research initially focussed on aircraft technicians who were exposed to very high overall noise levels, typically over 120dB. A range of health problems has been described for the technicians, which the researchers linked to high levels of low frequency noise exposure. However other research has not confirmed this. Wind farms expose people to sound pressure levels orders of magnitude less than the noise levels to which the aircraft technicians were exposed. The Portuguese VAD group has not produced evidence to support their new hypothesis that infrasound and low frequency noise from wind turbines causes similar health effects to those experienced by the aircraft technicians.*

More recent measurements[7, 8] have demonstrated that infrasound and low frequency sound produced by regularly encountered natural and man-made sources, such as the infrasound produced by the wind or distant traffic, is comparable to that of modern wind turbines, noting that:

> *Infrasound levels in the rural environment appear to be controlled by localised wind conditions. During low wind periods, levels as low as 40dB(G) were measured at locations both near to and away from wind turbines. At higher wind speeds, infrasound levels of 50 to 70dB(G) were common at both wind farm and non-wind farm sites.*
>
> *Organised shutdowns of the wind farms adjacent to [sic: measurement locations] indicate that there did not appear to be any noticeable contribution from the wind farm to the G-weighted infrasound level measured at either house. This suggests that wind turbines are not a significant source of infrasound at houses located approximately 1.5 kilometres away from wind farm sites*

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6 Institute of Acoustics Bulletin – Bowdler, Bullmore, Davis, Hayes, Jiggins, Leventhall, McKenzie - *Prediction and Assessment of Wind Turbine Noise* –March 2009

7 Sonus report for Pacific Hydro - *Infrasound measurements from wind farms and other sources* – November 2010 - see http://www.pacifichydro.com.au/media/192017/infrasound_report.pdf

8 Evans, T., Cooper, J. & Lenchine, V., *Infrasound levels near wind farms and in other environments*, South Australian Environment Protection Authority, Adelaide, 2013

In 2010, the UK Health Protection Agency published a report[9] on the health effects of exposure to ultrasound and infrasound. The exposures considered in the report related to medical applications and general environmental exposure. The report notes:

> *Infrasound is widespread in modern society, being generated by cars, trains and aircraft, and by industrial machinery, pumps, compressors and low speed fans. Under these circumstances, infrasound is usually accompanied by the generation of audible, low frequency noise. Natural sources of infrasound include thunderstorms and fluctuations in atmospheric pressure, wind and waves, and volcanoes; running and swimming also generate changes in air pressure at infrasonic frequencies.*
>
> *[...]*
>
> *For infrasound, aural pain and damage can occur at exposures above about 140 dB, the threshold depending on the frequency. The best-established responses occur following acute exposures at intensities great enough to be heard and may possibly lead to a decrease in wakefulness. The available evidence is inadequate to draw firm conclusions about potential health effects associated with exposure at the levels normally experienced in the environment, especially the effects of long-term exposures. The available data do not suggest that exposure to infrasound below the hearing threshold levels is capable of causing adverse effects.*

Also, a recent State Government of Victorian Department of Health document[10] concludes the following in relation to infrasound from wind farms:

> *Infrasound is audible when the sound levels are high enough. The hearing threshold for infrasound is much higher than other frequencies. Infrasound from wind farms is at levels well below the hearing threshold and is therefore inaudible to neighbouring residents.*

These studies all indicate that infrasound levels from wind farms are anticipated to be comparable with existing ambient levels.

In February 2015, the National Health and Medical Research Council (NHMRC) released a statement[11] addressing human health effects of wind farms which includes consideration of noise. Based on consideration and review of over 2,500 publications, the NHMRC was not able to identify any reliable evidence of direct health impacts from wind farm noise.

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9 Health Protection Agency UK – *Health Effects of Exposure to Ultrasound and Infrasound – Report of the independent Advisory Group on Non-ionising Radiation* - 2010

10 *Public Statement: Wind Turbines and Health - July 2010*

11 NHMRC Statement: *Evidence on Wind Farms and Human Health* 2015, National Health and Medical Research Council

Annexure E – AAAC review of the Acoustic Group report

Association of Australian Acoustical Consultants

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1 June 2015

Select Committee on Wind Turbines
PO Box 6100
Parliament House
Canberra ACT 2600

Attention: Dr Richard Grant

Dear Sir,

REVIEW OF THE ACOUSTIC GROUP REPORT
"THE RESULTS OF AN ACOUSTIC TESTING PROGRAM CAPE BRIDGEWATER WIND FARM"

A review of The Acoustic Group report titled, "The results of an acoustic testing program Cape Bridgewater Wind Farm" (the Study) has been conducted.

The overall conclusion drawn from the review is that the Study provides no new credible scientific evidence, and further, no scientific evidence to support the media reporting positively of the Study.

The Study measures infrasound at the blade pass frequency and multiples of the blade pass frequency. The level of infrasound is similar to the levels measured previously by others and is well below the threshold of human perception.

The Study suggests that there is a "pattern" of high severity disturbance associated with four turbine operating modes. When all data are considered, there are limitations, contradictory and limited data and the results do not support the description of a "pattern".

The Study includes a hypothesis that "sensations" felt by the participants might be related to the measured level of infrasound. The hypothesis is based on a very limited subset of the data, with any data excluded from the analysis if it did not fit the theory. When all data are considered, the evidence does not support the hypothesis.

Measured Infrasound

Figure 49 of the report indicates that the level of infrasound at the blade pass frequency and multiples of blade pass frequency are in the order of 45 to 71 dB re 20μPa. This is not new and has previously been measured by others at similar levels.

The established threshold of human perception at these frequencies is in the order of 110 dB re 20μPa at 5Hz (Watanabe and Møller, 1990) and even higher at lower frequencies. That is, although the infrasound can be detected by instruments, it cannot be perceived by humans.

Since the Study, researchers have simulated the character and level of infrasound measured at wind farms to determine any reported symptoms or sensations. The research, conducted by Colin and Kristy Hansen (Hansen et al, 2015), Renzo Tonin and Associates (Tonin and Brett, 2015) and Channel Island Acoustics (Walker and Celano, 2015), indicates that there is no reported symptoms or sensations to this level, or indeed higher levels, of infrasound.

Sensation Pattern

The Study claims to have *"found a pattern of high severity of disturbance to be associated with four different operating scenarios of the wind farm being:*

- *when the turbines were seeking to start (and therefore could drop in and out of generation)*
- *an increase in power output of the wind farm in the order of 20%*
- *a decrease in the power output of the wind farm in the order of 20%, and*
- *the situation when turbines were operating at maximum power and the wind increased above 12m/s".*

There is no statistical analysis supporting this claim. For the claim to be made, an expert in statistics should have been retained to design the experiment and to analyse the data in a scientific manner.

The "pattern" is based on the analysis of "sensation" classified as "severity category 4" or "5". Of the 522 occurrences where a resident identified a severity category 4 or 5, the Study identifies the conditions as fitting into one of the above categories on 194 occasions. That is, the pattern is based on 37% of the occurrences being classified as one of the four operating scenarios or an average of less than 10% per operating scenario. To provide context, 63% of the occurrences were not classified in any of the four operating scenarios.

Contrary to this pattern, there are many occasions when sensations were recorded when the wind turbines were shut down. For example, during the shutdowns on 22 May and 24 May 2014, the occupants of House 88 identified 9 separate occasions when the sensation level was classified as category 4. That is, at a time when the turbines were not operating, the sensation was classified as a "substantial impact (disruptive)", which is described as "quality of life diminished due to change in character of the area".

Although the Study states, "For one resident, sensation, noise and vibration were observed with the wind farm shutdown", levels of sensation were recorded at all three houses during periods of shutdown. For example, at House 87 on 13 June, sensation was classified by the occupants as category 4 when turbines were not operating and at House 89 on 15 and 22 May, sensation was classified as category 2 when turbines were not operating. On 21 May at 6:10am when turbines were shut down, a resident of House 89 recorded the diary entry, "Sudden awakening (awakening with a start/adrenalin surge to gut)".

Conversely, a resident of House 89 stated, "During the second week, the Wind Facility was in shutdown for eleven days, due to work being undertaken on power lines" … "During the shutdown we slept." However, although the turbines were shutdown during the day, they were restarted on most nights.

Based on the above, there does not appear to be any establishment of a pattern without ignoring contradictory occurrences.

Sensation and Infrasound

The Study conducts an analysis of the level of infrasound recorded during category 5 sensations compared with category 2 sensations. However, only a very narrow band of category 5 sensations were included in the analysis. The report states that there were 81 occasions when category 5 sensations were recorded but only 31 are included in the analysis. For example, data were excluded if high or low wind speeds were recorded, even though these periods represent two of the four operating scenarios described as "a pattern of high severity of disturbance". The reason given for excluding the data was that the blade pass frequency and harmonics could not be detected.

Rather than trying to understand the reason why category 5 sensations were recorded when infrasound from the wind farm could not be detected, the Study excludes the contradictory data and proceeds with a hypothesis. No explanation as to why a severity category 5 could be recorded without infrasound from the wind farm being detected has been provided. A scientific approach would explore or, at the very least, identify this prior to establishing a hypothesis.

Conclusion

The AAAC Wind Farm Subcommittee has conducted a review of The Acoustic Group's Cape Bridgewater report and has concluded that:

- The level of infrasound measured is similar to the level previously measured by others;
- The claimed "pattern" between high severity sensation and modes of operation is not based on a statistical analysis and ignores contradictory occurrences; and
- The hypothesis that there is a link between "sensations" and infrasound is based on excluding data that do not support the hypothesis.

Based on the above, it is considered that the Study does not follow a rigorous scientific method and provides no justification for the AAAC Position Statement to be updated.

Yours faithfully,

Australian Association of Acoustical Consultants

Annexure F – L Huson & Associates Pty Ltd Review Report

MARSHALL DAY Acoustics

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13 April 2016

WestWind Energy Pty Ltd
Level 1
12-14 Prince Street
Gisborne VIC 3437

Attention: Adam Gray

Dear Adam

LAL LAL WIND FARM
L. HUSON & ASSOCIATES PTY LTD REVIEW REPORT

INTRODUCTION

Marshall Day Acoustics Pty Ltd (MDA) prepared a report in relation to a proposed planning permit amendment for the Lal Lal Wind Farm titled Rp 002 2015386ML - *Lal Lal Wind Farm - NZS 6808:2010 Noise Assessment* dated 11 September 2015 (the MDA Report).

The current planning permit for the wind farm, reference PL-SP/05/0461, was issued in 2009 and refers to NZS 6808:1998 *Acoustics – The assessment and measurement of sound from wind turbine generators* (NZS 6808:1998) which was the current version of the standard at that time and which was referenced in the relevant Victorian Planning Provisions and Victorian Government's *Policy and planning guidelines for development of wind energy facilities in Victoria* (the Victorian Guidelines) dated May 2003. The MDA Report provides an updated noise assessment for the wind farm using the revised, 2010 version of the New Zealand Standard, 6808:2010 *Acoustics – Wind farm noise* (NZS 6808:2010) as this standard is nominated across all recent iterations of the Victorian Guidelines.

The MDA Report was incorporated into an application package prepared by WestWind Energy Pty Ltd which seeks approval for several proposed amendments to the current planning permit. The proposed amendments relevant to noise include updating references from NZS 6808:1998 to NZS 6808:2010, and proposed changes to the permit's conditions relating to post-construction noise commissioning requirements.

A peer review of the MDA Report has been prepared by L Huson & Associates Pty Ltd. The review forms part of a submission to the planning permit amendment by the Lal Lal Environment Protection Association Inc. The findings of the peer review are detailed in a report titled *Review – Lal Lal Wind Farm Planning Permit Amendment October 2015* and dated December 2015 (the Peer Review Report).

The Peer Review Report seems to generally support the proposal to amend the planning permit for the Lal Lal Wind Farm, at least to the extent noted in its introduction:

> *We support a revision to the current noise conditions contained in planning permit number PL-SP/05/0461, dated 30 April 2009, for the Lal Lal Wind Farm to reflect recent planning guidelines that refer to the 2010 version of the New Zealand Standard 6808:2010 'Acoustics – Wind farm noise'.*

With regard to the application of NZS 6808:2010 as documented in the MDA Report, the Peer Review Report also acknowledges that:

> [...] *the assessment by MDA has applied an assessment in accordance with NZS6808:2010* [...].

However, the Peer Review Report does not support all of the proposed changes to the planning permit including in the WestWind Energy application.

The Peer Review Report does provide comments regarding a number of technical aspects of the assessment detailed in the MDA Report. Key technical aspects have been broadly categorised by MDA as follows:

- Noise sensitive locations
  Identifying noise sensitive locations neighbouring the proposed wind farm
- Noise limits
  Nominating suitable noise limits for proposed wind farm neighbours including host landowner properties
- Turbine sound data
  Correctly accounting for the likely wind turbine sound emissions
- Noise modelling
  Implementing a suitable noise model, based on ISO 9613-2:1996[1]

MDA has considered these aspects raised in the Peer Review Report. Our comments about each of the above four topics are itemised separately in this letter along with a brief overview of the various iterations of the Victorian Government's *Policy and planning guidelines for development of wind energy facilities in Victoria* which are topical to the wind farm.

VICTORIAN GUIDELINES

Several iterations of the Victorian Guidelines have been relevant to the Lal Lal Wind Farm during the various phases of its planning. For clarity, relevant versions of the Victorian guideline document are detailed in Table 1 below along with notes about the corresponding stage of the wind farm's planning.

Table 1: Evolution of the Victorian guideline's noise related components

Document iteration	Noise related items	Wind farm stage
May 2003	Reference to NZS 6808:1998	Applicable at the time of the panel hearing
June 2015	Reference to NZS 6808:2010 Details the concept of High Amenity Areas	Applicable at the time the MDA Report was prepared
November 2015	No significant changes relevant to noise	Applicable at the time the Peer Review Report was prepared
January 2016	Provides additional guidance regarding High Amenity Areas, as discussed in the *NOISE LIMIT* section below	Currently applicable

[1] ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation* (ISO 9613-2:1996)

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NOISE SENSITIVE LOCATIONS

The Peer Review Report lists two sets of coordinates that have not been included in the MDA Report. The two properties are detailed in Table 2.

Table 2: Properties identified in the Peer Review Report as missing in the MDA Report (GDA94)

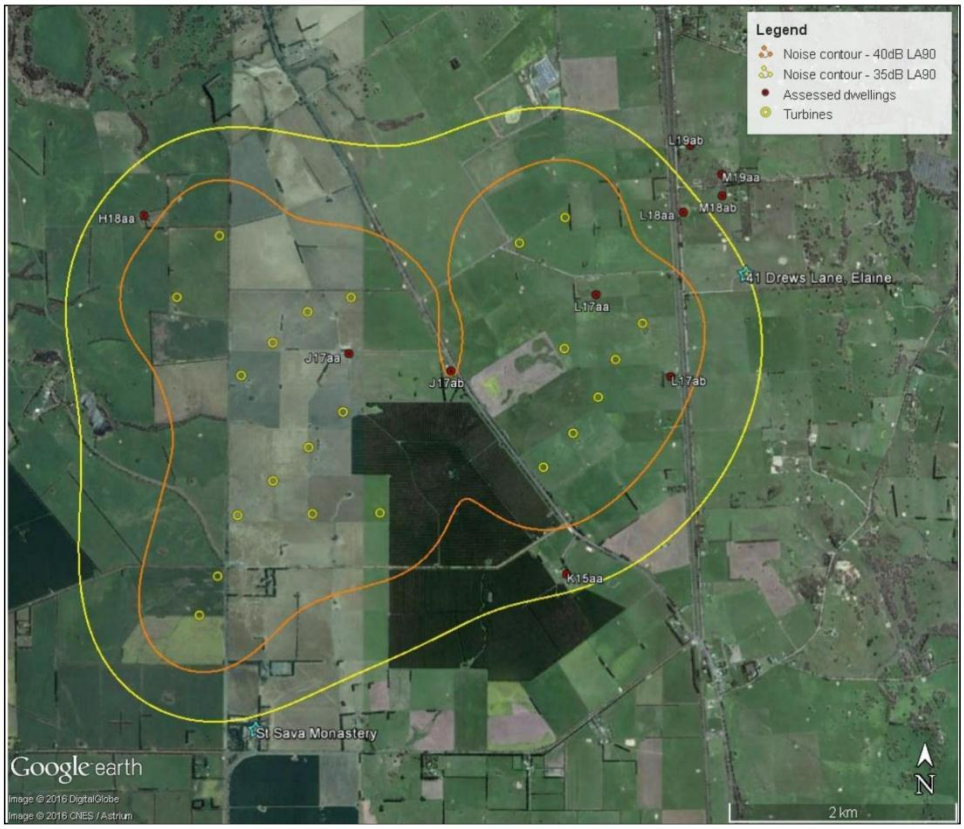
Reference	Easting	Northing	Zone*
41 Drews Lane, Elaine	238,476	5,818,187	55H
St Sava Monastery	762,709	5,814,190 **	54H

* The coordinate reference and zoning are not detailed in the Peer Review Report. The reference system and zones noted in this table are based on current site understanding

** The Northing coordinate listed in the Peer Review Report is *581419 S*. This value may be a typo and has been interpreted as '5,814,190' for the current review.

The properties presented in Table 2 are also shown in Figure 1 together with the 35 and 40 dB L_{A90} noise contours[2].

Figure 1: Noise contour map showing properties listed in the Peer Review Report



[2] As provided in Section E2 of Appendix E of the MDA Report

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41 Drews Lane, Elaine

WestWind Energy has advised that the dwelling at 41 Drews Lane, Elaine did not exist at the time when the original planning permit was issued[3]. This dwelling is therefore not considered a relevant noise sensitive location in accordance with Condition 23 of the original planning permit which states:

> […] *the operation of the wind energy facility must comply with the noise criteria specified in NZS6808:1998* […] *at any dwelling existing on land in the vicinity of the proposed wind energy facility as at the date of the issue of this permit, to the satisfaction of the Minister for Planning.*

Notwithstanding this, as indicated in Figure 1, noise levels from the Lal Lal Wind Farm at this dwelling are predicted to be 35 dB L_{A90} in accordance with the methodology detailed in Section 7.0 of the MDA Report.

Compliance with a base noise limit of 40 dB L_{A90} is predicted to be achieved at this new dwelling by a margin of 5 dB.

St Sava Monastery

The St Sava Monastery was referenced as property I14aa in the noise assessment[4] submitted as part of the original planning permit application. Section 7.0 of the 2008 MDA Report states:

> *One of the properties (I14aa) identified for background noise monitoring using the preliminary layout will not be included in the noise assessment as noise levels were predicted below 35dBA using the proposed layout.*

As indicated in the noise contour map provided in Figure 1, noise levels from the Lal Lal Wind Farm at the St Sava Monastery are predicted to be 34 dB L_{A90} in accordance with the methodology detailed in Section 7.0 of the MDA Report.

Compliance with a base noise limit of 40 dB L_{A90} is therefore predicted to be achieved at the St Sava Monastery by a margin of 6 dB.

NOISE LIMITS

The MDA Report applies a base noise limit of 40 dB L_{A90} for the noise assessment of the Lal Lal Wind Farm. The Peer Review Report provides the following comments about this issue:

> *The MDA REPORT has elected not to set a lower baseline target noise levels of 35 dB L_{A90} that would be suitable for a high amenity noise area.*
>
> *We disagree with the arguments in the JACOBS and MDA reports against allowing the area to be designated a high amenity noise area.*
>
> *[…]*
>
> *It would be appropriate to require an objective assessment of high amenity noise areas surrounding the Project.*

The concept of a high amenity area was introduced in the 2010 version of NZS 6808. Section 5.3 of NZS 6808:2010 provides details of high amenity noise limits, requiring that where a noise sensitive location is situated within a high amenity area, as defined in Sections 5.3.1 and 5.3.2 of NZS 6808:2010, wind farm noise levels (L_{A90}) during evening and nigh-time periods should not exceed the background noise level (L_{A90}) by more than 5 dB or 35 dB L_{A90}, whichever is the greater, for wind speeds below 6 m/s at hub height. High amenity noise limits are not applicable during the daytime period.

---

[3] It is our understanding that the occupiers of the dwelling lodged an objection to the amendment which was subsequently withdrawn

[4] Report No. 001 R01 2007344 *Lal Lal Wind Farm - Noise Assessment* dated 5 February 2008 (the 2008 MDA Report)

Section 5.3 of NZS 6808:2010 states that:

> *A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area…*

Subsequent to this, Section C5.3.1 of the Standard provides a calculation procedure for objectively evaluating whether relevant background noise levels for a potential high amenity area are sufficiently low to confirm the application of a high amenity noise limit.

High amenity noise limits are referenced in the Victorian Guidelines. The comments provided in the guidelines about high amenity limits have been revised across several recent versions of the guidelines. The most recent version of the guidelines, dated January 2016, provides arguably the most comprehensive discussion of how to apply the concept of high amenity areas in the Victoria context. As the January 2016 guidelines post-date both the MDA Report and the Peer Review report, they are discussed in some detail here.

Section 5.1.2.(a) of the January 2016 Victorian Guidelines states the following.

> *Under section 5.3 of the Standard, a 'high amenity noise limit' of 35 decibels applies in special circumstances. All wind farm applications must be assessed using section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in clause C5.3.1 of the Standard. Guidance can be found on this issue in the VCAT determination for the Cherry Tree Wind Farm.*

The definition of a high amenity area provided in NZS 6808:2010 is specific to New Zealand planning legislation and guidelines. A degree of interpretation is therefore required when determining how to apply the concept of high amenity area in Victoria, specifically in order to satisfy Section 5.1.2.a of the guidelines.

As detailed above, the current version of the Victorian Guidelines recommends that guidance on the application of the High Amenity noise limit be sourced from the VCAT determination detailed in the Cherry Tree Wind Farm Pty Ltd v Mitchell Shire Council decisions[5] which provide some additional context to this issue.

Paragraph 53 of the Cherry Tree Wind Farm Decision states the following:

> *The Tribunal does not accept that the permit conditions need to refer to the High Amenity Area provisions of the New Zealand standard because it has not been established that any such area could reasonably be identified within the environs of this wind energy facility.* […]

[5] Mitchell Shire Council interim decision dated 4 April 2013 (the Cherry Tree Wind Farm Interim Decision) and Mitchell Shire Council decision dated 27 November 2013 (the Cherry Tree Wind Farm Decision)

Justification for this statement was provided in Paragraphs 107 to 109 of the Cherry Tree Wind Farm Interim Decision:

> *107. We were invited by the respondents to treat the subject land and the locality as a high amenity area. This invitation meets with the immediate conundrum that the language of the standard is not translatable to the Victorian planning framework. The "plan" referred to in section 5.3 is a plan as defined by the Resources Management Act of New Zealand. Section 43AA of that Act defines "plan" to mean "a regional plan or a district plan". No such animals exist under the Victorian legislation.*
>
> *108. Applying the standard mutatis mutandis to the Victorian experience we treat the plan referred to in the standard as a planning scheme approved under the Planning and Environment Act 1987. The Mitchell Planning Scheme does not anywhere expressly or by implication "promote a higher degree of protection of amenity related to the sound environment of a particular area". Approaching the matter by a process of elimination it can be seen with certainty that the controls contained within the Farming zone, which includes most of the locality, do not answer this description. The purpose of the Farming zone is to encourage agricultural use, which is not an inherently quiet land use. In fact reference to the zone purposes confirms that agricultural use is to be preferred to residential use if there is potential conflict between the two.*
>
> *109. Accordingly the Tribunal concludes that the subject land and its locality is not capable of designation as a high amenity area because it does not possess the necessary characteristics of such an area as specified in the NZ standard.*

As detailed in Paragraph 108, for the land surrounding the wind farm to be considered a high amenity area, the zoning of the land must be identified in the relevant planning scheme as *promoting a higher degree of protection of amenity related to the sound environment*.

As discussed above, NZS 6808:2010 states that a high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area. The area surrounding the proposed wind farm is generally zoned Farming Zone as shown in the planning map presented in Appendix C of the MDA Report.

The following points are noted about the Farming Zone:

- The Farming Zone in the Moorabool Planning Scheme dated 4 February 2016 is not considered to promote a higher degree of protection of amenity related to the sound environment.
- The Victoria Planning Provisions Practice Note prepared by the Department of Sustainability and Environment titled *Applying the rural zones* and dated March 2007 states the following:

  > *The Farming Zone is designed to encourage diverse farming practices, some of which can have significant off-site impacts. For this reason, the level of amenity that can be expected in this zone will usually not be compatible with sensitive uses, particularly housing.*

Based on the above and following guidance from the VCAT determination for the Cherry Tree Wind Farm, as recommended by the Victorian Guidelines, the high amenity noise limit detailed in NZS 6808:2010 is not considered to be applicable for residential properties in the vicinity of the Lal Lal Wind Farm.

As detailed in Section 6.3 of the MDA Report, the applicable base noise limit is considered to be 40 dB L_{A90} for all noise sensitive locations, as defined in NZS 6808:2010.

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Host noise limits

An increased base noise limit of 45 dB L_{A90} was presented in Section 6.3 of the MDA Report based on guidance from the final report by *The European Working Group on Noise from Wind Turbines* (ETSU-R-97).

This is consistent with the recommendation of the Draft National Guidelines[6] to increase the applicable base noise limit by 5 dB.

TURBINE SOUND DATA

The purpose of the noise assessment detailed in the MDA Report is to determine whether the proposed wind farm can achieve the requirements of the Victorian Guidelines and NZS 6808:2010 with a turbine model satisfying the requested specification amendments.

The MDA Report stated the following in Section 8.0 *Conclusion*:

> *An assessment has been undertaken, using the Senvion 3.2M114 wind turbine model with a hub height of 104m, in accordance with NZS 6808:2010 as required by the current Victorian Guidelines at twenty (20) residential properties identified by WestWind in the vicinity of the project.*
>
> [...]
>
> *If the turbine selection and/or layout are to be changed, compliance with the relevant noise limit will need to be reassessed.*

Sound Power Data

The sound power data used for predicted noise levels at residential properties in the vicinity of the proposed wind farm was provided by the manufacturer based on measurements undertaken in accordance IEC 61400-11, as recommended in Section 6.2.1 of NZS 6808:2010:

> *For the purposes of this Standard it is recommended that wind farm sound level predictions be based on the apparent sound power and tonality values for the nominated wind turbine model, determined in accordance with IEC 61400-11.*

A presentation[7] by Erik Sloth was also referenced in this section of the Peer Review Report to justify the claims regarding the inadequacy of sound power data determined in accordance with IEC 61400-11.

Reference to this presentation can be misleading. Some of the reasons are as follows:

- Quoting parts of a PowerPoint presentation out of the context of the oral presentation may misrepresent the intent of the author
- It is our understanding that the purpose of Erik Sloth's presentation was to critique the 2002 version of IEC 61400-11 which is now obsolete. In particular, we understand that the quoted text refers to the shortcomings of an assessment undertaken at 10 m Above Ground Level (AGL) and is therefore not necessarily relevant to a hub height assessment as required by NZS 6808:2010.

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6 EPHC *National Wind Farm Development Guidelines – Draft* dated July 2010

7 *Problems related to the use of the existing noise measurement standards when predicting noise from wind turbines and wind farms* presented at the 2004 AusWind Conference

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Tonality

The Peer Review Report provides the following comments regarding tonality:

> *A guarantee of compliance to earlier versions of IEC 61400-11, or the latest version with small sample size, is of little value if the assessment of tonality is "more akin to playing the lottery". We have no confidence that such a guarantee proposed in the MDA report will achieve the objective of ensuring the absence of tonal special audible characteristics in practice.*

As detailed in Section 3.4 of the MDA Report, NZS 6808:2010 emphasises the assessment of special audible characteristics including tonality during the post-construction measurement phase of a project:

> […] *as special audible characteristics cannot always be predicted, consideration shall be given to whether there are any special audible characteristics of the wind farm sound when comparing measured levels with noise limits.*

An assessment of the potential for tonality is, however, possible during the planning phase of a project as detailed in Section 6.2.1 of NZS 6808:2010:

> *For the purposes of this Standard it is recommended that wind farm sound level predictions be based on the apparent sound power and tonality values for the nominated wind turbine model, determined in accordance with IEC 61400-11.*

An assessment of tonality in accordance with NZS 6808:2010 is included in the MDA Report based on tonality assessment results for the candidate turbine carried out according to IEC 61400-11:2006[8]. The outcome of the assessment, which was based on information provided by the manufacturer for the candidate turbine, was that a penalty for tonality was not considered applicable for any of the assessed wind speeds.

However, recognising that the constructed turbine model may differ from the candidate turbine and the ultimate objective is for the wind farm noise at receptor locations to be free of special audible characteristics (including tonality). With this in mind, Section 2.2.3 of the MDA Report states:

> […] *we envisage that the procurement contract for the site would stipulate that the turbines must not produce emissions which would attract a penalty when assessed in accordance with the relevant noise criteria and any associated conditions of consent.*

[8] IEC61400-11:2006 *Wind turbine generator systems - Part 11: Acoustic noise measurement techniques*

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NOISE MODELLING

ISO 9613-2:1996

The MDA Report applies ISO 9613-2:1996[9] for predicting levels of noise from the Lal Lal Wind Farm.

This approach is considered consistent with NZS 6808:2010. In particular, Section 6.1.3 of NZS 6808:2010 states the following:

> *There is not a standardised sound propagation calculation method directly applicable to wind turbines. However, an example of a prediction method (from ISO 9613-2) that has been shown to correlate well with measured data for wind farms is detailed in Appendix D. This method provides a good balance between accuracy and completeness on one hand, and the effort of obtaining data to enter into the model on the other. Other prediction methods that can be shown to be appropriate for a given situation may be used, provided the details, assumptions, and limitations of the model are stated.*

Experience with relevant wind farm projects in jurisdictions referencing NZS 6808:2010, specifically Victoria and New Zealand, suggests that ISO 9613-2:1996 is the most commonly used method for predicting wind farm sound.

The use of ISO 9613-2:1996 for predicting wind farm noise (as detailed in Appendix D of the MDA report)is also supported by international research publications and measurement studies conducted by Marshall Day Acoustics. For these reasons, the ISO 9613-2:1996 prediction method is implemented by Marshall Day Acoustics for every wind farm project with noise predictions carried out in accordance with NZS 6808:2010.

The Peer Review Report comments as follows regarding ISO 9613-2:1996:

> *The MDA report has used ISO9613 to predict noise levels surrounding the Project site. Reference has been made to a report by Bass, Bullmore and Sloth (1998) suggesting that this report "found that the ISO 9613-1:1996 model provided a robust representation of upper noise levels which may occur in practice, and provided a closer agreement between predicted and measured noise levels than alternative standards such as CONCAWE and ENM. Specifically, the report indicated the ISO 9613-2:1996 method generally tends to marginally over predict noise levels expected in practice." This statement is misleading. The Bass, Bullmore and Sloth report (Joule study) advised the use of an alternative model in preference to ISO9613.*

For reference, relevant extracts regarding CONCAWE, ENM and ISO 9613-2:1996 from the Conclusion of the Joule Report[10] are noted here:

> *- Models that rely on analytical descriptions of sound propagation through the atmosphere* [CONCAWE, ENM] *are overly sensitive to changes in meteorological parameters. Variations in noise levels of up to 30dB(A) were predicted by these models, whereas measured variations under the same range of meteorological conditions were limited to less than 10dB(A).*
>
> *- The more advanced empirical model tested was that set out in ISO 9613-2. This method generally provide high levels of accuracy to within 2dB(A) in predicting received noise levels under 'conditions favourable to noise propagation', or downwind propagation.*

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

[10] Bass, Bullmore and Sloth - *Development of a wind farm noise propagation prediction model*; Contract JOR3-CT95-0051, Final Report, January 1996 to May 1998.

Further, page 143 of the Joule Report comments as follows regarding the accuracy of the prediction methods considered in that report and the selection of a preferred model:

> *The results of this section* [of the Joule Report] *have demonstrated that each of the ENM, IEA and ISO 9613 methods of calculation are capable of providing a high degree of accuracy when calculating far field noise levels radiated from elevated noise sources. The decision as to a recommended calculation procedure therefore rests on the simplicity of the models and the confidence limits that can be placed on their output.*

In light of these comments from the Joule Report, it is not clear why the Peer Review Report suggests that the quoted content from the MDA Report is misleading.

Terminology

As described in the preceding section, the MDA Report applies the ISO 9613-2:1996 prediction method. A note about terminology may be helpful at this stage.

In the strict sense, the MDA Report applies a modified version of ISO 9613-2:1996. That is, the ISO 9613-2:1996 method is applied in accordance with the standard with the exception of the attenuation factors for ground effect and screening which are adjusted in some cases as detailed in Appendix D of the MDA Report. Specifically:

- In instances where the ground terrain provides marginal or partial acoustic screening, the barrier effect is limited to not more than 2 dB
- Screening attenuation is calculated based on the screening expected for the source located at the tip height of the turbine (in contrast to hub height in non-adjusted ISO 9613 predictions)
- In instances where the ground falls away significantly between the source and receiver, such as valleys, an adjustment of 3 dB is added to the calculated sound pressure level. A terrain profile in which the ground falls away significantly is defined as one where the mean sound propagation height is at least 50 % greater than would occur over flat ground.

These adjustments are consistent with those proposed in the Joule Report and the Institute of Acoustics UK document *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise.*

For simplicity of reference, the MDA Report refers to the adjusted model directly as ISO 9613-2:1996.

Ground factor

The ISO 9613-2:1996 prediction method accounts for sound absorption from the ground using a Ground Factor value which ranges from G=0, as would occur with concrete or asphalt, to G=1 which characterises porous ground which, according to the standard, "*…includes ground covered by grass, tress or other vegetation, and all other ground surfaces suitable for the growth of vegetation such as farming land.*"

Appendix D of the MDA Report provides a comprehension discussion justifying the choice of ISO 9613-2:1996 input parameters used for the noise assessment, including the application of a ground factor value of G=0.5.

The Peer Review Report states that the:

> *…MDA report references good practice guidelines from the UK for a justification to use G=0.5. Given the climate in the UK, it would be reasonable to use a 50/50 mixed ground terrain value of G=0.5 for an ISO9613 noise model in the UK. However, in Victoria this model input parameter is not considered appropriate. For example, the South Australian EPA wind farm noise models are required to use G=0 if ISO9613 is used.*

Appendix D of the MDA Report provides several references that support the use of a ground factor value of G=0.5, among these is a UK Institute of Acoustics journal article dated March/April 2009 detailing a joint agreement between UK practitioners in the field of wind farm noise assessment. The joint statement indicates that the ISO 9613-2:1996 method is an appropriate standard for wind farm noise predictions and specifically designates G=0.5 as the appropriate ground characterisation. As noted by the Peer Review Report, the joint statement was prepared by UK practitioners and so would likely concern wind farm assessments in UK. The other references provided in Appendix D of the MDA Report are not specific to the UK and include guidance offered by NZS 6808:2010 and a study of wind farm noise from a Victorian wind farm.

The Peer Review Report comments noted above also reference the 2009 South Australian EPA Guidelines. A relevant extract from the South Australian guidelines is provided in Figure 2.

Figure 2: Extract from Page 10 of the 2009 South Australian EPA Guidelines

> A conservative approach should be used for predicting wind farm noise by calculating noise levels in octave bands from at least 63 to 4,000Hz to determine an overall predicted level and using the following inputs:
>
> - atmospheric conditions at 10ºC and 80% humidity,
> - weather category 6 (if CONCAWE method is utilised),
> - hard ground (zero ground factor).
>
> If another prediction method and modelling inputs are employed to carrying out the noise level prediction, the details of the model should be clearly stated and the approach discussed with the Authority.

The use of a ground factor value of G=0.5 has been applied by MDA for several South Australian wind farm projects, with supporting discussions provided that are similar to those from Appendix D of the MDA Report. This approach has been accepted by the South Australian EPA for multiple projects[11] as an acceptable input parameter in conjunction with the other input parameters described in the MDA Report.

PANEL REPORT FOR THE LAL LAL WIND FARM 2009

The Peer Review Report includes a discussion of recommendations made by the Lal Lal Wind Farm panel hearing as detailed in the Panel Report titled *Lal Lal Wind Energy Facility Permit Application PL- SP/05/0461 And Native Vegetation Removal Permit Application PL07/067* dated 11 February 2009.

The relevance of this Panel Report in relation to this planning permit amendment is limited as the relevant noise standard at the time was the 1998 version of NZS 6808 and not the current NZS 6808:2010.

Furthermore, the Panel Report extracts quoted in the Peer Review Report do not contradict the outcome of the MDA report.

Yours faithfully
MARSHALL DAY ACOUSTICS PTY LTD

Christophe Delaire

Associate

[11] Such projects include Waterloo 2, Stony Gap, Ceres and Allendale

Annexure G – Arup Peer Review Report

Herbert Smith Freehills

Lal Lal Wind Farm Noise Impact Assessment

Peer Review

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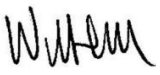
		Signature			
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Contents

1 Introduction

The Lal Lal Wind Farm is proposed to consist of sixty (60) 3.2MW wind turbines located south of Ballan, Victoria.

Marshall Day Acoustics (MDA) have previously undertaken a noise assessment (*Lal Lal Wind Farm NZS6808:2010 Noise Assessment*, MDA Report No. 002 2015386ML dated 11 September 2015) and subsequent revised noise level predictions (*Lal Lal Wind Farm: Revised Wind Farm Noise Level Predictions*, dated 12 August 2015) reflecting minor changes to the wind farm layout, updated wind turbine sound level information, consideration of two additional candidate turbines and an additional participating property.

Arup has been requested by Herbert Smith Freehills to provide a peer review of the noise impact assessment documentation prepared for the proponent (WestWind Energy Pty Ltd) by MDA in relation to its compliance with NZS6808-2010 and other relevant guidelines.

2 Information Reviewed

The following project documentation has been reviewed;

- *Lal Lal Wind Farm NZS6808:2010 Noise Assessment*, MDA Report No. 002 2015386ML, dated 11 September 2015
- *Lal Lal Wind Farm: Revised Wind Farm Noise Level Predictions*, dated 12 August 2015

The original approval documentation and associated reference documentation has not been reviewed, for example;

- Turbine sound power level reference information provided to MDA by Senvion
- Previous background noise monitoring reports, including MDA Reports 001 R01 2007344 (5 February 2008), Report 001 2010178ML (4 April 2011), Report 002 2010178ML (4 April 2011).

3 Planning Requirements

The operation of wind farms creates noise due to the interaction of the wind turbine blades with the wind and from the mechanical equipment used to generate electricity in the turbines. This noise has the potential to impact on people living or working near to the wind farm, and is required to be assessed as a part of the planning and approval process for wind farm developments. As wind farm noise has particular characteristics, and requires noise measurements to be undertaken in windy conditions, usual measurement and assessment standards adopted in Victoria, such as AS 1055[1] and SEPP N-1[2] are unsuitable. Specific guidelines such as NZS 6808:2010[3] (and previously NZS 6808:1998[4]) have therefore been developed to address the unique requirements for the prediction, measurement and assessment of sound from wind farms.

The planning policy for wind farms in Victoria is given in *Victoria Planning Provisions for Wind Energy Facilities* Clause 52.32[5]. The application of the planning provisions is described in the general policy and planning guidelines for development of wind energy facilities[6,7].

The planning provisions require the noise assessment for wind farm projects to be undertaken in accordance with NZS 6808:2010 (amendment VC78[8], 15 March 2011).

There are other standards and guidelines such as AS 4959, the draft National Guidelines[9] and the UK ETSU-R-97[10] that can provide helpful background information and secondary guidance that can also assist with the assessment of projects where the New Zealand Standard does not provide detailed or explicit guidance.

In particular, the New Zealand Standard states that it does not set limits that provide *absolute* protection for residents from audible wind farm sound, but rather

1 AS 1055.1-1997 *Acoustics - Description and measurement of environmental noise - General procedures*, Standards Australia, 1997.
2 *State Environment Protection Policy (Control of Noise from Commerce, Industry and Trade) No. N-1*, Victoria Government Gazette No. S31, 1989.
3 New Zealand Standard 6808:2010 *Acoustics – Wind farm noise*, Standards New Zealand, 2010.
4 New Zealand Standard 6808:1998 *Acoustics – The Assessment and Measurement of Sound from Wind Turbine Generators,* Standards New Zealand, 1998.
5 Victoria Planning Provisions, Wind Energy Facility, Clause 52.32.
6 *Policy and planning guidelines for development of wind energy facilities in Victoria*, Victoria State Government, January 2016.
7 It is noted that the original MDA assessment referenced the June 2015 version of this guideline, but the document was updated in January 2016 to include some additional guidance related to high-amenity area noise limits.
8 Advisory Note 35, Amendment VC 78 Wind energy facility provisions – Clause 52.32, March 2011.
9 *National Wind Farm Development Guidelines – Draft*, Environment Protection and Heritage Council, July 2010.
10 *The Assessment and Rating of Noise from Wind Farms*, UK Department of Trade and Industry, ETSU-R-97, September 1996.

provides guidance on noise limits that are considered *reasonable* for protecting sleep and amenity from wind farm sound at noise sensitive locations.

4 Review of 2010 Noise Assessment

Since the *Revised Wind Farm Noise Level Predictions* completed in August 2016 refer to the original 2010 noise assessment, it is reasonable to also include a review the initial report.

The initial assessment was generally undertaken in accordance with NZS 6808-2010 as required by the Victoria Planning Provisions.

The determination of specific noise limits is not undertaken in detail in the assessment, but rather it refers to documentation associated with the original noise monitoring undertaken in 2007. Nevertheless, while background noise level measurements have been undertaken for the project, the approach used in the assessment is to adopt the 40 dBA 'Base Limit' at all receivers regardless of whether higher noise levels might be allowable at high wind speeds using the 'background +5' approach. I agree that this is a conservative approach, and is being increasingly adopted in wind farm noise assessments.

I have therefore not undertaken any review of the background noise level measurements or analysis.

I concur that the more conservative High Amenity Area noise limit considered in the New Zealand Standard should not apply. I accept that application of the High Amenity Area noise limit in the Victorian context is not straightforward because the provisions of NZS 6808:2010 are partly dependent on New Zealand specific planning legislation which separately identifies High Amenity Areas in their planning controls. Nevertheless, it is my experience that the intent of the application of the High Amenity Area limit in NZS 6808:2010 is that it would only apply to a very small number of areas that have been identified as requiring additional protection over that which would be applied more generally – and I accept that the current Victorian planning zones in the region are not comparable to those in the New Zealand planning controls which would require it.

In particular, based on the Victorian EPA's Noise from Industry in Regional Victoria[11] (NIRV) guideline, while it is not directly applicable to wind farm developments, would suggest that the following planning zones could be considered as requiring 'additional amenity'; Green Wedge A (GWAZ), Rural Conservation (RCZ) and Rural Living (RLZ). The dwellings within the immediate vicinity of the proposed Lal Lal Wind Farm are within a Farming Zone, leading to the conclusion that, based on their zoning, a High Amenity Area limit would not be required.

Nevertheless, the 2016 guideline does suggest assessment against part C5.3.1 of NZS 6808:2010 as a further test that may be applied to determine whether the High Amenity Area noise limit might be justified, and I therefore believe that it would be reasonable for this test to be applied to the locations considered by the assessment. It should be noted that if the High Amenity Area limit were adopted at some receivers, it would only apply at wind speeds of 6 m/s or less.

---

11 *Noise from Industry in Regional Victoria*, Publication 1411, Victorian EPA, October 2011.

I note that a 45 dB(A) noise limit is proposed at properties of participating landowners (ie landowners with a written agreement in place). The adoption of a limit for participating landowners is not strictly considered under NZS 6808:2010, but is discussed in the Working Group on Noise from Wind Turbine recommendations (ETSU-R-97)[12] and the South Australian wind farm environmental guidelines[13]. I therefore concur that adopting a 45 dB(A) noise limit for participating landowners is reasonable, on the basis of adopting best practice.

The identification of noise sensitive locations (ie those where wind turbine noise levels are ≥ 35 dB(A)) is reasonable, and 11 properties are identified.

The noise level predictions have been undertaken using the ISO 9613-2 noise propagation model, which has been shown in national and international studies[14,15,16,17] to provide reasonable results for wind farm noise level predictions. In my opinion, the calculation parameters that have been adopted for temperature, humidity and ground absorption are reasonable, and correspond to best practice.

Furthermore, the noise level predictions have adopted the following conservative assumptions;

- Barrier effect limited to 2 dB
- Screening based on turbine tip height, not hub height
- +3 penalty for 'concave' ground topography.

The considerations are not explicitly required by NZS 6808:2010 or implemented in ISO9613, but are commonly adopted as good practice for wind farm noise assessment.

The assessment does not provide any detailed assessment of SACS, but this is acceptable as there is no requirement for it to do so in accordance with NZS 6808:2010. The assessment of SACS is only required at commissioning stage, following construction of the wind farm.

In my opinion, there are some aspects lacking from the noise assessment.

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12 *The Assessment and Rating of Noise from Wind Farms, The Working Group on Noise from Wind Turbines*, ETSU-R-97, UK Department of Trade and Industry, September 1996.

13 *Wind farms environmental noise guidelines,* Environment Protection Authority South Australia, July 2009.

14 Bass, J.H., Bullmore, A.J. and Sloth, E. *Development of a Wind Farm Noise Propagation Model*, Final Report for European Commission Contract JOR-3-CT95-0051, 1998.

15 Bullmore, A., Adcock, J., Jiggins, M. and Cand, M., *Wind Farm Noise Predictions and Comparison with Measurements*, Wind Turbine Noise 2009, Aalborg, Denmark, 2009.

16 Delaire, C., Griffin, D. and Walsh, D., *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*, Proc. 4th International Meeting on Wind Turbine Noise, Rome, Italy, 11-14 April 2011.

17 Evans, T. and Cooper, J., *Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms*, Proc. Acoustics 2011, Gold Coast, Australia, 2011.

One issue is that the assessment does not appear to provide an integer wind speed assessment (ie tabulated receiver noise levels at integer wind speeds other than the 95% or worst-case). This would not change the outcomes of the assessment, but is required by NZS 6808-2010.

Furthermore, there does not appear to be any assessment of;

- noise impacts from construction,
- noise from transformers, substations and fixed equipment against SEPP N-1 or NIRV,
- discharge noise and Aeolian tones from transmission lines.

These are not required to be assessed under NZS 6808-2010, and are typically less critical than noise from the wind turbines themselves. Nevertheless, it is good practice for wind farm noise assessments to include at least a brief assessment of these noise sources to confirm that they will comply with the relevant requirements.

I understand that transmission lines are not included as part of current application, and so it may be appropriate to address noise from the transmission equipment elsewhere.

Finally, with regards to the noise level contour maps, I note that these only show the specific 'noise sensitive' receivers. In my opinion, these would be better to show all nearby properties.

5 Review of 2016 Revised Wind Farm Noise Predictions

The Revised Wind Farm Noise Predictions document provides an update of the wind farm noise level predictions to reflect revised turbine and receiver arrangements, and additional candidate turbines.

In particular the following turbine types are considered;

- Senvion 3.2M114
- Senvion 3.4M122
- Senvion 3.4M140 (serrated trailing edge blades)

The spectral (octave band) sound power data for the additional 3.4M122 and 3.4M140 turbines is not currently available, and so the spectral information used in the calculations has been based on the information provide for the 3.0M122 turbine. MDA notes that this is considered to be representative due to the close physical similarity between the turbines. The blade serrations on the 3.4M140 considered as a candidate turbine are also noted to cause a small shift in spectral noise output towards higher frequencies.

There are limitations on the updated information because MDA have not been provided with the actual measured data for the specific turbine types being considered. It would have been preferential to base the revised predictions on measured data for the actual turbines rather than rely on assumptions about similarities with other turbines.

Nevertheless, in the context of this assessment, I consider this to be reasonable because of the noted similarities between the various turbines, and on the basis that further modelling will be required to be carried out post-approval at the pre-construction stage to confirm that the wind farm noise levels meet the necessary limits.

The revised prediction report also provides a detailed review of the potential for tonality of the candidate turbines. This analysis is not strictly required by the New Zealand Standard at the assessment and approval stage of the project – and is usually undertaken during the post-construction commissioning assessment. Nevertheless, it still provides some helpful information.

Again, there are some limitations, most critically that the tonal audibility assessment is based on *nearfield* measurements (ie the IEC 61400-11 reference noise level measurements made within several hundred metres of the turbine), whereas the necessary post-construction assessment will be undertaken at the sensitive receivers, located around 1,000m or more from the turbines. Propagation over this distance will change the spectral characteristics of the wind farm sound, and the resultant tonal audibility. Additionally, the tonality of the 3.4M122 turbine has been based on the measurement information for the 3.0M122 turbine, and the tonality measurements are referenced to wind speeds at 10 m AGL rather than at hub-height.

Due to these limitations, the tonal audibility assessment is therefore, in my opinion, of somewhat limited value, except perhaps as a way for the proponent to understand the potential risks of selecting a particular turbine from the range of candidates.

The revised noise predictions are shown in Table 5 of the MDA report, and indicate that the predicted wind farm noise levels will comply with the base 40 dB(A) noise limit at all of the non-participating receiver locations. The 45 dB(A) noise level criteria for participating receivers is predicted to be marginally exceeded at one location (J17aa) for the 3.4M122 turbine.

In my opinion, the conclusion that the noise levels from the proposed wind farm will generally meet the requirements of NZS 6808:2010 at non-participating receivers appears to be reasonable.

I note that revised noise level predictions also do not provide an integer wind speed assessment (ie tabulated receiver noise levels at integer wind speeds other than the 95% or worst-case) as required by NZS 6808-2010.

Furthermore, in my opinion, the revised prediction document should also include updated maps including at least the 35, 40 and 45 dB(A) wind farm sound level contours.