DEVELOPMENT APPLICATION

RESPONSE TO MINISTERIAL INFORMATION REQUEST

Mount Emerald Wind Farm

September 2014

PORT BAJOOL creating communities on the tropical tablelands

RATCH-Australia Corporation

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ATTACHMENTS

REFERENCES

1 DEFRA (UK) report NANR116: *'Open/closed window research'* (April 2007)

2 A.Bullmore, J.Adcock, M.Jiggins, M.Cand *Wind Farm Noise Predictions: The Risks of Conservatism*. Second International Meeting on Wind Turbine Noise, France 2007

3 Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effects (http://tinyurl.com/RUK-OAM-Report)

A. INTRODUCTION

This report has been prepared in response to each specific item contained within an Information Requests issued by the Department of State development Infrastructure and Planning (DSDIP), following the decision by the minister to "call-in" the project on 11 June 2014.

B. ECONOMIC

1. ***Provide a brief overview and context for this development within the broader Far North Queensland region and local (Mareeba Shire/Tablelands) economy, identifying key industries and employment, unemployment rates, basic socio-economic characteristics of its people or households and population growth projections. This information is readily available from council's published information and ABS data***.

A detailed response to this request is provided in Attachment A – Socio-economic Baseline and Market Analysis.

The description of the existing socio-economic environment provides a baseline of the key socio-economic characteristics and conditions of the study area from which potential impacts of the project can be assessed, including:

- Review of existing State and local government strategies relevant to the economic environment of the study area.
- Analysis of population, demographic and housing indicators, based on the review of existing available data for the study area.
- Analysis of economic information, including data relating to industry, employment and income and information on business and industry near the project.

The description of the existing economic environment principally draws on data and information from the Australian Bureau of Statistics (ABS) 2011 Census of Population and Housing. This is supplemented with data and information from:

- Queensland Government Statistician, relating to population projections.
- Local government websites of Tablelands Region and Mareeba Shire, relating to historical and existing regional context and land uses.
- National Institute of Economic and Industry Research, relating to data on Gross Regional Products and business counts.

The key characteristics of the study areas – Atherton and Mareeba localities, Tablelands region and broader Far North Queensland region include:

- A residential population of about 21,618 people in the Atherton and Mareeba SA2s, (Study Area) comprising about 46.8 per cent of the Tablelands region population, at 46,175 people. The Tablelands region population is growing at a rate slower than the broader Far North Queensland population. Major projects such as the Mount Emerald Wind Farm can help to retain population by providing medium and long-term employment and income opportunities for existing businesses and residents, or by encouraging new residents to move to the region for employment.
- High levels of cultural diversity compared with Queensland as a whole, and lower levels of cultural diversity compared with the Far North Queensland region. In particular, Mareeba

had a high proportion of people who were Indigenous and spoke a language other than English at home.

- Low levels of population mobility and high proportions of home ownership, indicating a relatively stable population. Housing costs are similar to Far North Queensland, although weekly rent was generally higher in Mareeba and Atherton compared with Tablelands region.
- Relatively low levels of socio-economic advantage, indicated by low rates of labour force participation, higher levels of unemployment compared with Far North Queensland, high proportions of low income households and low levels of access to economic resources. The project would provide employment opportunities for local people, and options for local farmers to supplement their income through casual work, machinery hire or labour hire. The occupation and skills set of the population suggest the Tablelands region is able to provide workers with generic trade, labouring, machinery operation, and accommodation and food services skills that would support the project.
- Businesses and industry concentrated in the primary industries, construction industry and services sectors such as tourism and aged care, and a GRP that is growing at a rate slower than Queensland overall. There are a number of businesses in the industry sectors that could benefit from the project, particularly in the construction, manufacturing, accommodation and food services and agricultural sectors.

2. ***Provide an overview analysis of Queensland's renewable energy markets and mix, with particular emphasis on the current and future role of wind in meeting renewable energy targets, and the proposed development's potential contribution in meeting state and national renewable energy targets***.

A detailed response to this request is provided in Attachment A – Socio-economic Baseline and Market Analysis.

The market analysis draws on publicly available information to collect data on the role of wind in meeting renewable energy targets in Queensland. Key sources of information include:

- Policy options for increasing the uptake of renewable generation in Queensland: A submission to the Queensland Environment and Resources Committee on behalf of Sucrogen Pty Ltd (2010), Roam Consulting Pty Ltd and Synergies Economic Consulting Pty Ltd.
- Mandatory Renewable Energy Target scheme (2010), Australian Government Department of the Environment.
- Queensland Renewable Energy Plan 2012 (2012), Queensland Government.
- Federal Large-scale Renewable Energy Target (2013), Australian Government Department of the Environment.

Key findings of this analysis are:

- Renewable energy projects are strategically supported by regional policy. The Tropical North Queensland Renewable Energy Industry Development Plan provides a pathway for co-ordinated development of the renewable industry in the Tropical North Queensland region and acknowledges that a key area of wind resource in the region is located on the Atherton Tablelands, between the localities of Atherton and Mareeba.
- Queensland's large-scale renewable energy market has generally lagged behind most of Australia's other states in terms of large-scale renewable energy investment over the past fifteen years with most of Queensland's renewable energy is sourced from bagasse and hydro resources. The Queensland Government released the Queensland Renewable Energy

Plan (QREP) as a means of securing Queensland's share of investment and jobs that would be stimulated by the Federal renewable energy target.

- It is unlikely Queensland will meet the goals of the 2012 QREP, evidenced by the relative lack of activity in Queensland's large-scale renewable sector since the inception of the expanded RET. The lack of progress in large-scale renewable development in Queensland means that it is more critical than ever for renewable projects in the State to proceed.
- Wind capacity in Queensland will play a vital role in meeting the objectives of the QREP 2012. Wind turbines, along with generation from bagasse, are the two most prospective large-scale renewable generation technologies in Queensland that can deliver large volumes of renewable energy. However, the number of feasible bagasse projects located in Queensland is somewhat limited, although there is at least three times as much prospective wind capacity in Queensland that could feasibly be developed.

3. ***Provide a discussion of the state of play in the regulatory environment for renewable energy and outline the implications for the project's development prospects (best case - worst case) in light of the current high level of uncertainty***.

The current uncertainty in the regulatory environment for renewable energy is focussed on the Renewable Energy Target (RET) and its review and future prospects.

The Mount Emerald project will be subject to the federal government RET scheme, just like any other renewable power station throughout the country, whether it be a wind farm, hydro plant or even solar panels on your roof.

Most jurisdictions world-wide do have governmental incentives to support more rapid transition to less harmful and not well entrenched technologies such as wind and solar generation. In Australia, this is provided through the RET Scheme.

Incentives for renewables help level the playing field. They match and exceed existing market distortions favouring traditional forms of fossil fuel generation and attempt to account for the un-costed negative impacts (pollution) whilst providing an incubator environment to allow supply chains, manufacturing and labour forces to grow with greater certainty.

What is the RET – The Renewable Energy Target or RET; is a federal government initiative which has the ultimate goal of seeing 20% of Australia's electricity generation sourced from renewable energy by 2020. To accomplish this; for each unit of electricity (Megawatt hour) produced by a credited renewable power station a renewable energy credit is created. At the end of each year, electricity retailers must surrender a number of these credits equivalent to the target percentage of their customer base. Credits can be bought directly from the power station owner (just like the electricity) or from an open market. The addition of the credit allows renewable power to compete with traditional sources such as coal and gas which are cheaper but do not take account of their pollution.

> **Level Playing Field** – In Australia, both state and federal governments provide subsidies to the coal industry. Direct subsidies include coal terminal lease fees and providing infrastructure (road and rail) so coal can be transported to electricity generators or to port loading facilities.
>
> The whole mining industry receives a subsidy in the form of a tax credit on the diesel used in trucks and machinery. Mining companies do not pay the federal government tax on fuel. This subsidy currently amounts to $2 billion a year or an $87 annual contribution from every Australian[A]. ([A] - *The real cost of coal is quickly adding up*, University of Sydney – Faculty of Arts and Social Sciences – Linda Connor and Stuart Rosewarne, 21 May 2012).

Historically, coal fired power stations in Australia have been developed, constructed and owned by the respective state government. As part of this development fuel supply contracts were agreed at rates much lower than market rates. For example, the New South Wales government had the opportunity to have a major coal seam developed by the private sector at full market prices. Whitehaven Coal offered to provide coal at $55 / tonne, but assessment found this fair market price would raise the price of electricity considerably. The NSW government undertook to develop the coal seam itself for $1.5 billion and sell coal to the electrical generators at an artificially low price of $31.16 per tonne. As such, is committing to a loss of economic value on each tonne of coal it produces, thus providing a pseudo subsidy to coal-fueled electricity.

The removal of the RET scheme would see the project become uneconomic in the short-term (10 years), as a suitable power price for the energy generated by the wind farm would not be available to support a viable financial case.

However, if fuel sources such as coal and gas continue to increase in cost and hence the base price paid for electricity generation also increases, then it is possible the project will become viable again further into the future.

The concept of the removal of the RET on residential electricity prices is also interesting.

In the report "Estimated energy costs for 2013-14 retail tariffs", commissioned by the state government, Queensland Competition Authority (QCA), it estimated the cost of complying with the RET to a consumer to be $4.15/MWh. For an average household using 6.6MWh/year this equates to $27 or a little over $2/month. This report was written by expert economic consultants (ACIL Tasman) and was reviewed by further experts Frontier Economics. It should be noted, this cost is already included in a household electricity bill and has been since the scheme commenced in 2001.

C. NOISE

4. ***Provide an A3 plan showing numbered receptors, the most current aerial/ satellite imagery for the area, the current cadastral boundaries, and the six noise contour modelling scenarios, plus further wind speed increments to 12 m/ s. Only three proposed scenarios have been provided instead of the six requested and the requested overlays on aerial photos have not been provided. All six noise modelling scenarios identified should be provided. This should include labelling or evidence that the noise contour maps have been calculated for the additional 12 m/ s wind speed increments.***

Updated Noise Contour Modelling is provided as Attachment B.

5. ***The Noise Assessment report has nominated an indoors/ outdoors noise reduction level of l0dB, and a 20dB reduction for air conditioned dwellings. A reasonable outside to inside limit is critical to the assessment of this development and therefore, field assessments should be carried out at a sample of affected or similar receivers to confirm the outside to inside linear (dB(Z)) and dB(A)) noise reduction as originally requested.***

Following discussions with Department of State Development, Infrastructure and Planning representatives regarding the noise impact assessment works the proponent was asked to undertake a review of the dwelling structures in the vicinity of the proposed Mount Emerald wind farm to assist in determining appropriate building sound attenuation levels.

In undertaking this review a representative batch of dwellings in relative proximity to the wind farm were photographed and an assessment made as to the basic components comprising the structure of each. Confirmation was also made as to whether a dwelling included air conditioning.

The locations of the assessed dwellings are shown in the figure below.

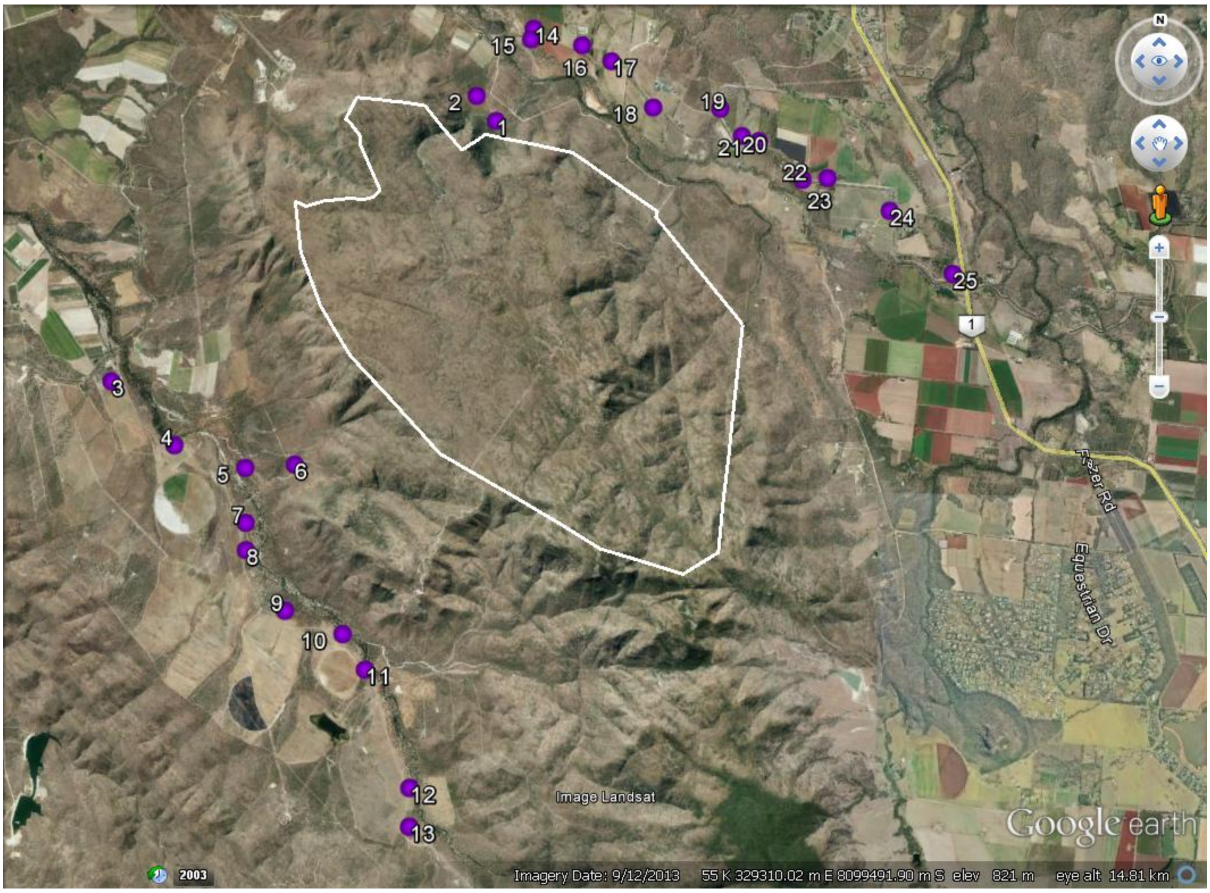

Figure 1 – Location of representative dwellings in relation to project site

Using this information along with some basic assumptions, an estimate of the sound attenuation through the building structure can be made using the method as outlined in Australian Standard *AS3671 Acoustics – Road traffic noise intrusion – Building siting and construction*.

Unless otherwise noted it was assumed for each dwelling;

- Critical room - Bedroom - located centrally within the dwelling with one external wall only (i.e. not a corner of the structure). This typically provides for lower attenuation than for a corner room.
- The size of the room was 5m by 4m with the external wall being 5m
- a ceiling height of 2.7m

The results of the site investigation and the attenuation estimations are provided for each location in the table below. A more detailed account of each assessment can be found in Attachment C.

Location	Structure Type	Air-conditioning	Distance to nearest WTG (63 WTG Layout)	Estimated Sound Attenuation with windows open dB(A)	Estimated Sound Attenuation with windows closed dB(A)
1	steel/timber clad		1,407	18	33
2	steel clad		1,668	15	19
3	rendered brick		3,257	21	35
4	rendered brick	YES	2,887	18	34
5	timber clad		2,279	18	33
6	rendered brick	YES	1,739	16	34
7	rendered brick	YES	2,751	15	35
8	rendered brick	YES	2,994	17	34
9	steel clad shed		3,192	15	17
10	rendered brick	YES	2,894	18	34
11	steel clad shed		3,152	13	23
12	rendered brick	YES	4,182	18	34
13	rendered brick	YES	4,613	18	34
14	rendered brick	YES	2,608	16	34
15	timber clad		2,462	19	33
16	masonry block		2,436	17	33
17	timber clad		2,265	18	33
18	timber clad		1,897	19	32
19	timber clad	YES	2,527	15	31
20	masonry block	YES	2,577	18	34
21	rendered brick		2,756	14	33
22	masonry block		2,947	16	34
23	steel clad		3,235	18	33
24	masonry block		3,767	18	34
25	masonry block		4,383	17	33

A summary of the findings can be group into four distinct structure types.

Structure Type	Number	With Air Conditioning	Min. Sound Attenuation with windows open dB(A)	Min. Sound Attenuation with windows closed dB(A)
Cladding (steel, timber or fibre sheeting)	8	1	15	19
Rendered Brick	10	8	14	33
Masonry Block	5	1	16	33
Shed	2	0	13	17
TOTAL	**25**	**10**	**13**	**17**

Reasonable Outside to Inside Sound Reduction and Appropriate Noise Limit

The *Environmental Protection (Noise) Policy 2008* (QEPP) in Schedule 1 notes an acoustic objective of 50dBA for a dwellings outdoors and 35dBA for a dwelling indoors during the daytime and evening; a difference of 15dBA. While not specifically noting a night-time outdoor value, given the structure of the dwelling will not change from daytime and evening to night-time it is practical to assume the indoor/outdoor 15dBA reduction will remain.

Thus, under the objectives set out in the QEPP a Sound Attenuation Value of 15dBA should be adopted.

Column 1	**Column 2**	**Column 3**			**Column 4**
Sensitive receptor	**Time of day**	**Acoustic quality objectives (measured at the receptor) dB**			**Environmental value**
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
dwelling (for outdoors)	daytime and evening	50	55	65	Health and wellbeing
dwelling (for indoors)	daytime and evening	35	40	45	Health and wellbeing
	night-time	30	35	40	Health and wellbeing in relation to the ability to sleep

Table 1 - Environmental Protection (Noise) Policy 2008 - Schedule 1 – Acoustic quality objectives

In noise assessments conducted as part of the development of the Mount Emerald wind farm a conservative assumption has been made for a sound attenuation value (indoor/outdoor noise reduction) of 10dBA, with windows open and 20dBA with windows closed. In determining an appropriate noise limit, only the lower 10dBA reduction is used as there is no way to determine when windows would be open or closed.

From the review of the dwelling types around the wind farm site the worst case is a reduction of 13dBA. It is noted this is less than the assumption made in QEPP but greater than the assumption adopted for the project noise assessments, and as such a 10dBA sound attenuation is considered to be appropriate.

By applying the 10dBA sound attenuation value to the minimum noise limit of 30dBA, as noted in QEPP for inside a dwelling at night, an overall outdoor limit of 40dBA is obtained. This is the value to which the wind farm has been designed and generally aligns with the limit as set out in the other applicable standard *NZS6808:2010 Acoustics – Wind farm noise*.

6. ***Background Noise Level v Wind Speed graphs for R06 and R16 have been provided but no regressions lines are included on R16. This information should be up-dated and provided.***

Updated background noise level v the wind speed graphs along with the calculated regression lines are contained in Attachment E – Appendix A.

7. ***Provide correlation between wind speed at the residence and wind speed at the towers. This needs to be provided in tabular form or similar.***

It is difficult to understand the relevance of the request for wind data at the residence. When conducting background noise measurements, the noise levels at the residence are recorded against the wind speed from the proposed site at the particular point in time. The site wind speeds are also used to provide the estimate of wind farm noise and thus compared to the background at the residence. This can be done as sound emitted from a wind turbine is known from field measurements and is guaranteed by the manufacturer for the range of wind speeds at the turbine. In this regard the actual wind speed at the residence affecting the background noise level at the particular point in time is not relevant.

Given the reliance on site wind data, no wind data records were collected at the background monitoring locations.

To provide a response to the information request a nearby Bureau of Meteorology (BoM) site was used as a representative of the surrounding district. The most suitable site was the Mareeba BoM located at the airport some 15km from the site. This site was chosen over the closer Walkamin BoM as it provided for a longer period of automatic data collection.

A table showing the various correlations and plots of wind speeds and directions during the monitoring period are shown below.

CORRELATION of WIND SPEED DATA Period 19/5/2011 – 18/6/2011						
Location		**80m tower**		**50m tower**		**Mareeba**
	Height agl.	**80m**	**10m**	**50m**	**10m**	**10m**
80m tower	**80m**		95.6%	82.4%	76.0%	25.9%
	10m	95.6%		84.0%	82.2%	24.6%
50m tower	**50m**	82.4%	84.0%		96.0%	15.8%
	10m	76.0%	82.2%	96.0%		14.8%
Mareeba	**10m**	25.9%	24.6%	15.8%	14.8%	

Table 2 – Correlation of wind speed data during the background noise monitoring period

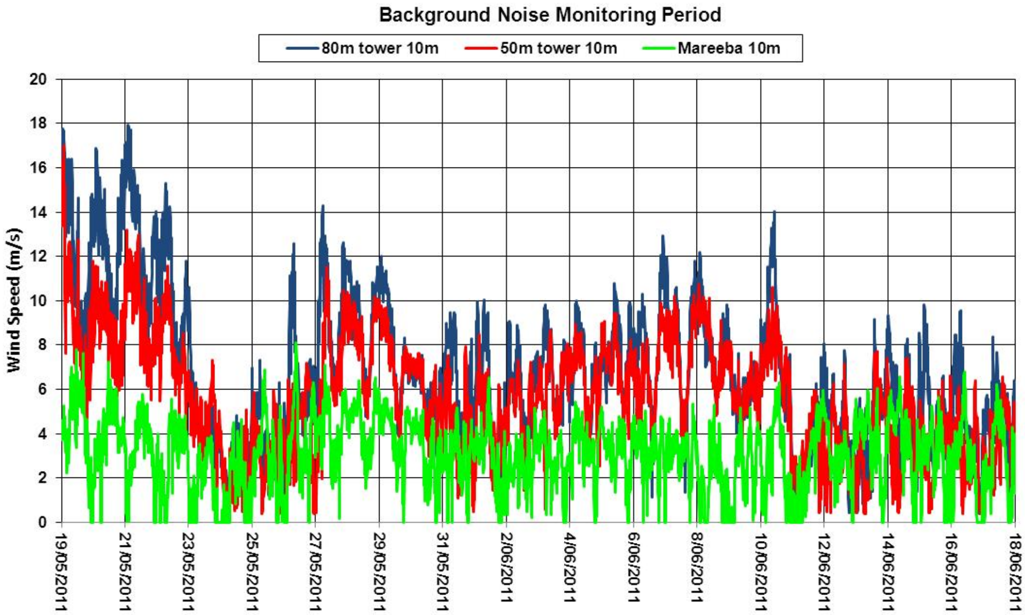

Figure 2: Wind Speeds during the background noise monitoring period

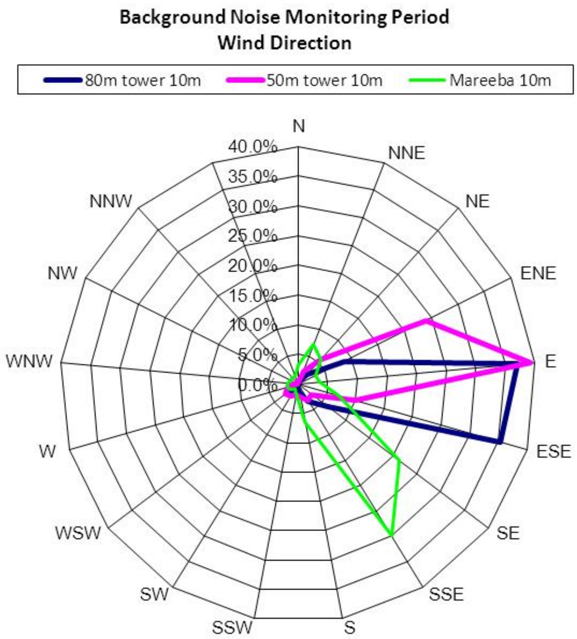

Figure 3: Wind Direction Rose for background noise monitoring period

8. ***The current draft Queensland planning guideline for wind farms recommends a limit of 35 dB(A) rather than 40 dB(A) for audible noise. In addition NZS 6808:20109 (referenced in the Mareeba Shire Planning Scheme) prescribes that if there is a difference of 8 dB or more between evening and night-time then the higher amenity criteria of 35 dB(A) should be applied. This does not appear to have been investigated in the report. To assess this averaged background noise levels for evening and night time at the receiver, monitoring locations should be provided and an assessment undertaken against the identified standard.***

It is important to recognise that there are several aspects involved in evaluating the relevance of the High Amenity criteria. Low background noise levels alone are not a sufficient justification for the reduced high amenity noise limit.

Section 5.3.1 of NZS6808:2010 states that the baseline noise limit of 40dBA 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.*

The definition of a high amenity area provided in NZS6808:2010 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 Queensland. In this regard, Section 4.1 of Attachment D comments:

> […] *NZS6808:2010 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 […]."*
>
> *We have reviewed the applicable planning documents for the Mareeba Shire Council, Atherton Shire Council and Tablelands Regional Council with a summary of this review provided in Appendix D. Across these three planning schemes, the land for the proposed MEWF and surrounding area is generally zoned for primary or rural production activities, typically with a rural zoning.*
>
> *It is considered that the identified zonings do no promote a higher degree of protection of amenity related to the sound environment. On this basis, a 40 dB L_{Aeq} base noise level limit is used for this noise assessment and the high amenity noise limit has not been applied.*

Notwithstanding this, further information relating to the High Amenity criteria detailed in Section 5.3 of NZS6808:2010 is presented below.

Informative analysis

For the case that planning documents promote a higher degree of protection of amenity, Comment C5.3.1 of NZS6808:2010 provides guidance to assess whether a high amenity noise limit is applicable. A summary of C5.3.1 is provided below:

- Only noise sensitive locations within the 35dBA noise contour should be considered
- Justification for a reduced high amenity noise limit is based on a comparison of background sound levels and predicted wind farm sound levels at a noise sensitive location. This comparison is commonly described as the Noise Perception Index (NPI)[1]
- If the NPI is less than 8dB then a high amenity noise limit is unlikely to be justified
- If the NPI is greater than 8dB then a high amenity noise limit is likely to be justified

Calculated NPI values using the background noise level analysis are presented in Attachment E - Appendix A and revised predicted wind farm noise levels, presented in Attachment E - Appendix B. The NPI method involves:

1. Identifying and separating evening and night-time measurements from the available background sound level data
2. For each identified 10 minute time interval, estimating the post-construction sound level by summing the measured background sound level and the predicted wind farm sound level. Note that this requires an assessment of predicted wind farm sound levels across a full range of wind speeds, from turbine cut-in up to the maximum wind speed measured during the assessment.
3. Comparing the estimated post-construction sound level with the measured background sound level.
4. Averaging the set of differences in Step 3 to determine the NPI.

Wind farm predicted sound levels at low wind speeds

Attachment D details available sound power level data for the proposed turbines. This data has been provided for the hub height wind speed range 8 m/s to 14 m/s. As noted in Step 3 of the NPI method, wind farm sound levels also need to be quantified at wind speeds below 8 m/s. In the absence of any manufacturer data for lower wind speeds, this assessment of NPI is based on extrapolated sound power level data, as illustrated in Figure 4.

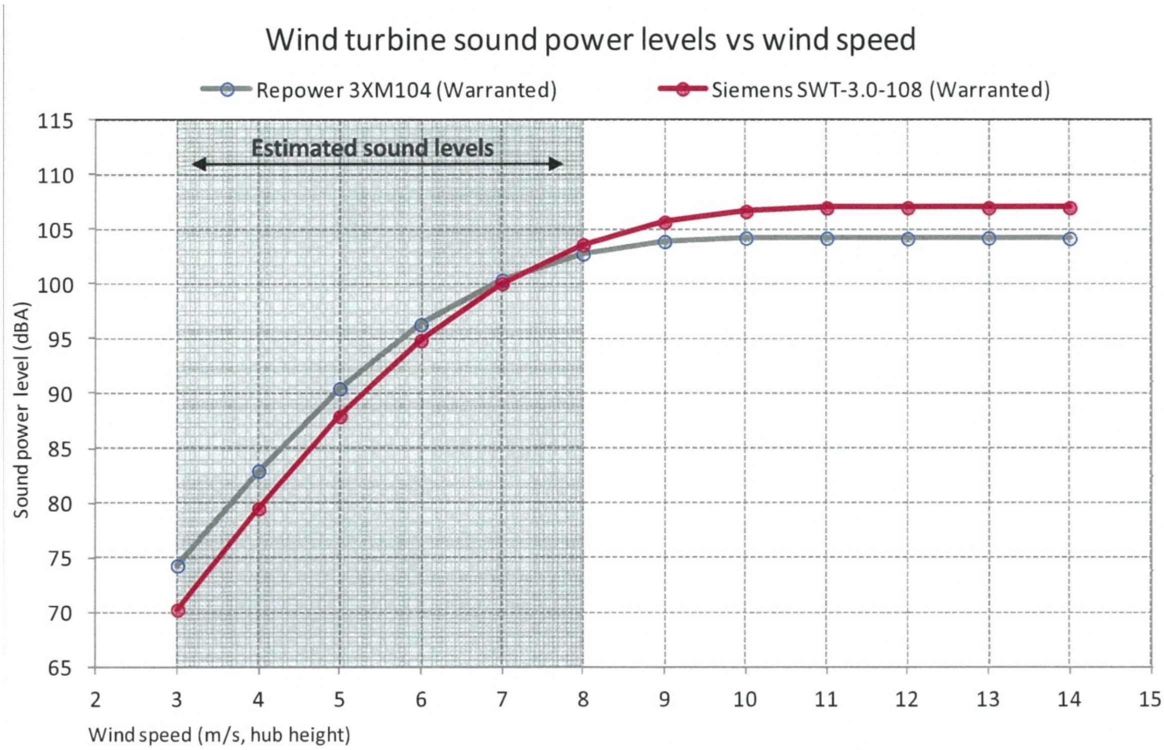

Figure 4: Turbine sound power level data, including estimated levels at low wind speeds

Wind speed range

The NZS6808:2010 method recommends that the 'background and wind farm sound levels should be for a range of wind conditions representative of long-term wind sampling at the wind farm.' Accordingly, this assessment uses all available data for evening and night-time periods, including periods with wind speeds below cut-in and above rated power.

Quantity of data

Analogous to the regression analysis presented in Attachment E - Appendix A, where typically at least 1400-2000 data points are required by guideline documents to provide a robust assessment, evaluating the NPI also requires a suitable quantity of data. NZS6808:2010 recommends that this "*should typically be in excess of 540 data points at night*". Correspondingly, we would expect that at least 240 data points are suitable for the evening period.

Results

For each of the background monitoring locations, calculated NPIs are presented in Table 3 and Table 4 for two (2) proposed turbine types.

Table 3: Calculated NPI for the REPower 3XM104 turbine

Location	Evening		Night-time	
	NPI	No. of data points	NPI	No. of data points
R05	-	29*	**10.60**	**334**
R06	3.57	336	6.94	745
R16	0.51	336	2.62	745
R26	1.12	672	3.27	1500
R31	0.54	336	1.74	761
R32	1.30	336	2.86	755

*NPI not calculated, insufficient data

Table 4: Calculated NPI for the Siemens SWT-3.0 108 turbine

Location	Evening		Night-time	
	NPI	No. of data points	NPI	No. of data points
R05	-	29*	**9.98**	**334**
R06	3.68	336	7.05	745
R16	0.59	336	2.79	745
R26	1.07	672	3.31	1500
R31	0.46	336	1.71	761
R32	1.21	336	2.73	755

*NPI not calculated, insufficient data

The calculated NPI for location R05 is not presented for the evening period due to insufficient data. For the night-time period, the NPI exceeds the NZS6808:2010 8dB threshold. However, this assessment has only been able to include 334 data points, which is less than the guideline quantity nominated in NZS6808:2010. Accordingly, we consider that this result should be treated as provisional, and that additional background noise monitoring be considered at this location.

The calculated NPI for location R06 is approximately 7dB for the night-time period, for both turbine types considered. As this is only moderately less than the NZS6808:2010 threshold, variations in sound power level data at low wind speeds or layout adjustments could significantly impact on the NPI assessment results, potentially causing it to exceed 8dB.

The calculated NPI for locations R16, R26, R31 and R32 are all comparatively low, at least 4 decibels below the 8 dB NPI threshold detailed in NZS6808:2010.

Comments

As noted in Attachment E - Appendix C1, we do not consider that the planning scheme zoning relevant for receiver locations, neighbouring the proposed Mt Emerald Wind Farm, promote a higher degree of amenity protection. On this basis, we consider that the High Amenity criteria detailed in Section 5.3 of NZS6808:2010 are not applicable.

To satisfy the request for information, we have carried out an NPI assessment using available background noise level data and wind farm noise predictions. This assessment indicates that at five of the six monitoring locations the NPI is less than the 8dB threshold nominated in the New Zealand Standard, which further indicates that High Amenity criteria are not applicable.

At one of the background noise monitoring locations, only a limited quantity of evening and night-time data is available for the assessment, due to much of the collected data being affected by a local, mechanical noise source and as such removed from analysis. Based on this reduced data set, the calculated NPI is greater than the 8dB threshold.

It is expected a further round of background noise monitoring will be conducted following project approval, but prior to commencement of construction. This work will be required as part of the performance testing and compliance assessment as required under the wind turbine supply contract. This work should provide for the collection of sufficient data to allow the NPI to be reassessed.

9. ***Provide information regarding the proportion of nearby receivers that are currently air- conditioned.***

Please refer to the response to Information Request 5.

10. ***Presentation of the weather data to clearly show variation between seasons at the noise monitoring locations as relevant to the noise assessment.***

Attachment F - 2 year Data Verification Report for tower 9530 and Attachment F - 2 year Data Verification Report for tower 9531, contain a Long-term Bureau of Meteorology (BoM) Comparison with the nearby Walkamin Research Station which shows the average monthly wind speeds for each location.

It is reasonable assumption for Walkamin Research Station to represent the long-term weather pattern of the surrounding district.

11. ***12 months of continuous, time indexed, wind direction and speed data for the two Mt Emerald monitoring masts, and equivalent Figure 18 - Analysis of Wind Data plots has been provided. A comparison of mast wind speed data to measured receiver wind speed data is required for the noise monitoring period. This information was not evident from the additional information supplied and should be supplied.***

Please refer to Attachment F - 2 year Data Verification Report for tower 9530 and Attachment F - 2 year Data Verification Report for tower 9531, for information on on-site measurement masts.

12. ***Further justification of accuracy of modelling based on environmental conditions is required, rather than the assumption that all variability will be based on turbine sound power level fluctuations. For example, wind turbine noise can typically vary by up to 5 dB(A) from that predicted using ISO 9613.2:1996.***

Information contained within Attachment D - Appendix E of the Mt Emerald Wind Farm Noise Impact Assessment (Marshall Day Acoustics 16 April 2014) provides information on the noise prediction model.

13. ***Provide averaged measured noise levels for day, evening and night-time periods for each monitoring location.***

Attachment E – Appendix D contains a review of background noise levels considering time of day. Representative levels are provided below in Table 5.

Table 5: Representative levels for different daytime periods

Location	L_{Aeq}			L_{A90}			L_{A10}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
R05	54	54	51	22	49	17	57	58	57
R05**	47	47	40	20	18	16	47	51	39
R06	44	36	37	25	22	20	47	40	41
R16	51	46	37	26	33	25	43	50	43
R26	48	45	40	26	26	25	44	50	46
R31	48	44	39	29	30	27	47	49	43
R32	41	42	39	28	30	29	46	46	44

Day 0700 hrs to 1800 hrs
Evening 1800 hrs to 2200 hrs
Night 2200 hrs to 0700 hrs
** Likely extraneous noise removed.

For noise levels for daytime periods with consideration of wind speed, refer to Attachment E – Appendix A, as described in Information Request Response 6.

14. ***Demonstrate how the development will achieve the requirements of Part 2 and 3 of the Environmental Protection (Noise) Policy 2008. The report should also consider the Department of Environment and Resource Management guidelines - Planning for Noise Control.***

Part 2 and 3 of the Environmental Protection (Noise) Policy 2008 (QEPP)

Purpose of the QEPP

The purpose of the QEPP is stated in Part 2 of the policy as follows:

The purpose of this policy is to achieve the object of the Act in relation to the acoustic environment.

In turn, the *Environmental Protection Act 1994* (the Act) states the following:

The object of this Act is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).

An important aspect of the objective of the Act is the concept of balancing the protection of the environment with the need for beneficial development. This is an approach adopted in noise management policies throughout Australia.

The way in which the purpose of the QEPP is achieved is detailed in Part 2, Item 6 of the policy, titled *How purpose of policy is achieved*, which states:

The purpose of this policy is achieved by—

a) identifying environmental values to be enhanced or protected; and

b) stating acoustic quality objectives for enhancing or protecting the environmental values; and

c) *providing a framework for making consistent, equitable and informed decisions about the acoustic environment.*

Item 7 from Part 3 of the QEPP identifies the environmental values for the acoustic environment, noting:

The environmental values to be enhanced or protected under this policy are —

[…]

(b) the qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following —

(i) sleep;

(ii) study or learn;

(iii) be involved in recreation, including relaxation and conversation; and

(c) the qualities of the acoustic environment that are conducive to protecting the amenity of the community.

NZS 6808: Purpose and consistency with QEPP

The foreword of NZS 6808:2010 outlines the overall purpose of the document as follows:

The purpose of this Standard is to provide suitable methods for the prediction, measurement, and assessment of sound from wind turbines. These methods may be applied during the processes of planning and developing a wind farm, then for confirming compliance with resource consent conditions covering sound levels, and also for the investigation and assessment of noise complaints about operating wind farms.

The foreword of NZS 6808:2010 provides further explanation of the intentions of the assessment methodology as follows:

Wind farm sound may be audible at times at noise sensitive locations, and this Standard does not set limits that provide absolute protection for residents from audible wind farm sound. Guidance is provided on noise limits that are considered reasonable for protecting sleep and amenity from wind farm sound received at noise sensitive locations.

The foreword of the Standard then goes on to note that the consensus view of the committee responsible for the development of NZS 6808:2010, including representatives from New Zealand's Ministry of Health and Institute of Environmental Health Inc., 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 farm.

In terms of the types of sensitive uses that the NZS 6808:2010 was designed to protect, the Standard defines the criteria which are applicable to locations termed *noise sensitive locations*. The definition of noise sensitive locations is stated to include the following:

The location of a noise sensitive activity, associated with a habitable space or education space in a building not on the wind farm site. Noise sensitive locations include:

a) *Any part of land zoned predominantly for residential use in a district plan;*

b) *Any point within the notional boundary of buildings containing spaces defined in (c) to (f);*

c) *Any habitable space in a residential building including rest homes or groups of buildings for the elderly or people with disabilities*

d) *Teaching areas and sleeping rooms in educational institutions*

e) *Teaching areas and sleeping rooms in buildings for licensed kindergartens, childcare, and day-care centres; and*

f) *Temporary accommodation including in hotels, motels, hostels, halls of residence, boarding houses, and guest houses.*

In some instances holiday cabins and camping grounds might be considered as noise sensitive locations. Matters to be considered include whether it is an established activity with existing rights.

Based on the above stated purpose, intent and scope of NZS 6808, the following points of similarity with the QEPP are noted:

- NZS 6808:2010 is intended to provide a reasonable level of protection for the environment, consistent with the QEPP and parent Act's objective to protect the environment while allowing for beneficial development;
- NZS 6808:2010 sets out values of the environment to be protected; these values are the acoustic amenity for a range of residential and educational sensitive uses, which are comparable to the QEPP's statement of acoustic qualities that are conducive to human health; and
- NZS 6808:2010 sets out objective criteria specifically intended for the reasonable protection of amenity for recreation, rest and conversation, as per the environmental values of the QEPP.

Operational wind farms are a unique type of noise source that require dedicated assessment methodologies; in particular, methods that are suited to the quiet rural locations in which wind farms are usually developed, and methods that account for the complicating influence of wind speed on background and source noise levels. In the absence of an endorsed state-wide assessment procedure that is specific to wind farms, and in recognition of the reference to NZS 6808 in the local planning scheme, the use of NZS 6808:2010 represents an assessment procedure which is consistent with, and therefore achieves the objectives of, Part 2 and 3 of the QEPP.

QEPP & NZS 6808:2010 – Approach to Noise Management

In addition to the comparison of objectives and intents detailed in the preceding section, a discussion of the equivalence of noise management between the QEPP and NZS 6808:2010 has previously been detailed in Attachment D, Section C4 of Appendix C. For ease of reference, relevant sections of this discussion are reproduced here:

The assessment of wind farm noise detailed in NZS6808:2010 […] *involves measurements of the $L_{A90,10min}$ noise descriptor. It can also involve a regression analysis of two weeks or more of noise data correlated with wind speeds at the wind farm to establish variations in noise level with wind speed. This approach differs significantly from the more general noise assessment methods and guidance provided in the Queensland Government's state noise policies. While this means that a direct comparison of the wind farm noise and general noise guidelines is not practicable there is, nonetheless, a degree of commonality across the various documents.*

For example, NZS6808:2010 nominates a base noise level of 40 dB $L_{Aeq,10min}$, which is applicable outside of dwellings neighbouring a wind farm. Allowing for a sound reduction of 10-15 dB through an open window[1]*, an estimated base noise limit of 25-30 dB L_{Aeq} would apply inside a dwelling, for example, in a bedroom. While a direct comparison with Queensland's acoustic quality objective is not practicable due to differences in noise* *descriptor, it can be noted that the NZS6808:2010 approach is broadly consistent with the lowest acoustic quality objective of 30 dB $L_{Aeq,adj,1hr}$ for dwellings indoors during night-time.*

Similarly, in relation to variation in background noise levels, NZS6808:2010 provides a mechanism for wind farm noise to be up to 5dB higher than the background noise level ($L_{A90,10min}$) except in low noise level conditions where the base noise level would apply. As wind farms do not operate during periods of little or no wind and the noise from wind farms is, on average, significantly reduced under conditions where the wind blows from a receiver to the wind farm (that is, the receiver is upwind), wind farms could be considered a non-continuous noise source in the context of the EPP Noise 2008.

Section 10 Item 2(b) of the EPP Noise 2008 allows for a 5dB margin above the background noise level ($L_{A90,T}$) as a means of controlling background creep from non-continuous sources. Again differences in noise descriptors mean direct comparison of NZS6808:2010 and the EPP Noise 2008 is not practicable. Nonetheless, the similarity of margins of the background noise levels indicates a degree of commonality across the documents.

On balance, it is considered that an assessment of audible wind farm noise in accordance with NZS6808:2010 is likely to provide an outcome that is broadly consistent with the noise management approaches described in the Queensland Government's noise policy documents. Moreover, NZS6808:2010 is better equipped to address the fundamental variations in noise level with changes in wind speed that occur with a wind farm. Accordingly, NZS6808:2010 are used herein as the primary noise assessment guidance document.

ENVIRONMENT & RESOURCE MANAGEMENT GUIDELINES - PLANNING FOR NOISE CONTROL

The guideline document *Planning for Noise Control* (PNC) published in 2004 provides information about a range of subjects including operational noise criteria for industrial and commercial operations, and details of factors to be considered in the assessment of new development including the effects of meteorological conditions on sound propagation.

In the time since the PNC guidelines were published, alternative Queensland noise criteria have been published in the *Environment Protection (Noise) Policy* 2008. The assessment of the Mount Emerald Wind Farm has therefore addressed the more recent noise criteria of the QEPP, as discussed in the preceding section. For context, it is noted that the noise criteria within the PNC guidelines set out limits that are significantly lower than the QEPP or NZS 6808:2010. Importantly, the PNC guideline limits are considerably lower than those applied to wind farm development in other jurisdictions in Australia, and which are not considered to be practically achievable. In this respect, it is noted that noise policies in Queensland and across Australia are normally defined in recognition of the specific characteristics of the noise source in question; in relation to wind farm development, the following points are noted:

- Wind farms do not operate in still wind conditions and their operation varies significantly according to wind speed and direction. In contrast, the polices applied to general types of commercial or industrial noise source must deal with the potential for sources to operate continuously at all times throughout the day and night;
- Noise policies for wind farms are specifically structured in recognition of the need to protect to neighbouring communities, while at the same time recognising the inherent practical limitations of controlling noise from an operational wind farm. The general principle of defining noise policies in recognition of the extent to which the noise can be controlled is clearly reflected in polices that are applied to other types of infrastructure which require dedicated assessment methodologies; notably road, rail and aircraft noise policies. This is consistent with the Queensland *Environment Protection Act 1994*

objective to *"protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future"*

Assessment considerations

In terms of the PNC guidance concerning factors to be addressed in a noise assessment, all relevant aspects have been factored into the Mount Emerald Wind Farm noise impact assessment. Notably, the PNC guidelines make reference to the types of factors that can affect the propagation of sound, including various types of thermal inversion conditions and wind conditions.

Atmospheric conditions are a key consideration in the assessment of operational noise levels of a wind farm. The noise levels associated with operation of the Mount Emerald wind farm have been predicted for conditions which enhance sound propagation between the wind turbines and receiver locations. Specifically, the predictions have been made using the calculation procedure specified in ISO 9613-2: 1996 *Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation* (ISO 9613-2).

ISO 9613-2 states that the standard:

> *specifies an engineering method for calculating noise at known distance from a variety of sources under meteorological conditions favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the wind blows from the source to the receiver within an angle of +/-45 degrees from a line connecting the source to the receiver, at wind speeds between approximately 1m/s and 5m/s, measured at a height of 3m to 11m above ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion.*

The use of ISO 9613-2 for the prediction of operational noise wind farm is supported by a range of international publications and reports, notably including the UK Institute of Acoustic's good practice guide on the assessment and rating of wind turbine noise.

<u>*References*</u>

[1] DEFRA (UK) report NANR116: *'Open/closed window research'* (April 2007)

15. *Manufacturer's testing conditions and methodology to determine wake effects are required.*

The specific information required to address this request was discussed with representatives of the Minister's department and was understood to primarily relate to the occurrence of an effect commonly referred to as amplitude modulation of wind farm noise.

The information provided in this response includes:

- Overview information related to wake effect considerations
- Information related to amplitude modulation

Turbine Wake Effects

Turbine wake effects are an important consideration for wind farm layout designers to factor into the arrangement and spacing of proposed turbine locations. Specifically, wake effects can potentially reduce the efficiency and reliability of the turbines; turbine arrangements and spacings are therefore chosen to reduce these effects.

To consider wake effects and their relevance to environmental noise from an operational wind farm, the following provides an overview of the way total noise levels from wind farms are modelled and occur in practice.

The prediction of environmental noise levels from an operational wind farm requires a representation of the sound emission characteristics of each wind turbine that forms part of the wind farm. This representation, referred to as the sound power level of the wind turbines, provides the basis for estimating corresponding noise levels at a distance from the turbine.

In the case of the Mount Emerald Wind Farm noise assessment (Attachment D), the sound power level data has been sourced from manufacturers and is consistent with test standard *IEC 61400-11 Wind turbine generator systems – Part 11: Acoustic noise measurement techniques.* The sound power level data represents the sound emission characteristics of a single wind turbine for a stated hub-height across a range of wind speeds.

To predict environmental noise levels from the proposed Mount Emerald Wind Farm, it has been assumed that all of the turbines of the proposed wind farm simultaneously experience the same inflow wind speed. Subsequently, it has been assumed that all turbines simultaneously emit sound power levels equivalent to the manufacturers test data. This method is consistent with the NZ 6808:2010 standard adopted in the noise impact assessment, and accepted international practice for the assessment of predicted operational wind farm noise levels.

In practice, wind speeds across the wind farm would inevitably vary, and the inflow air conditions at each turbine location will vary from the conditions in which the manufacturers test sound power data was derived. These variations may lead to changes in the sound emission characteristics of the turbines. For example, an increase in air turbulence as a result of terrain, atmospheric conditions or upwind turbines can potentially give rise to an increase in the sound emission characteristics of an individual turbine when compared to the assumed value. Conversely, the effect of upwind turbines can result in reduced wind speed at the downwind turbines compared to the assumed wind speed across the wind farm. This in turn may lower the sound emission characteristics of an individual turbine compared to the assumed value.

In considering the implications of these variations in conditions across a wind farm layout, the key point to note is that the predicted noise levels at neighbouring dwellings are the result of the combined influence of a number of turbines. The types of variations described above are unlikely to equally apply simultaneously to all of the turbines. In practice, some of the wind turbines could experience wind conditions which result in a slight increase above the assumed sound power level, whilst others could experience wind conditions which result in a slight reduction below the assumed sound power level.

Accordingly, a change in the emission characteristic of any individual turbine would therefore generally not give rise to an equivalent change in the total operational noise level of the wind farm. Specifically, the balance of slight increases and decreases in turbines emissions across the wind farm reduces the likelihood of the variations of individual turbine emissions translating to equivalent variations in the total combined noise level of the wind farm.

While there is no precise method or recommended procedure to evaluate the likelihood or magnitude of these types of effects on individual turbine emissions, post-construction measurements of operational wind farms have demonstrated that the assumptions of constant wind speed and manufacturers sound power test data provides a reliable basis for estimating total operational wind farm noise levels. An example of this type of study[2], which considered the effect of variations in wind conditions across a commercial scale wind farm layout, indicated that the effect of reduced wind speed at turbines located downwind of other turbines tended to reduce the total noise levels at downwind receptor locations.

Notwithstanding the above, operational noise levels from the proposal would normally be controlled by way of standard conditions which accompany a wind farm planning consent, in combination with the performance specifications normally incorporated into the procurement contracts for wind turbines.

These conditions normally include requirements to conduct commission noise testing to demonstrate that the noise limits have been achieved. In the unlikely event that noise emissions varied significantly from the assumptions made in this assessment, the operator and their suppliers would be required to undertake all steps necessary to offset the variation and enable continued compliance with environmental noise requirements.

AMPLITUDE MODULATION

Amplitude modulation is a normal feature of a correctly functioning wind turbine, described as the rise and fall in broadband noise level corresponding to the rotation of the blades. This characteristic is typically most evident in close proximity to the turbine.

Other reported characteristics of modern wind farm noise relate to an effect sometimes referred to as 'atypical' or 'other' amplitude modulation which relates to the rhythmic rise and fall in the level of noise, over and above the normal variation in noise associated with a wind farm. If present, atypical levels of amplitude modulation can attract a special audible characteristics' penalty to compliance testing results.

In this respect, Section 5.4.2 of NZS 6808:2010 states the following:

> *Wind turbine sound levels with special audible characteristics (such as tonality, impulsiveness and amplitude modulation) shall be adjusted by arithmetically adding up to +6dB to the measured level at the noise sensitive location.*

A study[3] released by Renewable UK in December 2013 presents the findings of a detailed research programme by an international consortium into atypical amplitude modulation of wind farm noise. The UK study found that situations can arise where the modulation of wind farm noise is sufficient to lead to increased annoyance from wind farm noise. However, based on the evidence available at sites where it was identified, its occurrence may be relatively infrequent.

Importantly, the study found that the factors which give rise to the effect are multiple and complicated, rather than a single phenomenon such as wake effects. As a result, the study determined that it is not feasible to reliably predict the likelihood of atypical amplitude modulation occurring at a particular site. While the NZ standard (NZS 6808:2010) used to assess Mount Emerald Wind Farm requires that wind farms be designed with no special audible characteristics at nearby residential properties, the standard concurrently recognises that these types of effects cannot always be predicted. Specifically, Section 5.4.1 of the standard notes:

> […] *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.*

In terms of commission monitoring, an important outcome of the UK study is a new method proposed for objectively measuring and assessing atypical amplitude modulation during post-construction monitoring.

Further, the UK study determined that if atypical modulation were to arise from a scheme, turbine management systems can be used to control the individual turbines responsible so that the impacts are mitigated under the particular conditions where they occur, on a case by case basis.

In recognition of the limited apparent extent of this reported matter, the subject of enhanced amplitude modulation has not altered the current approach to assessing wind farm noise in Australia. Specifically, current noise policies continue to represent a suitable basis for designing and assessing new wind farm developments.

References

[2] A.Bullmore, J.Adcock, M.Jiggins, M.Cand *Wind Farm Noise Predictions: The Risks of Conservatism*. Second International Meeting on Wind Turbine Noise, France 2007

[3] Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effects (http://tinyurl.com/RUK-OAM-Report)

16. ***Provide an extract of the Danish EPA detailing the LFN methodology adopted for the assessment used to generate the levels in table 12.***

The following is an extract from Statutory Order on Noise from Wind Turbines, 15 December 2011, pursuant to the Danish Environmental Protection Act.

1.4. Determination of low-frequency noise from wind turbines

The level of low-frequency noise, e.g. in the nearest dwelling, is determined by use of Equation 1.4.1.

$$L_{pALF} = L_{WA,ref} \div 10 \cdot \log(l^2 + h^2) \div 11dB + \Delta L_{gLF} \div \Delta L_{\sigma} \div \Delta L_a$$

where:

l = the distance from the base of the wind turbine to the calculation point

11 dB = correction for distance, 10 x log 4π

ΔL_{gLF} = correction for ground effect at low frequencies (Table 1.4)

ΔL_{σ} = sound insulation at low frequencies (Table 1.4)

ΔL_a = air absorption, ($\alpha_a \times \sqrt{l^2 + h^2}$) where the absorption coefficient α_a is shown in Table 1.4.

Equation 1.4.1. Calculation of low-frequency noise from wind turbines in 1/3 octave bands

1/3 octave centre frequency in Hz	10	12,5	16	20	25	31,5	40
ΔL_{gLF}: ground correction, onshore wind turbine (dB)	6,0	6,0	5,8	5,6	5,4	5,2	5,0
ΔL_{gLF}: ground correction, offshore wind turbine (dB)	6,0	6,0	6,0	6,0	6,0	5,9	5,9
ΔL_{σ}: sound insulation (level difference) (dB)	4,9	5,9	4,6	6,6	8,4	10,8	11,4
α_a in dB/km	0,0	0,0	0,0	0,0	0,02	0,03	0,05

1/3 octave centre frequency in Hz	50	63	80	100	125	160
ΔL_{gLF}: ground correction, onshore wind turbine (dB)	4,7	4,3	3,7	3,0	1,8	0,0
ΔL_{gLF}: ground correction, offshore wind turbine (dB)	5,8	5,7	5,5	5,2	4,7	4,0
ΔL_{σ}: sound insulation (level difference) (dB)	13,0	16,6	19,7	21,2	20,2	21,2
α_a in dB/km	0,07	0,11	0,17	0,26	0,38	0,55

Table 1.4: Terrain correction for low-frequency noise for wind turbines location onshore and offshore respectively, sound insulation (level difference) and air absorption coefficients per 1/3 octave at a relative air humidity of 80% and an air temperature of 10º C

Ground correction for offshore wind turbines is valid for calculation of low-frequency noise in a building close to the coast. If noise is to be calculated in a building which, seen in the direction of the wind turbines, is more than 200 metres inland, the terrain correction for onshore wind turbines is used instead. For buildings located between 0 and 200 metres from the coast linear interpolation between the two values for terrain correction is made.

The total A-weighted sound pressure level $L_{pALF,\,tot}$ in the dwelling is then found by adding the sound pressure levels $L_{pALF,\,i}$ in each 1/3 octave band, cf. Equation 1.4.2.

$$L_{pALF,tot} = 10 \cdot \log \sum 10^{L_{pALF,I}/10}$$

Equation 1.4.2. Total sound pressure level

The uncertainty of the calculated sound pressure level $L_{pALF,\,tot}$ by use of this method is ±2 dB.

17. ***Noise Impact from roads, construction and associated wind farm turbine associated infrastructure, such as power transformers, has not been discussed in the noise report. This should be addressed along with recommendations for information to be included in the project EMP. Where Queensland guidelines do not exist for construction noise impact the levels in NZS 6808:2010 may be taken as a guide, or other suitable criteria developed based on suitable Queensland EPP criteria for intermittent noise sources.***

An assessment of Construction Noise is provided in Attachment G – Construction Noise and Ancillary Infrastructure.

Construction

Based on typical construction equipment and activities, predictions of noise levels at nearby residences are provided in Table 6 below.

Table 6: Indicative range of construction noise predictions, $L_{Aeq,\,15\,minute}$ dB

Construction Phase	Nearest property	Predicted level range
Access Road Construction	R78	45-50
On-site Substation	R05	35-40
Site Compound	R05	35-40
Turbine Foundations	R78	45-50
Cable trench digging	R78	45-50
Turbine Assembly	R78	45-50

Traffic

Traffic noise levels are predicted to increase by less than 1dB and approximately 1dB for the Kennedy and Hansen Road route options respectively.

Ancillary Infrastructure

Specific details of transformer selections are yet to be made, however noise emissions associated with this type of electrical plant are commonly in the range of 95-100dB L_{Aw}. While the specific transformers selections would not be finalised until the detailed design phase of the project, the typical emission ranges and separating distances are sufficient to determine that operational noise levels associated with transformers would be below 30dB externally at surrounding residential receiver locations.

The noise of the transformers is therefore expected to be well within the acoustic quality objectives noted by the EPP for the day and evening and external, even accounting for any adjustments (if applicable at the receptor) for the potential tonal characteristics associated with transformers.

18. ***Provide a revised tonal audibility assessment and data in 1/3 Octave bands rather than Octave bands for the Repower 3XM104 turbine.***

A tonality assessment is provided in Attachment H – One-third octave band tonality assessment.

The results of this assessment indicate the Senvion (REPower) 3XM104 turbine is not expected to be penalised for tonal characteristics.

19. ***Provide 1/3 Octave Band Tonal audibility assessment and 1/3 octave band data for Siemens for the SWT-3.0-101 and SWT-3.0-108 turbines.***

A tonality assessment is provided in Attachment H – One-third octave band tonality assessment.

The results of this assessment indicate some concerns with the Siemens SWT-3.0 101 turbine which may make it unsuitable for the site. Further investigation would be needed should this turbine be considered.

The Siemens SWT-3.0-108 turbine is not expected to be penalised for tonal characteristics.

D. LANDSCAPE VISUAL AMENITY

20. ***Provide the following information as notations to existing visual assessments:***

    a) typical turbine height compared to the height of existing power line pylons

Generally the height of the existing powerlines is approximately 40m, although this varies across the site depending on the design and function of the powerline towers. The turbine dimensions used in the LVIA has a hub height of 80m with rotor diameter of 101m for an overall tip height of 130.5m.

As new turbines come onto the market, it is possible the final turbine selected may exceed, in minor respects, the assessed turbine dimensions. Minor increases in size are unlikely to alter the determination of visual significance for residential view locations included in the LVIA.

Powerline towers are identified as “Existing 275kV transmission line” in Attachment I – Landscape Visual Impact Assessment.

It is assumed the basis for this question is attempting to apply some scale to the montages to provide confidence in their accuracy. The difficulty here is that in most cases the difference in distance to the transmission towers and the wind turbines does not allow for direct comparison.

However, Photomontage PM10 (figures 37 and 38 of Attachment I – Landscape Visual Impact Assessment) does provide this opportunity. In this image the transmission tower located on the horizon line at approx. 202^{O}, with a turbine close to the right, is located approximately 2060m from the viewpoint. The wind turbine to the right is approximately 3450m from the viewpoint and unfortunately does not provide the relative scale needed. The three larger turbines further to the right at 212^{O}, 218^{O} and 228^{O} are located approximately 2260m, 2080m and 1910m respectively from the viewpoint and as such can be used for scaling purposes. As the height of these towers is roughly twice the height of the transmission tower some confidence can be gained from the accuracy of the montages.

b) identification of site ridgelines and their elevations as seen from various viewpoints

Viewpoint locations and identified ridge lines are shown in the figures below.

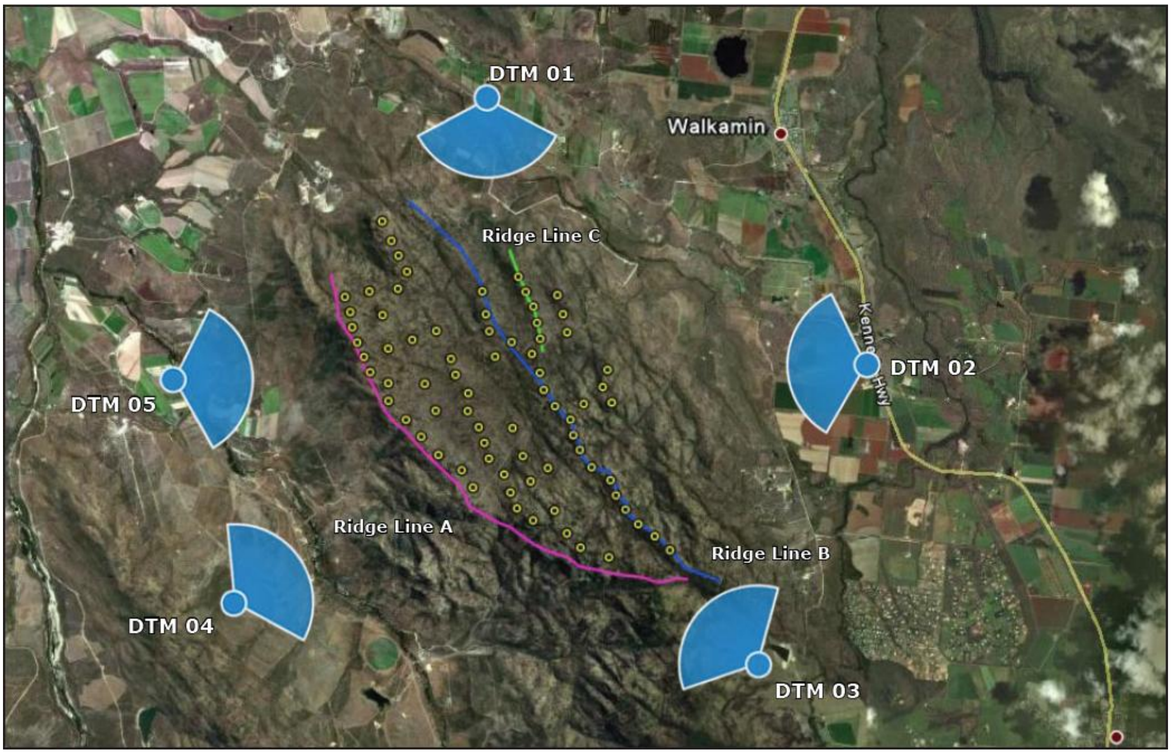

Figure 5: Attachment I DTM Simulations – Viewpoint Locations and identified Ridge Lines

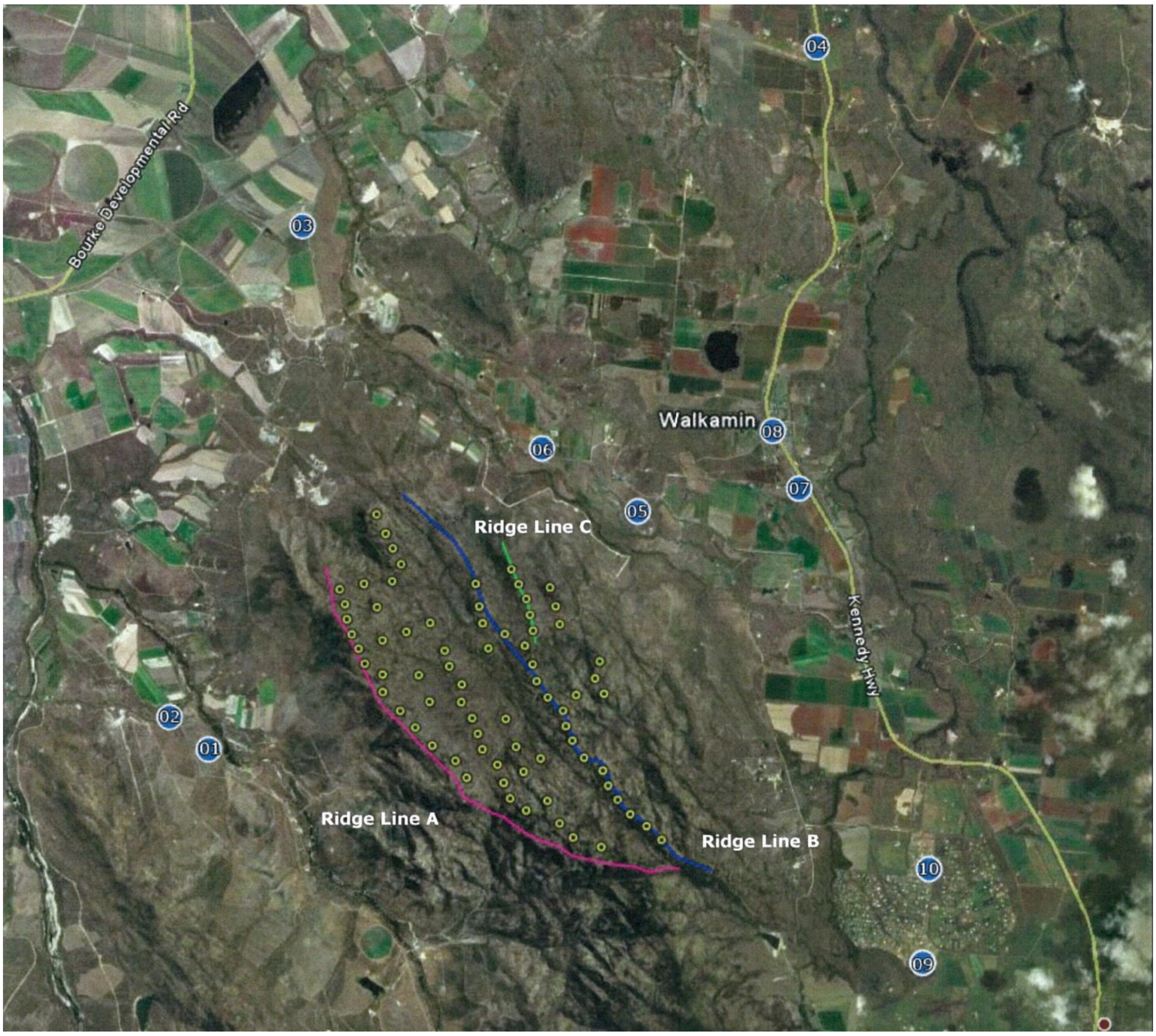

Figure 6: Attachment J - Trueview Photosimulations – Viewpoint Locations and identified Ridge Lines

The approximate lengths and elevations of the Ridge Lines shown in the above figures are provided in the table below.

Ridge Line	Length	Min. elevation	Max. elevation	Avg. elevation
	(km)	(m)	(m)	(m)
A	8.66	830	1078	920
B	8.73	706	1009	864
C	1.83	754	827	810

c) numbering visible turbines in each view and their ground level elevations

Photomontages included in Attachment J - DTM Simulations and Attachment K - Trueview Photosimulations include wind turbine numbering and ground level data.

d) calculation of length (km) of visible array of skyline turbines relative to the total length of visible skyline ridge.

The below table uses information provided in;

- Attachment J - DTM Simulations
- Attachment K - Trueview Photosimulations

Viewpoint	Horizon Length (visible skyline)	Visible Array Length
	(km)	(km)
VP01	5.7	3.0
VP02	6.4	2.8
VP03	9.2	2.2
VP04	12.2	3.5
VP05	3.6	3.1
VP06	4.0	3.1
VP07	6.1	3.2
VP08	6.3	3.5
VP09	8.7	2.0
VP10	8.0	2.4
DTM01	4.9	2.9
DTM02	6.1	3.3
DTM03	6.6	0.2
DTM04	6.0	2.9
DTM05	5.9	2.5

Assumptions

1 – calculations performed using the 75 wind turbine layout originally proposed. A reduction in wind turbines will reduce the calculations.

2 – if any part of the WTG is visible it is included

3 - Primary Human Field of View recognised as 124^{O} horizontal and 55^{O} vertical

4 – Calculation based on the distance from the viewpoint to the centre of wind farm site at 328000E 8101000N

Extrapolating further on this concept it is interesting to understand what component of a person's total field of view the proposed wind farm would comprise from each view point.

The basic method for calculating this component is;

- Calculate the distance to each turbine in the field of view
- Using a field of view of 124^{O} horizontal and 55^{O} vertical determine the area of the view at this distance
- The area of the turbine is assumed to be the full rotor disc (diameter 101m) and a 5m diameter tower [Area = $\pi \times 101^2/4 + (80\text{-}51) \times 5 = 8{,}157m^2$]. This assumes the whole turbine is visible and does not allow for topographic screening
- Sum the individual percentages together to get a total wind farm percentage. This will be further conservative as it does not allow for turbines obscuring each other.

The table below displays the results of this analysis.

Viewpoint	No. WTG Visible	Avg. Distance to WTG	Total Field of View Area	Area of Wind Farm in Field of View
		(m)	(m^2)	%
VP01	21	4,254	9,398,000	2.2%
VP02	25	4,958	12,766,000	1.9%
VP03	44	8,274	35,559,000	1.2%
VP04	71	12,552	81,832,000	0.7%

VP05	40	3,901	7,902,000	5.4%
VP06	35	3,749	7,302,000	4.8%
VP07	59	6,416	21,380,000	2.4%
VP08	54	6,558	22,338,000	2.1%
VP09	36	8,229	35,171,000	1.0%
VP10	44	8,006	33,289,000	1.3%
DTM01	29	4,699	11,466,000	2.6%
DTM02	58	6,287	20,528,000	2.6%
DTM03	2	2,938	4,482,000	0.4%
DTM04	24	7,949	32,816,000	0.7%
DTM05	26	5,061	13,304,000	1.7%

21. *Advise of HV Transmission line connections to the grid e.g. the likely number, location and size of any extra pylons.*

The location of the proposed connection point to the grid is shown on Attachment L – MEWF Turbine locations and development footprint.

The design of the infrastructure required for this connection is the responsibility of the electricity network operator (Powerlink). However, it is envisaged new pylons will be required at the entry and exit point of the connection yard.

Given the location of the connection point within the proposed wind farm property, the local topography and locations of external viewpoints it is not anticipated there will be any significant views of the HV connection from outside of the wind farm property.

22. *The periods during which any houses may experience shadow flicker (and view distances), notwithstanding that such periods may be less than 30 hours per year*

A detailed Shadow Flicker Assessment is provided in Attachment M – MEWF Shadow Flicker Assessment RevE.

The results of this investigation show only 3 receptors will experience levels of shadow flicker form the proposed wind farm.

Receptor	GPS Coordinates		Worst case shadow flicker hours per year	Max. shadow hours per day	Realistic shadow flicker hours per year
	Easting (m)	Northing (m)	h:mm	h:mm	h:mm
R05	325,084	8,099,119	4:24	0:13	2:22
R49	331,555	8,100,953	8:37	0:13	4:53
R78	327,662	8,103,902	4:00	0:14	1:58

Appendix C of Attachment M – MEWF Shadow Flicker Assessment RevE provides a calendar of Shadow Flicker events for each of the affected receptors for a typical year. A summary of these events is included in the table below.

Date of Event(s)	Starting Time of Event(s)	Duration Range (worst case scenario)	Duration Range (realistic case scenario)	WTG causing Event	Distance to WTG
Day / Month	hh:mm	minutes	minutes		(m)
Receptor R05					
4th May – 16th May	07:20 to 07:25	4 to 13	2 to 7	19	1,857
28th Jul – 9th Aug	07:31 to 07:35	3 to 13	2 to 8	19	1,857
Receptor R49					
23rd Feb – 3rd Mar	17:58 to 18:03	5 to 13	2 to 5	50	1,829
17th Mar – 25th Mar	17:50 to 17:56	2 to 12	1 to 6	51	1,975
8th Apr – 16th Apr	17:31 to 17:36	4 to 13	2 to 7	52	1,946
27th Aug – 4th Sep	17:30 to 17:36	4 to 13	2 to 9	52	1,946
19th Sep – 26th Sep	17:35 to 17:38	5 to 12	3 to 8	51	1,975
10th Oct – 19th Oct	17:31 to 17:37	3 to 13	2 to 9	50	1,829
Receptor R78					
2nd Feb – 12th Feb	17:55 to 17:58	6 to 14	2 to 6	2	1,781
30th Oct – 9th Nov	17:24 to 17:30	5 to 14	3 to 8	2	1,781

E. TRAFFIC IMPACT

23. ***Provide a clear description of all possible access routes (in their entirety) to the site for oversized vehicles. This should include at least a high level identification of constraints along the network and identification of measures that would be put in place to allow state government and council to assess these impacts.***

A detailed response to this request is provided in Attachment N – Mount Emerald Wind Farm Traffic Impact Assessment; Technical Note 2 – Traffic Impact Assessment Engineering Response.

Two possible access routes for oversized vehicles were analysed in their entirety from Cairns Port to Mount Emerald. Maps detailing these two routes have been included in Attachment N - Appendix A.

A summary of each route is detailed in Table 7 below:

Table 7: Possible access routes for oversized vehicles from Cairns Port to Mount Emerald

Route No.	Traversed Roads
1	Dutton Street, Kenny Street, Draper Street, Bruce Highway (Ray Jones Drive), Bruce Highway (Innisfail – Cairns), Palmerston Highway (Innisfail – Ravenshoe), Millaa Millaa – Malanda Road, Malanda – Atherton Road, Mars Lane, Tinaroo Falls Dam Road, Kairi Road, Lawson Street, Kennedy Highway (Mareeba – Ravenshoe), Hansen Road, Springmount Road, Kippen Drive.
2	Dutton Street, Kenny Street, Port Connection Road (Bunda Street), Martyn Street, Mulgrave Road, Sheridan Street, Captain Cook Highway (Cairns - Mossman), Kennedy Highway (Cairns - Mareeba), Kennedy Highway (Mareeba - Ravenshoe), Hansen Road, Springmount Road, Kippen Drive

Of the roads listed in each route above, Dutton Street and Kenny Street (partial) are controlled by Cairns Regional Council, and Marks Lane, Kiari Road, Lawson Street, Hansen Road, Springmount Road and Kippen Drive are controlled by Tablelands Regional Council/Mareeba Shire Council. All other listed roads are state controlled roads maintained by the Department of Transport and Main Roads (TMR). It is noted that all roads forming *Route 1* to Hanson Road are gazetted B-Double routes while the Kennedy Highway (Cairns – Mareeba) which forms a section of *Route 2* is a non-approved B-Double route. It is suggested that Lawson Street is utilised for both directions of travel on *Route 2* to avoid traversing through the township of Tolga when transporting large material components despite being a gazetted B-Double route for south bound traffic only.

A high level identification of constraints and measures, which may be required to be implemented, has been completed for each route to allow State Government and Councils to assess the impact of these constraints:

It is recommended that a horizontal and vertical (crests and sags) geometry check, in addition to checking the vehicle envelope, is completed for the full length of each route. Due to their generally narrower road widths, it is noted that the horizontal geometry of Council-controlled roads should be checked. Horizontal geometry limits and overhanging rainforest canopy experienced on the Kennedy Highway (Cairns – Mareeba) via *Route* 2 will not permit the turn paths and the large envelope exhibited by the B-Doubles when transporting larger components (such as the rotor blade, hub, machine house components and steel sections). Contrary to this, there may be the potential for vehicle configurations with a smaller vehicle envelope and tighter turn path to utilise *Route* 2 when transporting smaller components under a permit as it is significantly shorter in comparison to *Route 1*.

Due to the substantial turn paths and large vehicle envelope exhibited by the oversized vehicles and material components, traffic control may be required at intersections where over-dimensional vehicles (wide loads) are required to turn. These intersections have been identified for both Routes 1 and 2 and are detailed in Table 8 and Table 9, respectively (refer below). Also listed for each intersection are minor works and additional control measures that may need to be implemented.

Table 8: Intersections potentially requiring traffic control and measures involving minor works – Route 1

Intersection	Potential measures/works that may be require implementation
Dutton St / Kenny St	• Traffic Control • Remove and re-erect signage • Check clearance to railway crossing signals • Check clearance to overhead power lines
Kenny St / Draper St (roundabout)	• Traffic Control • Remove and re-erect signage • Check clearance to overhead power lines
Draper St / Bruce Highway (Ray Jones Drive)	• Traffic Control • Remove and re-erect signage • Check clearance to signal mast arms
Bruce Highway (Innisfail - Cairns) / Palmerston Highway (Innisfail - Ravenshoe)	• Traffic Control • Remove and re-erect signage
Millaa Millaa - Malanda Road / Malanda - Atherton Road	• Traffic Control • Check clearance to overhead power lines
Malanda - Atherton Road / Marks Lane	• Traffic Control
Marks Lane / Tinaroo Falls Dam Road	• Traffic Control • Remove and re-erect signage

Tinaroo Falls Dam Road / Kiari Road	• Traffic Control • Check clearance to overhead power lines
Kiari Road / Lawson St	• Traffic Control • Check clearance to overhead power lines • Remove and re-erect signage
Lawson St / Kennedy Highway (Mareeba - Ravenshoe)	• Traffic Control
Kennedy Highway (Mareeba - Ravenshoe) / Hanson Road	• Traffic Control

Table 9: Intersections potentially requiring traffic control and measures involving minor works – Route 2

Intersection	**Potential measures/works that may be require implementation**
Dutton St / Kenny St	• Traffic Control • Remove and re-erect signage • Check clearance to railway crossing signals • Check clearance to overhead power lines
Kenny St / Port Connection Road (Bunda Street)	• Traffic Control • Remove and re-erect signage • Check clearance to overhead power lines
Port Connection Road (Bunda Street) / Martyn Street	• Traffic Control • Remove and re-erect signage • Check clearance to overhead power lines
Martyn Street / Mulgrave Road	• Traffic Control • Remove and re-erect signage • Check clearance to overhead power lines
Mulgrave Road / Captain Cook Highway (Sheridan Street)	• Traffic Control • Remove and re-erect signage
Captain Cook Highway (Cairns - Mossman) / Kennedy Highway (Cairns - Mareeba) (Roundabout)	• Traffic Control
Kennedy Highway (Mareeba - Ravenshoe) / Hanson Road	• Traffic Control

Any areas requiring a temporary lane closure must comply with the *Far North Queensland – Table of Allowable Lane Closures (TALC)* and will require an approved Traffic Guidance Scheme and Traffic Management Plan prior to implementation. It is also suggested that a Community Liaison Officer is utilised to communicate lane closures with the relevant Local Authorities; local business or organisations which may be affected; and the general public. It should be noted that these issues are not restricted to the locations noted above and the following issues may be experienced along the entire route:

- Vertical clearance of vehicle envelope to overhead power lines, gantry signs, signal mast arms, street lights and overhead fauna crossings (rope bridge, Palmerston Highway and Kennedy Highway (Cairns – Mareeba)) should be assessed to determine if there is a requirement to consult/engage the Department of Transport and Main Roads (TMR), Cairns Regional Council, Tablelands Regional Council or Ergon Energy as applicable for any adjustments that may be required to their assets.
- Structural integrity of culvert and bridge crossings should be determined by consulting TMR, Cairns Regional Council or Tablelands Regional Council as applicable to request

recent inspections including details of type of inspection carried out. Further assessments may be required depending on the completeness of previous inspections.

- Requirement for permits and escorts to traverse the detailed routes should be identified and obtained as required.

It is recommended that a visual inspection is completed to identify areas of potential conflict along the entirety of the route prior to the commencement of any localised detailed investigations (if required).

24. ***An assessment of the access to site (along Hansen Road and Springmount Road) for vertical geometry which utilises recent survey data.***

To the best of our knowledge, recent survey or adequate topographical data does not exist at this time to allow a more detailed assessment of the access to site via Hansen Road and Springmount Road. Several sources were investigated, including the Queensland Government's Physical Road Network, and Geoscience Australia's Digital Topographic Data. However, at the time of this report, the Digital Elevation Model (DEM) has insufficient detail to perform such an investigation, and the Physical Road Network currently provides horizontal geometry only. In addition, survey from remote-sensing methods, such as Light Detection and Ranging (LiDAR), does not currently exist.

The Technical Note: Mount Emerald Wind Farm Traffic Impact Assessment Engineering Responses, undertaken by SKM 2012, provides a response to a query from the TRC, "Demonstrating the capability of the vertical profiles of Hansen and Springmount Roads accommodating any proposed drop deck or low loader transport of turbine components." This assessment of vertical geometry was based on a best fit to the GPS data recorded during a vehicle drive-through of the route as no detailed survey existed. The response to TRC 51 is included for information in Attachment N - Appendix B and the longitudinal sections (issued as Appendix C of the SKM 2012 technical report) are included in Attachment N – Appendix C.

25. ***Provide further information on how staff travel to site can be managed in a way that will allow the maximum number of staff vehicles to remain below 30 vehicles per day (as indicated in the Traffic Impact Assessment.***

To respond to the Question 25 of the ministerial call (dated 11 June 2014), the following reports were reviewed:

- Technical Note: Mount Emerald Wind Farm Traffic Impact Assessment Engineering Responses – 19 December 2012 undertaken by SKM. The report will be referred to as SKM 2012
- Mount Emerald Wind Farm Traffic Impact Assessment (TIA) – 8 August 2011 undertaken by SKM. This report will be referred to as SKM 2011

Based on the information reviewed, the SKM 2011 TIA report assumes a maximum of 30 vehicles per day for workers during the construction stage of the project. The SKM 2012 technical report outlines in detail the estimated number of workers per month for the two year construction phase. Figure 7 summarises the estimated total number of workers during the construction phase (based on the information provided within Attachment N - Appendix D (From SKM 2012 Appendix B)). Figure 7 outlines the total estimated workers for the project during the construction phase (blue line) which includes the estimated construction-related workers (green line) and the estimated skilled/unskilled contract labourers (red line).

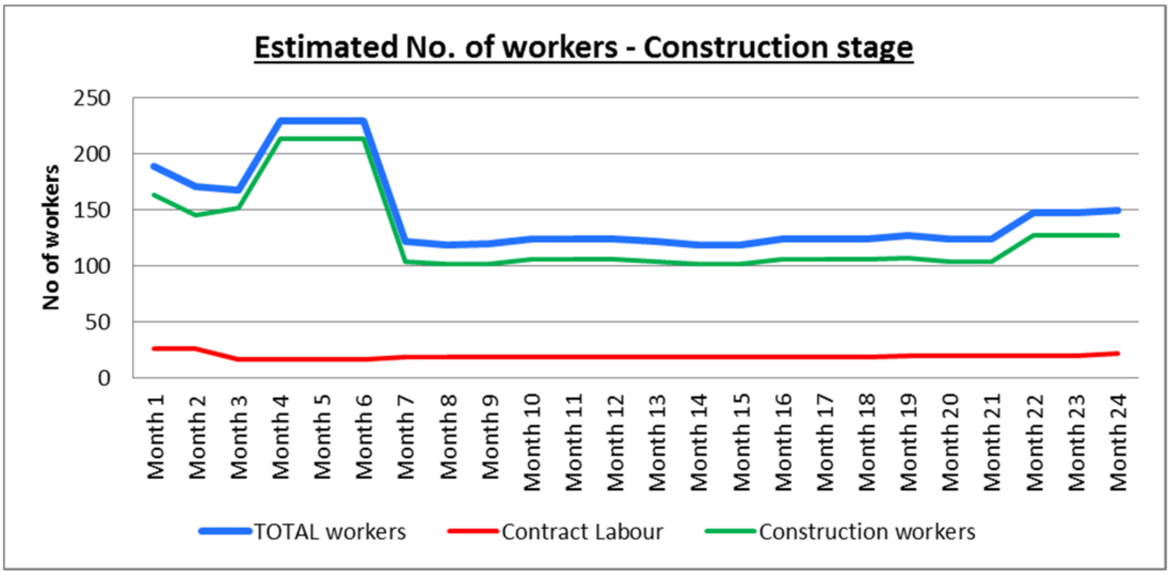

Figure 7: Estimated total number of workers during construction stage (24 months)

The estimated maximum numbers of workers expected to be on site during month 4 to month 6 of the construction phase is approximately 229. Of these 229 workers, 16 workers will be contract skilled and unskilled labourers and are expected to arrive and depart the site via individual or shared private vehicles.

The following assumptions (which are consistent with the previous traffic reports) have been adopted for the assessment:

- All construction workers are expected to arrive and depart the project site via dedicated 30 seater worker buses. These buses will have several pick up and drop off points at key townships
- All skilled and unskilled contract labourers are expected to arrive and depart the project site via their own vehicles. It is expected that some skilled and unskilled labourers arriving and departing the project site will carpool. Given the remote location of the project site to key townships, a conservative carpooling ratio of two people per car for the skilled and unskilled contract labours was adopted for this assessment

Based on the assumptions above, the maximum number of trips generated by the estimated number of workers during the construction is expected to be 16 vehicles per day, which comprise eight 30-seater buses and eight light vehicles. To provide a robust assessment, a nominal 10 additional vehicles per day has been added to allow for unscheduled visits, deliveries, private vehicles, miscellaneous tasks, and for construction workers who need to bring their own vehicles with trade specific tools. This makes an estimated total of 26 vehicle movements at the site per day.

Therefore, the estimated number of worker-related vehicles travelling to/from the project site is expected to be 26 vehicles per day which is expected to occur for only 3 of 24 months during the construction phase. The worker-related vehicles generated per day for the remaining 21 months will be less than the anticipated 26 vehicles per day experienced during the peak construction phase.

The estimated number of worker-related vehicles to /from the project site is less than the assumed 30 vehicles per day outlined within the SKM 2011 TIA report and SKM 2012 technical note. However, to maintain the number of worker-related vehicles arriving/departing the project site at or below the expected 30 vehicles per day, the following recommendations should be adopted by the client and the nominated construction contractor during the construction phase:

- The nominated construction contractor will provide a 30-seater shuttle bus services for construction workers arriving and departing the project site.
- The 30-seater shuttle bus will service the key townships where the construction workers live.
- Provide minimal or restricted on-site parking to discourage workers arriving to and departing from the project site via private vehicles.

These measures should be outlined in detail within the construction management plan to be developed in close consultation with the relevant Local Authorities and stakeholders.

Note that the estimated work-related vehicles per day outlined within this assessment are for a pre-feasibility design level. The construction schedule and estimated number of workers for each task may vary depending on the construction methods adopted by the nominated contractor for this project. Detailed worker numbers and construction schedules would become available once the project execution contracts have been awarded, which can only occur once this project is approved. Any changes to the construction worker numbers and schedules would be captured within a detailed construction traffic management plan which should be undertaken during the post approval stage in close consultation with the relevant Local Authorities and stakeholders.

26. ***Should sufficient measures to restrict staff traffic to 30 vehicles per day not be provided a new assessment identifying the worst case traffic impact on the road network should be provided.***

It should be noted that the estimated work-related vehicles per day outlined within this assessment is for a prefeasibility design level. The construction schedule and estimated number of workers for each task may vary depending on the construction methods adopted by the nominated contractor for this project. Detailed worker numbers and construction schedules would become available once the project execution contracts have been awarded, which can only occur once this project is approved. Any changes to the construction worker numbers and schedules would be captured within a detailed construction traffic management plan which should be undertaken during the post approval stage in close consultation with the relevant Local Authorities and stakeholders.

F. ECOLOGY

27. ***The response to the Information Request dated April 2014 does not directly respond to the flora or fauna issues raised but refers to a "comprehensive Environmental Impact Statement (EIS) prepared as part of the requirements for project approval under the Environment Protection and Biodiversity Conservation Act (EPBC)." The EIS has not been supplied and, therefore, provide the following additional information:***

    a) ***EPBC Protected Vegetation Communities - discussion on the occurrence (or otherwise) of EPBC protected vegetation communities identified by the Protected Matter Report.***
    b) ***Regional Ecosystem Mapping – the Appendix D2 amended mapping is difficult to interpret. Provide appropriate shading.***
    c) ***Queensland Herbarium (HERBECS) database -define the search area. The search area should be extended to a 25 km radius, or the centre point of the search area should be located to best capture relevant habitats.***
    d) ***Field survey - clarify the location of the high intensity and low intensity sites and show these on Appendix A2.***

e) ***Queensland Museum and Birds Australia Atlas databases - if these were searched, then that data should be provided. If they were not searched, then searches should be provided.***

f) ***Wildnet (Wildlife Online) database - the data base search area should be increased to 25 km, or the centre point of the search area should be located to best capture relevant habitats.***

g) ***Known & Expected species assemblage - the species listing in Appendix I2 is incomplete. Not all species listed in the site profiles are reported in Appendix I2 and vice versa.***

h) ***Conservation Significant species - there are inconsistencies in the discussed flora species. Not all species are conservation significant in the context of the report (e.g. Eucalyptus lockyeri). Conservation significance should be clearly defined.***

i) ***The likelihood of occurrence is only addressed for the EPBC search tool results, and not for the WildNet and HERBRECS search results. Species that are listed to occur in the WildNet and HERBRECS search results are noted in the literature review but no reason is given for their exclusion from consideration. Further discussion is required about the likelihood of occurrence.***

j) ***Weed species - comprehensive discussion of legislative requirements should be provided. There are inconsistent levels of discussion (e.g. grader grass v lantana). The possible beneficial project consequences should be discussed in relation to weed and feral species.***

k) ***The data sources for all fauna species listed in Appendix Bl should be provided.***

1) ***The correct species status under the EPBC Act and the Nature Conservation Act should be provided for all species.***

m) ***Biodiversity status should be provided for Regional Ecosystems. Provide sufficient/ additional/ further detail and discussion about the following:***

- ***the likelihood of occurrence of the EPBC Act protected vegetation communities***
- ***the likelihood of occurrence of all relevant conservation significant species.***
- ***species profiles (life history information) for conservation significant species and identification and assessment of potential impacts, including known threatening processes***
- ***existing habitat values of the site in the context of both conservation significant and other flora and fauna species.***

n) ***Wildlife/ connectivity corridors should be discussed at internal site, local and landscape levels, including any possible consequences that may arise from the project. Discussion should include all fauna and plants.***

o) ***Ridgelines (particularly when associated with rock pavements) have been identified as being ecologically significant. The construction and operational impacts on these areas need to be clearly identified, what proportion will be impacted, and what the possible impacts on*** **Homoranthus porteri*,* Plectranthus amoenus** ***and*** **Grevillea glossadenia** ***will be.***

p) ***Back on Track species and/or regionally significant species.***

A detailed Environmental Impact Statement (EIS) prepared as part of requirements for project approval under the Environment Protection and Biodiversity Conservation Act (EPBC) is provided as Attachment O.

28. ***If the Civil Aviation Safety Authority has any lighting requirements in relation to the proposal, then fauna assessments must consider the effects of this requirement.***

Civil Aviation Safety Regulation (CASR) 139.365 requires the proponent of a proposed structure "*…the top of which will be 110m or more above ground level…*" to notify the Civil Aviation Safety Authority (CASA) of their intention and to provide the proposed height and location of the building or structure. If the proposed obstacle, building or structure is deemed to be hazardous to aircraft operations CASA may direct the proponent to light or mark the hazard in accordance with the Manual of Standards (MOS Part 139 — Aerodromes). CASA formerly provided guidance material on lighting of wind farms in Advisory Circular AC 139-18(0) *Obstacle Marking and Lighting of Wind Farms,* now withdrawn.

Following a recent risk review of manmade objects located away from regulated aerodromes CASA is contemplating the development of a regulatory framework similar to that of the United States Federal Aviation Administration for marking and lighting of obstacles. The United States regulations define obstacles as buildings, objects and structures of 150m or more in height. In conjunction with rulemaking activity, CASA intends to review Advisory Circular 139-08(0) on reporting of tall structures and will consider reviewing the withdrawn Advisory Circular 139-18(0) on lighting of wind turbines to refer to lighting requirements for structures 150 metres or more above ground level. Updated guidance material is normally released with new regulations, following a process that may require two years to complete.

At this point in time it is not anticipated the wind turbines will need night time obstacle lighting as no blade tip will be over 150m above the existing ground level.

29. ***Demonstrate how the development will achieve the requirements of Part 3(7) - Environmental Values and Acoustic Quality Objectives of the Environmental Protection (Noise) Policy 2008: The environmental values to be enhanced or protected under this policy are - (a) the qualities of the environment that are conducive to protecting the health and biodiversity of ecosystems, in the context of any impacts on fauna.***

As is shown in Noise contour mapping provided in Attachment B, the maximum sound levels expected on the wind farm site itself are 55-60dBA. These noise levels would occur at maximum wind turbine output with wind speeds (at 80m above ground) in excess of 12m/s. Field measurements at similar wind speeds show existing background noise levels of a comparable (around 60dBA) nature.

Potential impacts on key species

Northern Quolls do display some tolerance to human activities, being known to inhabit human dwellings in the vicinity of the site, and thus become accustomed to induced noise levels. However, it is not well understood how the species may react to construction noise. (Refer to Section 15.3 of EIS Attachment O)

The use of wind farm site by microbats would seem to be restricted to lower wind speeds (Refer to Section 17.4.3 of EIS Attachment O) with a proven method for mitigating fatalities is to increase the cut-in wind speed at which turbines commence operation. At such wind speeds noise generated by operating turbines would be considerably lower.

It is unlikely operating noise levels would result in disturbance to Spectacled Flying-fox given their apparent tolerance to similar noise levels (e.g. leaf blowers, grass cutters, lawn mowers and vehicles) directly beneath urban roosts. Noise levels upwards of 100dBA are used to in attempts to disperse colonies from roost sites in proximity to crops or townships.

30. ***The application's flora and fauna assessment identifies a need for further surveys, investigations and studies and these should be provided. The proposed development is a controlled action under the federal government EPBC Act and is required to be assessed by environmental impact statement. A copy of that EIS should be provided. This information is considered to be integral to assessment of the project.***

A detailed Environmental Impact Statement (EIS) prepared as part of requirements for project approval under the Environment Protection and Biodiversity Conservation Act (EPBC) is provided as Attachment O.

G. AERONAUTICAL

31. ***The final wind farm layout has to be provided showing all confirmed total heights (including tip of rotor) of the proposed turbines and proving that they do not exceed the height restriction of 1179.5m suggested by Air Services Australia.***

The table below provides the coordinates of each wind turbine in the 70 turbine layout, along with the ground elevation and overall tip height for each. The table also highlights which turbines are to be removed in reducing the layout to the current preferred 63 turbine layout.

As can be seen from this table none of the overall maximum heights of any turbines exceed the 1179.5m ceiling suggested by Air Services Australia.

WTG No.	GPS Coordinates		Ground Elevation	Overall max. height	WTG No.	GPS Coordinates		Ground Elevation	Overall max. height
	Easting (m)	Northing (m)	(m)	(m)		Easting (m)	Northing (m)	(m)	(m)
1	325,792	8103791	884	1,018	36	328,292	8098872	979.2	1,113
2	325,927	8103500	857	991	37	328,824	8099088	917.6	1,052
3	326,071	8103211	804.2	938	38	328,726	8098695	1013.9	1,148
4	326,263	8102926	795.1	929	39	329,067	8098362	1032.2	1,166
5	326,071	8102642	786.3	920	40	329,705	8098561	941.5	1,076
6	325,535	8102589	808.1	942	41	329,600	8098212	1034.4	1,168
7	325,197	8102351	826.7	961	42	330,338	8097956	1005.7	1,140
8	325,266	8102037	841.8	976	43	330,401	8098594	938.2	1,072
9	325,402	8101713	845.5	980	44	329,970	8099041	881.8	1,016
10	325,539	8101383	859.7	994	45	329,790	8099328	912.8	1,047
11	325,930	8101603	853	987	46	329,648	8099620	884.4	1,018
12	325,803	8102201	818.5	953	47	329,228	8099859	893	1,027
13	326,364	8101775	850.8	985	48	329,113	8100157	916.8	1,051
14	326,771	8101965	804.5	939	49	329,043	8100457	932.7	1,067
15	325,931	8101065	892.3	1,026	50	329,738	8100745	842.7	977
16	325,941	8100734	871.2	1,005	51	329,581	8101021	807.2	941
17	326,222	8100448	850.6	985	52	329,644	8101320	813	947
18	326,484	8100150	845.5	980	53	329,242	8100793	858.5	993
19	326,793	8099845	847.1	981	54	328,753	8100703	881.1	1,015

20	327,187	8099577	869.4	1,003	55	328,157	8100695	811	945
21	327,392	8099290	860.2	994	56	328,537	8100981	871.6	1,006
22	327,652	8099773	855	989	57	328,498	8101272	845.4	979
23	327,542	8100066	836	970	58	328,458	8101575	834.4	968
24	327,436	8100361	832.1	966	59	328,466	8101926	821.4	955
25	327,254	8100649	817.5	952	60	328,402	8102310	807.9	942
26	327,232	8100956	804.8	939	61	328,248	8102601	799.6	934
27	327,039	8101238	799.9	934	62	328,130	8102902	817.2	951
28	326,982	8101539	786	920	63	328,792	8102560	825	959
29	326,556	8101046	822.7	957	64	328,903	8102219	811.4	945
30	326,708	8100606	832.5	967	65	328,983	8101892	805.8	940
31	328,045	8100267	817.2	951	66	328,031	8101732	833.4	967
32	328,206	8099881	849.6	984	67	327,768	8101472	808.9	943
33	328,648	8099655	850.4	984	68	327,640	8101915	815	949
34	328,376	8099384	903.8	1,038	69	327,574	8102211	841.1	975
35	328,058	8099149	932.4	1,066	70	327,496	8102505	798.7	933

It is suggested the development approval conditions require that none of the turbines exceed an overall maximum tip height ceiling of 1179.5m as suggested by Air Services Australia.

32. ***Written confirmation from the Civil Aviation Safety Authority is to be provided, based on the final layout of the wind farm.***

It is suggested the development approval conditions require written confirmation from CASA on final layout of the wind farm.

As outlined in our Information Request Response to Mareeba Shire Council, April 2014 (Information Request 59, Response c)) the wind farm development enters into the Pre-construction project phase after the receipt of State and Federal development approval/s. The Pre-construction project phase involves the formal tender process for detailed design and construction of the wind farm. The tender process would also include the selection of the chosen wind turbine manufacturer / contractors, carrying out detailed design and undertaking pre-construction works.

It is during this period that the process of micro-siting is undertaken by the successful tenderer, which allows the finalisation of the wind turbine layout (based on the chosen wind turbine model) and the location of site infrastructure on the subject property.

33. ***Written confirmation from the Department of Defence is to be provided (based on the final layout).***

It is suggested the development approval conditions require written confirmation from Department of Defence on final layout of the wind farm.

As outlined in our Information Request Response to Mareeba Shire Council, April 2014 (Information Request 59, Response c)) the wind farm development enters into the Pre-construction project phase after the receipt of State and Federal development approval/s. The Pre-construction project phase involves the formal tender process for detailed design and construction of the wind farm. The tender process would also include the selection of the chosen wind turbine manufacturer / contractors, carrying out detailed design and undertaking pre-construction works.

It is during this period that the process of micro-siting is undertaken by the successful tenderer, which allows the finalisation of the wind turbine layout (based on the chosen wind turbine model) and the location of site infrastructure on the subject property.

H. WIND

34. ***The number of monitoring sites in relation to the size of the proposed wind farm and the complex terrain is unusually low. This adds to the uncertainty of the wind resource and calculated energy yield. A final wind turbine layout should be supplied with the turbine locations, information on size and capacity to provide certainty in relation to the energy yield assessments in the complex terrain around Emerald Hill.***

Information pertaining to the quality of the wind resource assessment and subsequent energy yield analysis is considered to be part of the overall financial viability of the project and as such is considered to be more relevant to any decision to proceed from the Mt Emerald Wind Farm Board rather than part of the development approval.

Wind Resource assessment at the Mount Emerald site commenced in May 2010, with the installation of two monitoring towers (1 x 80m tower and 1 x 50m tower). Each tower includes monitoring equipment installed at multiple levels to measure wind speed and direction, temperature and humidity.

In addition to these towers, two additional measuring devices (SODAR) which utilise sound waves, have been installed across the site to provide further coverage and reduce the uncertainty associated with the assessment. These units are easily transportable and do not require tall structures to be built to enable data to be collected at the heights required. By incorporating these units along with the tower installations, a robust understanding of the site wind resource can be compiled.

The current preferred wind turbine layout is provided in response to Information Request 31.

I. PLANNING

35. ***Provide justification, including reference to appropriate standards where applicable in respect of the 100m micro-siting tolerance included within the application material. This is considered a large variable distance for 'micro-siting'.***

Micro-siting is a critical component of the pre-construction detailed design work, allowing the final wind turbine layout and the location of site infrastructure to occur on the subject property.

The location of each wind turbine is subject to a number of influencing factors, which include:

- compliance to development approval conditions at State and Federal level/s;
- environmental constraints, such as avoidance of significant vegetation and habitat areas;
- turbine model;
- final wind speed and energy yield analysis;

- constructability, which takes into consideration geotechnical / civil engineering considerations;
- accessibility;
- land owner input;
- turbine manufacturers recommendations; and
- resource and cost-efficiency.

The Best Practice Guidelines for Implementation of Wind Energy Projects in Australia, confirms micro-siting to involve;

> *'on the ground siting of wind turbines to ensure compliance with permit conditions, ensure appropriate spacing between wind turbines, identify any peculiar local features that may assist/detract from energy production and to avoid any potential construction issues. Micro-siting will be carried out with regards to site constraints….'* Clean Energy Council (2013, p29).

In recognition of the above factors MEWF have requested a 100m micro-sighting tolerance. This request is in-line with the Collector and Boco Rock Wind Farms, New South Wales, which were approved in 2013 and 2010 respectively. In both approvals the Department of Planning & Infrastructure (DOPI) defined micro-Sighting as;

> *'a location allowance of 100 metres radius for Project components as long as impacts remain consistent with that assessed.'* (Collector Wind Farm - DOPI, 02/12/ 2013; p.2) (Boco Rock Wind Farm - DOP, 09/08/2010; p.4)

Further reference can be made to the NSW Land and Environment Court (Taralga Landscape Guardians v. Minister for Planning [NSWLEC 2007]) which considered, in relation to turbine or other component relocation at the Taralga Wind Farm, that a *'…250m relocation of any of the elements is not unreasonable'.*

In regard to Wind Farm Codes/Guidelines, we can confirm the draft Queensland Wind Farm State Code (April 2014), associated draft Queensland Wind Farm Planning Guideline (April 2014) and the Best Practice Guidelines – For Implementation of Wind Energy Projects in Australia (Clean Energy Council 2013) do not provide guidance on a relevant distance allowed for micro-siting.

Reference can however be made to the 2011 draft NSW Planning Guidelines-Wind Farms whereby micro-siting is defined as;

> '*…up to 100m from each turbine's nominated location will generally be permitted…'*.(NSW DOPI December 2011,p 36).

Further reference can also be made to the 2010 National Wind Farm Development Guidelines – draft, produced by the Environment Protection and Heritage Council (EPHC) which defines micro-siting as *'small adjustments to turbine position (typically less than 100m) subsequent to planning approval but prior to construction, usually to account for practical factors affecting constructability'* (EPHC July 2010, p 156).