Collector Windfarm – Technical Review of Supporting Documentation

- Final
- 24 June 2013

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Glossary

Term	Description
dB	Sound pressure levels are expressed in decibels as a ratio between the measured sound pressure level and the reference pressure. The reference pressure is 2×10^{-6} Pascal (Newtons per square meter).
dB(A)	The A-weighted sound pressure level in decibels, denoted dB(A) is the unit generally used for the measurement of environmental, transportation or industrial noise. The A-weighting scale approximates the sensitivity of the human ear when it is exposed to normal levels and correlates well with subjective perception over a number of different types of sounds. An increase or decrease in sound level of approximately 10 dB corresponds to a subjective doubling or halving in loudness. A change in sound level of 3dB is considered to be just noticeable.
dB(C)	The unit used for measuring occupational health and safety maximum industrial noise levels in Australia is the C-weighted sound pressure level in decibels, denoted dB(C). C-weighting has a relatively flat response when compared to an A-weighting network.
L_{A10}	The A weighted sound pressure level that is exceeded for 10% of the measurement period. It is often referred to as the average of the maximum values.
L_{A90}	The A weighted sound pressure level that is exceeded for 90% of the measurement period. Usually used to represent the background noise level.
L_{eq}	The equivalent continuous sound level. The steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.
L_{Aeq}	The A weighted equivalent continuous sound level is denoted L_{Aeq}.
L_{Max}, L_{FMax}, L_{SMax} L_{AMax}, L_{AFMax}, L_{ASMax}	The maximum measured linear (un-weighted or Z) sound pressure level. The L_{Max} variations, L_{FMax}, L_{SMax} are the L_{Max} levels using the "Fast" and "Slow" networks respectively. The A-weighted variations are also used in various guidelines and standards, L_{AMax}, L_{AFMax} and L_{ASMax}.
Frequency	The rate of repetition of a sound wave. The unit of frequency is the Hertz (Hz), defined as one cycle per second. Human hearing ranges approximately from 20 Hz to 20,000 Hz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands. For more detailed analysis each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
Background Noise Level	The lower ambient noise level, usually defined as the value of the time varying ambient noise level exceeded for 90% of the measurement time. Usually defined in the dB(A) scale - L_{A90}.
Acoustic Spectrum	The sound pressure level (or sound power level) as a function of frequency (eg octave band, 1/3 octave or narrow band). Generally used to identify noise sources or items contributing disproportionately to an overall noise level.

1 Introduction

The Department of Planning and Infrastructure (DP&I) has requested that SKM provide expert advice with respect to the Noise Impact Assessment for the Collector Wind Farm Environmental Assessment (EA) (APP, June 2012), and with respect to the Preferred Project and Submissions Report.

SKM was to provide the following Project Advice:

1) Review of the documentation provided by the Department with regard to the Director-General's requirements for the EA and of the relevant planning guidelines with particular regard to the draft NSW Wind Farm Planning Noise Guidelines (2011), the South Australian Environment Protection Authority's Wind Farms – Environmental Noise Guidelines, 2003 and industry standards and legislation.
2) The review would be provided in the form of a report providing independent expert advice and commentary on the:
3) Proponent's Noise Assessment and associated documentation, and if necessary, identifying gaps in the documentation to be addressed by the Proponent to ensure consistency of the project with the above Guidelines; and
4) Suitability of the proposed mitigation and/or management and/or protection measures if required.

This report details our findings.

2 Documents Reviewed

The following documents were reviewed:

1) Director General's Requirements for Collector Wind Farm Section 75F of the Environmental Planning and Assessment Act 1979 (dates, 15/10/10, 2/2/11 and 16/8/11) – Noise Impacts
2) Collector Wind Farm Environmental Assessment Chapter 7 "Noise Assessment" APP Corporation June 2012
3) Appendix F Collector Wind Farm Noise Impact Assessment, MDA Rp 002 R07 2010127SY, 4 June 2012
4) Collector Wind Farm Submission Response MDA Rp 003 draft 2012127SY, 13 November 2012
5) Collector Wind Farm Layout Refinements dated 21 December 2012
6) Collector Wind Farm Preferred Project and Submissions Report APP March 2013
7) Peer Review of Environmental Noise Assessment Collector Wind Farm by The Acoustic Group Pty Ltd, Report 42.5006.R1:ZSC, 23 September, 2012
8) Section 3 Response to Government Submissions and Section 4 Response to Public Submissions in the APP Collector Wind Farm Preferred Project and Submissions Report 1st February 2013
9) Adverse Impacts on Human Health Section 5 Friends of Collector 24 Sept 2012
10) Objection to the Proposed Collector Wind Farm Development MP10_0156 by Watts and Watts, 22 September 2012
11) Collector Wind Farm DP&I Peer Review Requests MDA letter dated 9 April 2013
12) Peer Review Comments South Australian EPA and Resonate Acoustics "Infrasound Levels Near Windfarms and in Other Environments" Issued by the South Australian EPA dated January 2013 by Steve Cooper, the Acoustics Group, dated 18th February 2013
13) Collector Wind Farm Department of Planning & Infrastructure Peer Review Requests MDA, 9 April, 2013

3 Director General EA requirements

The DG EA requirements include the following with respect to Noise Impacts:

1) Include a comprehensive noise assessment of all phases and components of the project. The assessment must identify noise sensitive locations, baseline conditions based on monitoring results, the levels and character of the noise criteria, modelling assumptions and worst case and representative noise impacts.
2) Noise impacts under operating meteorological conditions (wind speeds from cut in to rated power) including impacts under conditions that exacerbate impacts. The probability of such occurrences must be quantified.
3) If any agreements with residents are proposed for areas where noise criteria cannot be met, then provide sufficient information to enable a clear understanding of what criteria have been used.
4) Clearly outline the noise mitigation and management measures that would be applied to the project. This must include an assessment of the feasibility, effectiveness and reliability of the proposed measures and any residual impacts after these measures have been incorporated.
5) Include a contingency strategy that provides for additional noise attenuation should higher noise levels than predicted result.
6) Include an assessment of vibration impacts associated with the project.
7) The cumulative impact of adding the Collector Wind Farm in the presence of the effect of any adjacent wind farms needs to be assessed.

4 MDA Noise Impact Assessment June 2012

The Marshall Day Acoustics (MDA) Collector Wind Farm Noise Impact Assessment report dated 4 June 2012 [3] is a very comprehensive report and is generally very well written. It includes nearly all the information as required by the DG and states that the predicted noise levels are assessed against the SA 2003 guidelines (SA03) as required by the DG EA and against the Draft NSW Planning Guidelines Wind Farms issued by the NSW DP&I in Dec 2011 (DP&I 2011).

In Section 2 and Section 4.2 of their report, MDA [3] state that 34 dwellings have been identified with the assistance of the proponent for inclusion in the assessment. The basis for this choice must be explained more clearly by MDA as it is not immediately apparent.

With respect to background noise level measurements, MDA did not use the data at each site but rather chose to use the most stringent criterion. Thus, it is not fully incumbent for MDA to provide further details as would normally be required by the Guidelines and the DG requirements. However, to satisfy the Guidelines and DG requirements, the following would be required:

Appendix E does provide some details for the background noise level measurements. To be comprehensive, though, MDA should indicate the noise floor of the EL-316 loggers used. The NSW 2011 guidelines indicate a noise floor less than 20 dBA is preferred.

Also, to follow the DG requirements, MDA should indicate noise impacts under operating meteorological conditions (wind speeds from cut in to rated power) including impacts under conditions that exacerbate impacts. As per the DG, the probability of such occurrences must be quantified.

The DP&I 2011 NSW guidelines also indicate that at least 500 of the long term monitoring points should be used to from the worst case direction. MDA should indicate if their data complies with this requirement.

Table E2 includes background noise level statistics. In accordance with the DP&I Guidelines, the correlation coefficient should be specified for each polynomial order (linear up to one third).

Appendix H includes quite a comprehensive description of the background noise level measurement locations. The distance of the microphone locations is included for many of the sites but is missing from the involved receiver sites. It is a pity that photos were not included. It is recognised that MDA said that these could be made available if required but that they had not been included for privacy reasons.

The Reviewer generally agrees with the findings of this report. Predictions indicate that the requirements of SA03 should be met at all residential locations investigated apart from involved receiver N. At this location, the WHO guideline of 45 dBA will be potentially exceeded. However, involved receiver N has apparently waived the option of reduced turbine layouts and is intending to enter into a land holder agreement. This would retain the currently proposed layout and includes provisions to attenuate noise levels if required. The proposed noise attenuation options at this location (which included operational noise management strategies or a package of insulation measures such as ventilation treatments and façade element upgrades and are discussed in Section 7.0 of June 2012 MDA report) seem reasonable.

5 The Acoustics Group Review

This report refers to the MDA report [3] for Collector Wind Farm dated June 2012.

As part of the qualifications, the AG report [7] refers to Steve Cooper's review in relation to the proposed Flyers Creek Wind Farm dated 23rd September 2012. He states that he did a desk top review and that this was supplemented by preliminary noise testing in proximity to the Capital Wind Farm. He states that his testing "identified the possibility that noise originating from the wind farm could affect individuals". A review of this 2012 Flyers Creek Wind Farm AG report by the current Reviewer found that indeed this claim was made but assessed that the Report did not provide any conclusive evidence to support that possibility.

On page 6 of the AG report [7], it is stated that the MDA report [3] varies from the EA report [2] that identifies other turbines being considered. Table 3 in Section 2 of the EA does indeed list a number of turbine options but MDA do explain in their Submission Response dated November 2012 [4] that many turbines can be considered but the MDA report [3] was prepared to demonstrate viability of the project using turbines representative of the normal range of emission levels.

On page 8, the AG report [7] states that the Conclusion of the MDA report [3] "does not provide any identification of the impact the proposed wind farm will create". AG also takes issue with the report not describing impact despite the Title stating "Noise Impact Assessment" and references community complaints from existing wind farms. The AG report further states that the ambient noise level is significantly less than the criterion 35 dBA and that "any experienced acoustic engineer would be aware that generating a noise which is significantly greater than the existing ambient background level of an area can create an impact which should be addressed." We agree that generating a noise level significantly greater than the existing ambient can create an impact but suggest that the noise source level has to be at least at the minimum 30 dBA in accordance with AS1055 so that its absolute level is above that which can be disturbing.

On page 10, the AG report [7] says that the plots in Appendix G of the MDA report are misleading in that they don't include background noise levels for hub height wind speeds below 3 m/s. This is because background noise levels can be measured at wind speeds less than 3 m/s and would be lower than that at 3 m/s. However the Author notes firstly that the SA03 only requires that the plots report noise data from wind farm cut in speed and, secondly, we note that quite a number of the plots do indeed show wind speeds as low as 1 m/s and the noise data pair for that wind speed. This, the Author concludes that these plots are as required.

On page 11, the AG report states that the regression analysis in Appendix H does not differentiate between day and night. We note that the MDA report does provide a discussion of diurnal noise trends of representative datasets. They indeed find a clear trend of reduced noise levels during the night time period.

On page 13, the AG report states that "If one assumes that the wind farm ambient background level of the area from the regression analysis is around 20 dBA at the cut out speed (we believe that this should read cut-in speed – we have quoted the text as it is written), then it is an undeniable fact that wind farm noise at a nominal limit of 35 dBA would be clearly audible both inside and outside residential dwellings and would represent a significant impact in terms of the existing environment." We take note of the usage of the term "undeniable fact" and suggest that this term is somewhat emotive in this context. Yes, it is likely that if the ambient was 20 dBA, then a noise at 35 dBA would be audible outside in comparison. But we also note that, in an absolute sense, the noise level would not be high and while such a noise level could be heard outside, we feel that it is unlikely that such a noise would be perceptible inside unless someone was really listening for it and only under certain circumstances eg unfavourable weather leading to focussing of sound at that residence. At an absolute level of 35 dBA, the Reviewer feels that the impact would not necessarily be significant to the extent as has been suggested by AG simply because the level itself is low. This could be the case even for sound due to a wind turbine with a falling characteristic with increasing frequency.

On page 13, the AG report states that the MDA report [3] does not provide wind data at the microphone. This is true. However, the MDA report does discuss the issue of wind speed over the microphone when considering noise logger noise level data in Appendix E page E-5. MDA did review the data collected at the Wood Park and Tamaroo dwellings which indicated that wind speeds at the microphone did not exceed 5 m/s at any time whilst the background noise monitoring occurred. As MDA used the lowest measured background noise level measured to determine the relevant noise limit, this is fully acceptable.

On page 13, AG further suggests that with an external background noise level at times below 20 dBA, "there must therefore be even lower noise levels inside bedrooms of residences in rural area". We point out that this conclusion does not necessary follow as the internal noise level is usually due to internal noise sources rather external noise sources unless the external noise source level is quite high.

On page 14, the AG report [7] states that the MDA report [3] did not identify the relationship between the wind speed at hub height and the wind speed at the receiver location. We point out that this is not required by either of the SA03 or DP&I Guidelines.

The AG report [7] correctly identifies that the MDA report [3] does not identify "the frequency of occurrence of adverse meteorological effects". Further in the last paragraph on page 14, AG [7] state that with reference to the frequency of occurrence of adverse meteorological "It is quite likely that such an analysis would identify to the community the percentage of time when the wind farm would be inaudible or barely or clearly audible". It is true that such an analysis could indicate to the community the degree of noise propagation and could also indicate the percentage of time when worst case noise propagation might occur. However, there is not necessarily a correlation of propagation with indoor perceptibility and the noise model calculations were conducted on the assumption of worst case propagation in all directions at the same time. So the worst case noise levels are being predicted.

On page 15, the AG report [7] states that the MDA report [3] has failed to identify the potential audibility of turbine noise outside or inside residential dwellings, which therefore is a significant failure of the report…". We note that the neither the DG requirements nor the SA03 or DP&I 2011 guidelines call for this.

On page 16, the AG report [7] points out that the MDA "report nominates noise levels not impacts". The AG report criticises and does not agree with the SA03 and DP&I 2011 Guidelines approach which assesses impact based on the 35 dBA criterion. However, MDA have correctly followed the DG requirements. Note that Section 5 of the AG report [7] goes into detail as to why they do not support the

SA03 Guidelines approach which is a discussion that should be considered separate to an assessment of the MDA report compliance. This submission process is not the forum or means to debate public policy.

On page 22, the AG report [7] refers to Te Rere Hau wind farm in NZ and suggests that MDA had been taken to task for errors in modelling etc. However, MDA state that they were not responsible for the initial predictions. The AG report [7] also quote from Professor Leventhall and selectively choose texts to try and support their position. However, Professor Leventhall has explicitly stated his position that current wind farms do not have excessive infrasound (see Section 4.5 bottom of page 34 of the MDA report [3]).

On page 31, the AG report [7] states that "Any appropriately qualified and experienced acoustic engineer will be aware that…". Such terminology is emotive and not respectful.

On pages 32 -33, the AG report [7] refers to Steve Cooper's attendance at some residential locations where residents have apparently complained of "varying degrees of disturbance/impacts due to wind turbines". The AG reports on noise level measurements conducted by AG at Waterloo Wind Farm but no information is provided as to what equipment was used to conduct the noise level measurements nor of weather conditions or turbine power status (we understand that this latter information would not have been made available to AG by the owners). The data presented in Appendix H is what might be expected apart from a peak in the Sound Pressure Level in the region of 25 – 63 Hz which AG does not explain or comment on. AG [12] has indicated elsewhere that "the frequency spectrum from modern day wind turbines is predominantly elevated in the 0.7 to 6 Hz region" but these plots do not support this contention. At no point does AG describe the integration/time constant/averaging time of his analysis so it is impossible to make any use of the spectral data at infrasonic frequencies, including comparisons reported by AG.

On page 34, the AG states "The A weighted level was not constant and exhibited a variation in level which as nominated in the Guideline is identified as modulation. The modulation occurs over the entire audio spectrum". This statement is incorrect. The SA03 Guideline does not define modulation at all whilst the DP&I 2011 states in reference to amplitude modulation "An excessive level of modulation is taken to be a variation of greater than 4 dBA at the blade passing frequency". The AG report then states "Whilst not showing a significant variation in the A-weighted level the modulation is most obvious in the upper frequency bands as shown by comparison of the A weighted level versus the 2500 Hz 1/3 octave band". So what the AG report [7] seems to saying is that there is **no** excessive amplitude modulation based on the DP&I definition. And given the reference to amplitude modulation at the blade passing frequency, this reviewer does not understand why AG picked the 2500 Hz band to discuss potential modulation. Significant amplitude modulation is a very rare phenomenon and dependent on very specific conditions. This reviewer does not consider that this needs to be considered further at this time.

Appendix J of the AG report [7] shows a narrow band analysis of a turbine noise level measurement by AG. The very large SPL difference between the L1 and L90 values across most of the spectrum does seem odd but AG have not provided any explanation.

Narrow band spectra are shown in Appendix J (not in Appendix H as stated in AG) and AG concludes that "The frequency graphs clearly show that there are low frequency and infrasound components generated by the turbine". There is no argument about the presence of such components. Where there is argument is in relation to the actual level and whether there is any causality of health effects. Note that the sound pressure levels on these spectra are not validated as the measurement method, conditions of measurement and analysis method are not known.

On page 36, AG [7] talks about background noise level as a result of wind on the microphone. AG states "There is no difference for low wind speeds but above 10 metres per second the grassed field produces higher background levels". It is not surprising that this would be the case. The Standard and Guidelines do indeed call for data collected above a wind speed of 5 m/s at the microphone to be excluded.

Further on page 36, AG [7] goes on to state "As noted previously the MDA report does not provide information to identify the wind at the microphone versus the wind farm weather monitoring station so as to clarify the relationship between the wind farm and the wind at residential receivers". We again note that there is no requirement to provide this in the SA03 and DP&I Guidelines. We also note that the MDA report [3] does discuss the impact of wind on the microphone in Appendix E page E-5.

On page 37, AG [7] refers to "the modulation of the turbine noise external to the dwelling …" This is at 2500 Hz. They then state that the attenuation of the building eliminates the high frequency modulation inside the building. As indicated earlier, this reviewer does not understand why attention is drawn to an apparent modulation at 2500 Hz.

AG [7] quotes Moller on page 37. We note that the last paragraph of the quote states that "The rate of modulation of the low frequency noise from wind turbines (and higher frequencies as well) is often in the infrasonic frequency range eg the blade passage frequency, and the noise may thus be mistaken as infrasound, even when there is little or virtually no infrasound present".

AG [7] further state on page 37 "The measurement in proximity to the Waterloo turbines identifies the blade pass frequency of the turbines and the harmonics of that frequency to be present and those frequencies are also present outside and inside houses". We agree but question can these be heard and do they have any impact? Just being present as determined in an analysis does not mean that the presence of such frequencies is perceived nor does it mean that there is any impact on health.

On page 38, AG [7] claims that "The MDA report seeks to dismiss the presence of infrasound from wind turbines…". We do not agree. The MDA report admits that there is infrasound present but puts the infrasound into context of infrasound from many other noise sources.

On page 38, AG [7] is critical of a Sonus report "However, examination of the material in that report is not exactly definitive of what was measured, when the noise was measured, the source of the noise, and the prevailing conditions at the time." We level this exact criticism at AG in terms of the noise data presented in this very report. AG have not provided any of this information in relation to the results they provide in Appendices G and onwards!

Appendix L in the AG report [7] is interesting and shows that the low frequency and infrasonic noise levels inside and outside the house are low. The infrasound levels are definitely below threshold. A lot of the discussion on pages 39 – 41 regarding levels is interesting but we question what is the practical outcome? On page 38, AG refers to a Sonus report re infrasound at Cape Bridgewater. The AG report states on page 39 that "there is an issue in using one third octave band measurements to describe infrasound energy…". We say that there is no issue. The 1/3 octave band data certainly by definition reflects the narrow band data contained in that 1/3 octave band and is an accepted alternate method of presentation. If there are infrasonic peaks, then the one third octaves will reflect these peaks. Recall also that the 1/3 octave bandwidths are much narrower as centre frequency decreases so will approach narrow band anyway.

AG [7] say that residents at Waterloo identified a low frequency hum externally at a house 8 km from the Waterloo turbines. The upper spectrum on Figure M3 shows levels of infrasound well below hearing threshold and seeing the residents apparently reported hear a hum, it may well be that what they are responding to is the tones at about 23 Hz and 26 Hz. We query what is the source of these tones. It is unlikely to be the wind turbine as the fundamental blade frequency would be of the order of 1 Hz.

On page 41, AG [7] states that "For the purposes of this peer review, the attached Appendices are sufficiently detailed to reveal that even when wind farms in the Goyder area are apparently able to comply with the SA Guidelines, they are still generating adverse impacts at residential properties". We state that for the many reasons indicated above, AG have only demonstrated that around wind farms there is low frequency noise and infrasound. They have not demonstrated conclusively that "The measurement data appended to this review identifies that there are both low frequency noise and infrasound components generated by the turbines that are currently located in the region". Yes, AG has measured the presence of AG low frequency noise and infrasound. Wind turbines do generate higher levels of low frequency noise and infrasound close in (300 – 500m) but at distances of say 1 - 2 Km and more, the presence of low frequency noise and infrasound is not necessarily due to wind turbines but could also be present due to wind and other distant sources. AG have also not shown that "These impacts can be detected and measured when one looks to the use of non A-weighted measurement results" and have not demonstrated any causality in terms of impact.

In summary, we do not believe that the criticisms by AG of the MDA report are sustained. We have found many technical issues with the AG report that challenge the validity of their conclusions.

6 MDA Submission Response November 2012

This MDA report starts with some general comments about the operational noise assessment and then specifically addresses some of the issues raised by the AG report [7].

In the first paragraph on page 6, MDA provides Table 1 which gives a summary of the predicted noise levels for the nearest dwellings. It is not clear on what basis these dwellings were chosen and these need to be explained. There is also a typo in Table 1. The third range of levels should be between 29 dB and 32 dB.

We agree with the response by MDA with respect to the margin above background question and agree that there is a minimum level of noise that needs to occur before the noise itself becomes intrusive. We agree that even if this minimum level exceeds a very quiet background noise level, the noise will not necessarily be considered intrusive in the circumstance where its absolute level is low, even though much higher than the background noise level. That is why the revised Australian Standard AS1055 refers to background noise levels in range 30 – 60 dB.

We note a typo in the first sentence end of the second line where a word seems to be missing.

In relation to matters specific to the Collector Wind Farm, on page 11, MDA refer to the noise predictions and in the first dot point on the bottom of the page, state "…however, the only ISO 9613-2 weather condition adjustment relates to longer term averages which are not an appropriate basis for assessment". This latter statement needs to be explained in a little more detail.

On page 12, in the fourth dot point of the discussion of the noise prediction modelling, there is a missing reference at the end of the dot point.

We agree with the MDA discussion re candidate turbines, low frequency predictions, seasonal effects, tonality and amplitude modulation and low frequency noise.

With respect to C weighted calculations, MDA refer to consideration of (and in their subsequent letter dated December 21, 2012, of a review of) the Danish Statutory Order No 1284. It could be useful to provide a little more information in relation to this Order and how it was applied by MDA in this instance.

Based on the information provided, we assess that MDA has responded appropriately to the issues raised and to all relevant matters raised by the AG report. None of the clarifications suggested above will materially affect the outcome. Specifically, the requirements of the DG and the SA03 Guidelines have been addressed by MDA and they have demonstrated that the Collector Wind Farm can viably operate in accordance with the SA03 Guidelines. In terms of the SA03, Guidelines, the Collector Wind Farm impact will be marginal and acceptable. With respect to the stakeholder receiver N, the WHO recommended outdoor noise limit of 45 dBA (after adjustment for tonality) will be marginally exceeded but the stakeholder has signed an agreement in favour of landscaping and insulation measures to achieve suitable indoor levels. This approach is satisfactory.

7 MDA Collector Farm Layout Refinements

This letter presents updated operational noise predictions for the refined scheme layout.

In relation to uncertainty of prediction of C weighted noise levels, MDA states “Specifically, quoted uncertainty values for total C weighted noise emissions of the turbines are not provided in the available manufacturer’s literature”. So if this is the case, how can they then say in the next sentence “However, data provided by other turbine manufacturers indicates…”? Which others are there that are not included in the “the available manufacturers?

We agree with the choice of an uncertainty of +/- 6 dB for frequencies below 63 Hz. Below 20 Hz, the uncertainty should increase to +/- 10 dB to reflect the increased complexity of measurement.

The DP&I 2011 states that if the C-weighted noise (from 20 Hz upwards) is repeatedly greater than 65 dBA during the daytime or 60 dBC during the night-time, then a more detailed low frequency noise assessment should be undertaken. Based on a revised layout and consideration of the Danish Statutory Order No 1284, the MDA report shows that there is only one residential location within 2 km of a proposed turbine location that falls into this category (House Z – a non-involved receiver) and that the C weighted night time criterion is slightly exceeded for only one of the three turbine options. Thus further assessment is not required at this time. This issue should, however, be revisited and addressed once a final turbine selection has been made.

We agree with the MDA summary.

Note a typo of the repeated words “in the” in the third line of the second last para on page 6.

8 Friends of Collector Section 5 Sept 2012

The beginning of this Friends of Collector (FoC) submission includes many simplistic statements based on information from others, not necessarily always 100% accurate. Some examples follow:

On page 15, for instance, the FoC states "All of these factors suggest that audible noise produced from IWT's can and will be **far greater** than manufacturer's specifications suggest and **compliance monitoring detects**" (bolded by FoC). Where is the real evidence to support both of these statements? The FoC state that "this fact is well known" Is it a fact and is it well known? The reviewer suggests that this is not the case.

On page 16, FoC state "It is predictable that residences located at distances from operating IWT's are being exposed to low frequency noise and infrasound". Yes, we agree with this statement. The question is at what level? "We know that these waves can travel through buildings and cause walls, windows and people to vibrate". Yes, we are aware that sometimes windows vibrate perceptibly but walls exceptionally and people never. The only time that chests might feel a response is when exposed to extremely high levels of low frequency noise and infrasound. "What then are the levels of infrasound and low frequency waves actually generated by operational IWT's? **We do not know."** Low frequency and infrasound levels due to wind turbines are now known and are well documented eg Leventhall and Kyriakides 1976, Bryan 1976, SA EPA and Resonate 2013.

On page 17, FoC state that "Available recent studies strongly indicate that low frequency and infrasound generated by IWT's are greater than previously acknowledged and likely to be greater still with increases in height and size of turbines". These statements are being made by a number of parties but the credible peer reviewed evidence to support these contentions is lacking.

The above statement is followed by "These studies show that the lower frequency sound waves generated by IWT's indeed **predominate at distance**. They are modulated and are present at very significant levels… infrasound waves occurring in Australian residences near wind farms in the 50 – 70 dBZ range". Infrasound at 50 - 70 dBZ is not a significant level relative to the hearing threshold at infrasonic frequencies and also is not high enough to cause chest cavity resonance or symptoms of nausea or dizziness.

It further states on page 17 "There are also high levels of amplitude modulated low frequency waves which may be audible (as well as felt) to some individuals". Where is the evidence to support this statement? The AG report showed "amplitude modulation" at 2500 Hz. This is not a low frequency. Further, if the sound is audible at low frequencies, then it is likely that this frequency is in the range 31.5 – 63 Hz or higher.

On page 25, Table 2 lists the effects of "chronic low frequency vibration and subsequent physiological consequences". But what is doesn't show is the high level of infrasound required to elicit these responses. These levels are significantly higher than the infrasonic levels that occur in houses near wind turbines.

9 Objection by Watt and Watts

Watts and Watts have lodged an objection to the proposed Collector Wind Farm development. They have a general objection and have listed many grounds and, in this submission, have listed "noise, health and related issues".

Their first comment is as follows. "There is now significant national and international research and disquiet indicating that an undeniable health problem exists for people whose residences are sited in close proximity to industrial wind turbines. Undoubtedly there are multifactorial causes, but the most consistently demonstrated association is that of intrusive noise both audible and inaudible. Inaudible noise is both low frequency and infrasound."

There are a number of statements in this quote that require consideration. Firstly, not everyone would agree that there is an "undeniable health problem". Further, what is meant by "close proximity"? Most people could agree that a potential noise problem might occur within 500 metres but many would disagree that this occurs for distances greater than say 1 – 2 km. Whether a potential noise problem occurs or doesn't would depend on the number of operational turbines, their proximity to a location and the weather and wind condition at the turbines and at the receiver. Is noise "the most consistently demonstrated association". Certainly the evidence to support such a statement is lacking. Further, low frequency and infrasound can be inaudible. It depends on the level at which they occur. And infrasound is generally inaudible as its level due to natural and man-made noise sources is less than the threshold while low frequency noise is generally audible.

Is infrasound not actively "heard" but rather perceived as a vibration as Watts and Watts claim? Where is the evidence to support this contention?

Watts and Watts describe sound, sound measurement and sensory perception of sound. There are quite a number of statements which are incorrect. One example is "the A scale weights contributions of sound waves in the 1000 Hz to 6000 Hz range". In reality, it encompasses a much wider range but does indeed reduce the contribution of both high and low frequencies. It is commonly accepted that the human hearing ranges from 20 Hz to 20 KHz. It is therefore incorrect to state, as Watts and Watts have done, that "the A weighted scale **does not give**, or purport to give, a pure measure of frequencies outside the range of hearing of the human ear and **increasingly distorts** the contribution of lower frequencies as it moves down the spectrum". The A scale deals with the full hearing range. It does not "distort" anything. This sentence displays a lack of understanding of what the A weighting is. WHO puts it this way "The A-weighting is most commonly used and weights lower frequencies as less important than mid- and higher-frequencies. It is intended to approximate the frequency response of our hearing system."

There are many other similar examples in this submission. Another is "What then are the levels of infrasound and low frequency waves actually generated by operational IWT's. **We do not know**." The level of low frequency noise from wind turbines is actually well documented. The level of infrasound is also now documented as a result of the relatively recent discussions regarding the potential health impacts eg Leventhall and Kyriakides 1976, Bryan 1976, SA EPA and Resonate 2013.

"Despite wind energy company denials there is now a considerable and growing body of work that has found that **wind turbines do produce infrasound**." The reviewer is not aware that anyone has denied that infrasound is produced by wind turbines. The question is what levels of infrasound occur due to wind turbines at residences in the vicinity and whether this is potentially causing a health impact.

"It is accepted that up to 25% of any population will be impacted by infrasound." The reviewer is unaware of where this information came from, who this is accepted by or what impacts are considered.

The reviewer finds the Watts and Watts objection emotive and that many statements are incorrect or not supported. Some of the arguments put forward are in relation to the chosen guideline (SA03) and the submission process is not the forum for a debate on the criterion.

10 Collector Wind Farm Preferred Project and Submissions Report

We have reviewed the submissions received which are described in Section 3 and Section 4 of the Collector Wind Farm Preferred Project and Submissions Report. We have noted all responses that involve noise (Section 4.3 Noise Issues pages 64 – 70 and Section 4.7 Hazards and Risks - Issues Health and Safety pages 78 - 79 and will only comment on parts where we have any exceptions. Otherwise, this indicates that we agree with the response.

On page 66, the response refers to the SA EPA and Resonate Acoustics report and mentions that the report concluded "that the level of infrasound from wind turbines is insignificant and no different to any other source of noise", We agree that the report concludes as per the second statement in the sentence and point out that the report states also that "the contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment".

On page 79, a submission is quoted that statesthe issue is stated as "There is now significant national and international research and disquiet indicating that an undeniable health problem exists for people whose residences are sited in close proximity to industrial turbines". We take exception to this submission with respect to the term "undeniable" and to the undefined "close proximity". It is further stated in the submission that "Undoubtedly, there are multifactorial causes, but the most consistently demonstrated association is that of intrusive noise both audible and inaudible." Again we take exception to the term in the submission "undoubtedly" in this context and question where is the evidence to support the term "most consistently demonstrated association"?

In response to this issue, the proponent response quotes one reference which was in press at the time of writing the response. This reference is now published and is Crichton, F; Dodd, G; Schmid, G; Gamble, G; and Petrie, K.J. Can Expectations Produce Symptoms From Infrasound Associated With Wind Turbines? Health Psychology, Mar 11, 2013.

The reviewer agrees with the responses outlined in this Preferred Project and Submissions report.

11 MDA Collector Response to Peer Review Requests

On 9 April, 2013, the proponent provided a MDA response to the issues raised earlier in this review. The queries raised by the Reviewer were broadly related to questions relating to noise sensitive receiver locations, noise predictions and background noise level data.

The proponent, through MDA, has addressed all the questions raised apart from one minor clarification. MDA explained that the 34 dwellings identified were all within 3 km of the project site. They have not yet explained why the distance chosen was 3 km.

Based on the clarifications provided, the Reviewer is happy that the Proponent via MDA has satisfied the requirements of the DG and of SA03.

12 Conclusion and Recommendations

We have reviewed the Proponent reports and reports critical of the proponent's reports. We find that MDA has provided a very comprehensive report and that they have fulfilled the requirements of the DG.

In summary, we do not believe that the criticisms by AG of the MDA report are sustained. We have found many technical issues with the AG report that challenge the validity of the AG conclusions.

In terms of the SA03, Guidelines, the Collector Wind Farm impact will be marginal and acceptable. With respect to the stakeholder receiver N, the WHO recommended outdoor noise limit of 45 dBA (after adjustment for tonality) will be marginally exceeded but the stakeholder has signed an agreement in favour of landscaping and insulation measures to achieve suitable indoor levels. This approach is satisfactory.

13 References

Leventhall H. G., Kyriakides K. (1976) “Environmental Infrasound: its Occurrence and Measurement” in *Infrasound and Low Frequency Vibration* edited by W. Tempest, Academic Press, London, 1 - 18.

Bryan M.E. (1976) “Low Frequency Noise Annoyance” in *Infrasound and Low Frequency Vibration* edited by W. Tempest, Academic Press, London 65 – 96.

South Australian EPA and Resonate Acoustics “Infrasound Levels Near Windfarms and in Other Environments” January 2013