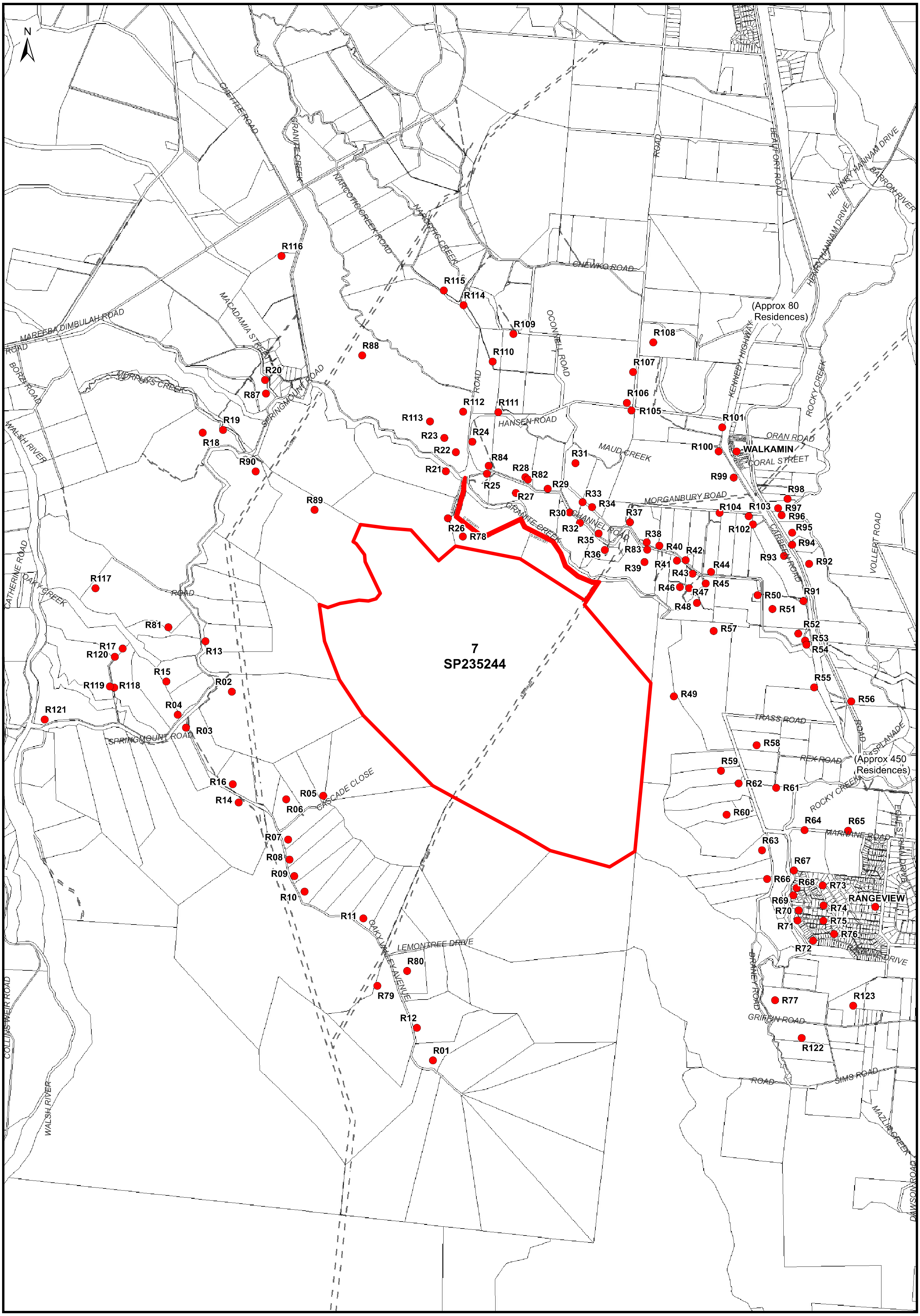
# APPENDIX A WIND FARM LAYOUT DETAILS

## A1 Wind farm site plan



N
7
SP235244
(Approx 80 Residences)
(Approx 450 Residences)
WALKAMIN
RANGEVIEW
CHETTLE ROAD
GRANITE CREEK
NARCOTIC CREEK ROAD
NARCOTIC CREEK
CHEWKO ROAD
OCONNELL ROAD
BEAUFORT ROAD
HENRY HANNAM DRIVE
BARRON RIVER
KENNEDY HIGHWAY
ROCKY CREEK
ORAN ROAD
CORAL STREET
MORGANBURY ROAD
MAUD CREEK
HANSEN ROAD
CHANNEL ROAD
CARBETH ROAD
VOLLERT ROAD
MAREEBA DIMBULAH ROAD
MACADAMIA STREET
MURPHYS CREEK
SPRINGMOUNT ROAD
BORZI ROAD
WALSH RIVER
CATHERINE ROAD
OAKY CREEK
TRASS ROAD
REX ROAD
MARNANE ROAD
CASCADE CLOSE
LEMONTREE DRIVE
OAKY VALE AVENUE
GRIFFIN ROAD
SIMS ROAD
MAZLIN CREEK
DAWSON ROAD
COLLINS WEIR ROAD
R116
R115
R114
R109
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R87
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R112
R111
R105
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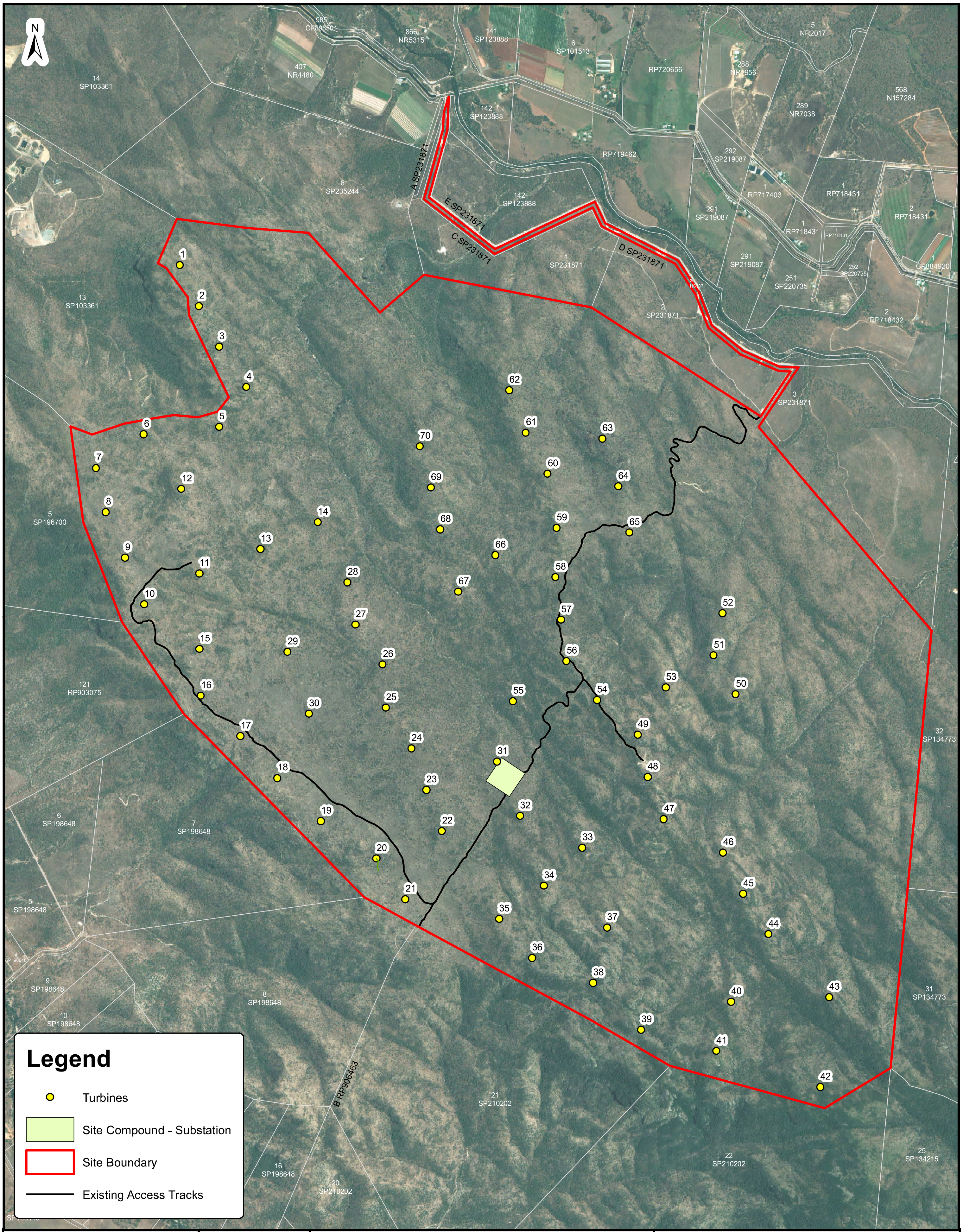


0 250 500 750 1,000
Meters (A3)

DIGITAL CADASTRAL DATA BASE - BOUNDARY INFORMATION, DERM AERIAL PHOTOGRAPHIC
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The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.

Date of Capture: August 2008.

Draft SP248138 - area to be opened as road (DERM ref 2011/006477)

| | |
|---|---|
| Project Manager | M. Jess |
| Compiled by | N.Watts |
| Map Projection | MGAz55 |
| Map Datum | GDA94 |
| File Reference | PR100246-146.mxd |
| Sheet Number | 1 of 1 |

Client
Ratch Australia Corporation Limited

Title
# Proposed turbine layout and substation position at Mt Emerald.



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| SCALE (A3) | DATE | DRAWING NO. | ISSUE |
|---|---|---|---|
| 1:24,000 | 20-9-2013 | PR100246-146 | 1 |

## A2 Turbine locations

| Turbine | GPS Coordinates (GDA94 Zone 55) | | Turbine | GPS Coordinates (GDA94 Zone 55) | |
|---|---|---|---|---|---|
| | Easting | Northing | | Easting | Northing |
| T1 | 325792 | 8103791 | T36 | 328292 | 8098872 |
| T2 | 325927 | 8103500 | T37 | 328824 | 8099088 |
| T3 | 326071 | 8103211 | T38 | 328726 | 8098695 |
| T4 | 326263 | 8102926 | T39 | 329067 | 8098362 |
| T5 | 326071 | 8102642 | T40 | 329705 | 8098561 |
| T6 | 325535 | 8102589 | T41 | 329600 | 8098212 |
| T7 | 325197 | 8102351 | T42 | 330338 | 8097956 |
| T8 | 325266 | 8102037 | T43 | 330401 | 8098594 |
| T9 | 325402 | 8101713 | T44 | 329970 | 8099041 |
| T10 | 325539 | 8101383 | T45 | 329790 | 8099328 |
| T11 | 325930 | 8101603 | T46 | 329648 | 8099620 |
| T12 | 325803 | 8102201 | T47 | 329228 | 8099859 |
| T13 | 326364 | 8101775 | T48 | 329113 | 8100157 |
| T14 | 326771 | 8101965 | T49 | 329043 | 8100457 |
| T15 | 325931 | 8101065 | T50 | 329738 | 8100745 |
| T16 | 325941 | 8100734 | T51 | 329581 | 8101021 |
| T17 | 326222 | 8100448 | T52 | 329644 | 8101320 |
| T18 | 326484 | 8100150 | T53 | 329242 | 8100793 |
| T19 | 326793 | 8099845 | T54 | 328753 | 8100703 |
| T20 | 327187 | 8099577 | T55 | 328157 | 8100695 |
| T21 | 327392 | 8099290 | T56 | 328537 | 8100981 |
| T22 | 327652 | 8099773 | T57 | 328498 | 8101272 |
| T23 | 327542 | 8100066 | T58 | 328458 | 8101575 |
| T24 | 327436 | 8100361 | T59 | 328466 | 8101926 |
| T25 | 327254 | 8100649 | T60 | 328402 | 8102310 |
| T26 | 327232 | 8100956 | T61 | 328248 | 8102601 |
| T27 | 327039 | 8101238 | T62 | 328130 | 8102902 |
| T28 | 326982 | 8101539 | T63 | 328792 | 8102560 |
| T29 | 326556 | 8101046 | T64 | 328903 | 8102219 |
| T30 | 326708 | 8100606 | T65 | 328983 | 8101892 |
| T31 | 328045 | 8100267 | T66 | 328031 | 8101732 |
| T32 | 328206 | 8099881 | T67 | 327768 | 8101472 |
| T33 | 328648 | 8099655 | T68 | 327640 | 8101915 |
| T34 | 328376 | 8099384 | T69 | 327574 | 8102211 |
| T35 | 328058 | 8099149 | T70 | 327496 | 8102505 |

## A3 Receiver locations

| Receiver | GPS Coordinates (GDA94 Zone 55) | | Receiver | GPS Coordinates (GDA94 Zone 55) | |
|---|---|---|---|---|---|
| | Easting | Northing | | Easting | Northing |
| R01 | 327108 | 8094240 | R63 | 333180 | 8098115 |
| R02 | 323399 | 8101041 | R64 | 333966 | 8098486 |
| R03 | 322551 | 8100377 | R65 | 334769 | 8098473 |
| R04 | 322401 | 8100614 | R66 | 333273 | 8097584 |
| R05 | 325084 | 8099119 | R67 | 333769 | 8097741 |
| R06 | 324402 | 8099053 | R68 | 333818 | 8097418 |
| R07 | 324438 | 8098311 | R69 | 333759 | 8097284 |
| R08 | 324461 | 8097943 | R70 | 333858 | 8097008 |
| R09 | 324552 | 8097638 | R71 | 333837 | 8096819 |
| R10 | 324741 | 8097351 | R72 | 334122 | 8096447 |
| R11 | 325824 | 8096858 | R73 | 334300 | 8097467 |
| R12 | 326812 | 8094840 | R74 | 334315 | 8097097 |
| R13 | 322913 | 8101970 | R75 | 334312 | 8096814 |
| R14 | 323526 | 8098996 | R76 | 334510 | 8096570 |
| R15 | 322190 | 8101228 | R77 | 333420 | 8095349 |
| R16 | 323417 | 8099332 | R78 | 327662 | 8103902 |
| R17 | 321385 | 8101835 | R79 | 326084 | 8095615 |
| R18 | 322861 | 8105817 | R80 | 326633 | 8095887 |
| R19 | 323237 | 8105869 | R81 | 322227 | 8102228 |
| R20 | 324011 | 8106789 | R82 | 328862 | 8104954 |
| R21 | 327346 | 8105105 | R83 | 331064 | 8103659 |
| R22 | 327532 | 8105458 | R84 | 328138 | 8105207 |
| R23 | 327320 | 8105720 | R87 | 324029 | 8106539 |
| R24 | 327836 | 8105651 | R88 | 325804 | 8107243 |
| R25 | 328105 | 8105059 | R89 | 324925 | 8104393 |
| R26 | 327385 | 8104239 | R90 | 323839 | 8105103 |
| R27 | 328640 | 8104706 | R91 | 333946 | 8102712 |
| R28 | 328814 | 8104996 | R92 | 334049 | 8103397 |
| R29 | 329227 | 8104783 | R93 | 333585 | 8103544 |
| R30 | 329632 | 8104345 | R94 | 333738 | 8103749 |
| R31 | 329738 | 8105254 | R95 | 333737 | 8103972 |
| R32 | 329821 | 8104154 | R96 | 333543 | 8104296 |
| R33 | 329870 | 8104536 | R97 | 333476 | 8104424 |
| R34 | 330044 | 8104444 | R98 | 333652 | 8104597 |
| R35 | 330166 | 8103957 | R99 | 332659 | 8104989 |
| R36 | 330281 | 8103655 | R100 | 332380 | 8105473 |

| Receiver | GPS Coordinates (GDA94 Zone 55) | | Receiver | GPS Coordinates (GDA94 Zone 55) | |
|---|---|---|---|---|---|
| | Easting | Northing | | Easting | Northing |
| R37 | 330744 | 8104165 | R101 | 332447 | 8105917 |
| R38 | 331053 | 8103796 | R102 | 333013 | 8104126 |
| R39 | 331012 | 8103431 | R103 | 332934 | 8104276 |
| R40 | 331286 | 8103732 | R104 | 332397 | 8104339 |
| R41 | 331610 | 8103457 | R105 | 330771 | 8106228 |
| R42 | 331773 | 8103467 | R106 | 330687 | 8106366 |
| R43 | 331900 | 8103216 | R107 | 330802 | 8106936 |
| R44 | 332241 | 8103249 | R108 | 331175 | 8107484 |
| R45 | 332142 | 8103035 | R109 | 328594 | 8107639 |
| R46 | 331667 | 8102969 | R110 | 328212 | 8107130 |
| R47 | 331836 | 8102949 | R111 | 328314 | 8106195 |
| R48 | 331981 | 8102675 | R112 | 327666 | 8106205 |
| R49 | 331555 | 8100953 | R113 | 327055 | 8106025 |
| R50 | 333099 | 8102820 | R114 | 327675 | 8108169 |
| R51 | 333372 | 8102564 | R115 | 327309 | 8108440 |
| R52 | 333849 | 8102111 | R116 | 324316 | 8109076 |
| R53 | 333977 | 8101981 | R117 | 320884 | 8102947 |
| R54 | 334001 | 8101907 | R118 | 321231 | 8101117 |
| R55 | 334143 | 8101119 | R119 | 321148 | 8101136 |
| R56 | 334828 | 8100860 | R120 | 321240 | 8101684 |
| R57 | 332290 | 8102160 | R121 | 319947 | 8100527 |
| R58 | 333082 | 8100051 | R122 | 333913 | 8094653 |
| R59 | 332424 | 8099580 | R123 | 334862 | 8095248 |
| R60 | 332526 | 8098770 | RANGEVIEW | 335269 | 8097070 |
| R61 | 333441 | 8099268 | WALKAMIN | 332711 | 8105470 |
| R62 | 332750 | 8099348 | | | |

## APPENDIX B ACOUSTIC TERMINOLOGY

| | |
|---|---|
| **Ambient** | The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source. |
| **dB** | Decibel. The unit of sound level. |
| **dBA** | A-weighted decibel. The A-weighting approximates the response of the human ear |
| **dBG** | G-weighted decibel. The G-weighting, as specified in ISO 7196:1996, approximates the response of the human ear to sound in the infrasound region. |
| **Frequency** | Sound can occur over a range of frequencies extending from the very low, such as the rumble of thunder, up to the very high such as the crash of cymbals. Sound is generally described over the frequency range from 63Hz to 4000Hz (4kHz). This is roughly equal to the range of frequencies on a piano. |
| **Infrasound** | Sound at frequencies less than 20 Hz. |
| **Octave Band** | A range of frequencies where the highest frequency included is twice the lowest frequency. Octave bands are referred to by their logarithmic centre frequencies, these being 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound. |

Noise is often not steady. Traffic noise, music noise and the barking of dogs are all examples of noises that vary over time. When such noises are measured, the noise level can be expressed as an average level, or as a statistical measure, such as the level exceeded for 90% of the time.

| | |
|---|---|
| $L_{A90}$ | The noise level exceeded for 90% of the measurement period, measured in dBA. This is commonly referred to as the background noise level. |
| $L_{Aeq}$ | The equivalent continuous sound level. This is commonly referred to as the average noise level and is measured in dBA. |
| $L_{pAL,F}$ | The A-weighted sound pressure level at low frequencies, found by summing the sound pressure levels in each one-third octave band from 10 Hz to 160 Hz. |
| $L_{WA}$ | The A-weighted sound power level is a logarithmic ratio of the acoustic power output of a source relative to $10^{-12}$ watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source. |

# APPENDIX C QUEENSLAND NOISE ASSESSMENT TOOLS

## C1 Environmental Protection Act 1994

Queensland's *Environmental Protection Act 1994* provides a regulatory mechanism for managing noise. The objective of the 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).*

The act defines environmental nuisance as

> *...unreasonable interference or likely interference with an environmental value caused by –*
>
> *(a) aerosol fumes, light, noise* [...]

Section 440 of the act includes for local noise laws to be prescribed by local governments while also providing nominal guidance for a range of common noise sources such as pumps, air conditioners, indoor and outdoor venues and transport noise. No specific guidance is offered for wind farm noise.

## C2 Environmental Protection Regulation 2008

To achieve to object of the EPA 1994, general noise guidance is provided in the *Environmental Protection Regulation 2008* and *Environmental (Noise) Protection Regulation 2008* (EPP Noise 2008) though not directly in relation to noise from wind farms.

EPP Noise 2008, in particular, details a series of acoustic quality objectives along with methods for controlling background creep[14].

*Acoustic quality objectives*

The acoustic quality objectives for dwellings are detailed in Table 14 below.

[14] An iterative increase in background noise levels in an area from the introduction, over time, of a range of noise sources which are required to satisfy noise limits based on background noise levels.

**Table 14: EPP Noise 2008 Acoustic quality objectives**

| 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 |

*Controlling background creep*

Regarding the control of background creep, Section 10 of the EPP Noise 2008 states the following:

> *(2) To the extent that it is reasonable to do so, noise from an activity must not be—*
>
> *(a) for noise that is continuous noise measured by $L_{A90,T}$—more than nil dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$; or*
>
> *(b) for noise that varies over time measured by $L_{Aeq,adj,T}$—more than 5dB(A) greater than the existing acoustic environment measured by $L_{A90,T}$.*

## C3 Ecoaccess draft document Guideline: Assessment of low frequency noise

Item S5(b) of the PSA 01/11 requires consideration of both audible and inaudible noise. We understand that inaudible noise is referenced to address levels of infrasound.

The Queensland EPA Ecoaccess draft document *Guideline: Assessment of low frequency noise* (LFN Guideline) provides assessment guidance for low frequency noise. The guideline discusses both low frequency noise and infrasound and while it claims to be "*...intended for planning purposes as well as for the evaluation of existing problems,"* much of the guidance relates only to in-situ measurements to address complaints. The application of the LFN Guideline to wind farm noise assessment is therefore somewhat unclear, particularly given that the document remains in draft form. Nonetheless, criteria proposed by the guideline are noted below.

*Low frequency noise*

The LFN Guideline defines low frequency sound as "*sound in the frequency range of 10 Hz to 200 Hz"* and outlines a four step assessment procedure as detailed in Table 15 below.

Table 15: LFN Guideline assessment phases

| Phase | Outline | Comments |
|---|---|---|
| 1. Initial screening | Where a noise imission occurs with an unbalanced frequency spectrum, the overall indoor sound pressure level us to be measured and where it exceeds 50 dB(Linear) further investigation is required. | While this initial screening process is intended to determine whether a detailed assessment is required, it does not provide a means of establishing whether a frequency spectrum is unbalanced or not. |
| 2. Audibility assessment | This phase is framed as a measurement tool as it, for example, requires review of recorded sounds and listening studies. The intent of this phase is to establish whether an alleged low frequency noise is likely to be audible.<br><br>This phase requires comparison of $L_{Aeq}$ and $L_{LINeq}$ levels, measurement of 1/3 octave band levels from 10 Hz to 200 Hz and comparison with hearing threshold curves for the best 10% of the population aged 55-60 years. | The Guideline notes that this phase is:<br><br>*"...intended for use in cases where an individual complains about low frequency noise and a decision needs to be made as to whether the particular noise is audible.*<br><br>*This assessment does no verify whether the noise is annoying or not. A sound that is audible is not necessarily unacceptable."*<br><br>For a planning phase assessment without measurements assessing the audibility of a sound is impractical. |
| 3. Annoyance due to tonal noise | The guideline provides a simple tonality assessment method based on comparison of adjacent one-third octave band levels and also details acceptable criteria for tonal noise based on time of day and tone frequency. | One-third octave band turbine sound power level data in the low frequency regions can be reviewed for tones according to the method detailed in the LFN Guideline.<br><br>Additionally, tonal audibility results assessed according to IEC61400-11 for candidate turbines can provide an indication of the presence of low frequency tones. It should be noted however, that the IEC standard typically does not include assessment of sound below approximately 50Hz. |
| 4. Annoyance due to non-tonal noise | Non-tonal noise is to be assessed by determining the A-weighted noise level in the frequency range 10 Hz to 160 | The guideline does not offer any method for predicting levels of low frequency noise prior during the planning phase. However, the Danish EPA 1284 document published in 2011* provides a method for estimating expected levels of low frequency noise from a wind farm, and similarly applies a criteria of 20 dB $L_{pAL,F}$.<br><br>In the absence of a suitable methodology for predicting LFNs in the guideline, it is considered appropriate to reference this Danish document. |

* Danish EPA document *Statutory Order on Noise from Wind Turbines (Translation of Statutory Order no. 1284 of 15 December 2011)*

Phases 1 and 2 as outlined above appear to be exclusively intended to address complaints of existing noise.

On this basis, it is considered appropriate for a planning stage assessment of low frequency noise to address Phases 3 and 4.

*Infrasound*

The LFN Guideline defines"*…sound in the frequency range below 20 Hz…*" as infrasound and provides recommended indoor G-weighted noise limits as detailed in Table 16 below.

**Table 16: Recommended limits for infrasound indoors**

| Type of Space | G-weighted sound level (dB) |
|---|---|
| Dwellings during day, evening and night | 85 |
| Inside classrooms and offices | 85 |
| Occupied rooms in commercial enterprises | 90 |

## C4 Recommended approach to assessment

The assessment of wind farm noise detailed in NZS6808:2010, as detailed in Section 2.0, 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[15], 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.

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

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.

To address the additional PSA 01/11 requirement for consideration of inaudible noise, a supplementary assessment of low frequency noise and infrasound is also detailed in this assessment, referencing criteria detailed in the LFN Guideline and using a range of available planning phase assessment methods to account for the lack of guidance offered by the LFN Guidelines.

## C5 Discussion

The level of a noise is one of many factors which influence how that noise is perceived; other factors are not related to the level, and include non-acoustic factors such as an individual's attitude to the noise in question, and the perceived benefits of the source of noise in question. Accordingly, whilst a policy may impose strict requirements to limit a noise source to low levels, the subjective nature of the way noise is perceived means that it is not possible to ensure an individual will consider the noise to be acceptable; there will always be a portion of the population which will experience a degree of annoyance to an audible sound. Importantly, no objective criterion can categorically define an audible level below which no individual would experience annoyance – it is a matter of individual opinion. The core objective of wind farm noise policies is to balance the advantage of developing wind energy projects, with protecting the amenity of the surrounding community from adverse noise impacts. Compliance with these policies may result in wind turbine noise being audible at some locations for some of the time.

# APPENDIX D REVIEW OF LAND ZONING

The Tablelands Regional Council is currently in the process of developing a new planning scheme which will replace a set of four existing planning schemes for the Atherton, Eacham, Herberton and Mareeba Shires. We understand that the proposed MEWF is positioned across the Mareeba Shire and Atherton Shire.

## D1 Mareeba Shire Council

2004 Mareeba Shire Council planning maps show the MEWF and surrounding area zoned as Rural. Item 4.77.2(b) of the Mareeba Shire Planning Scheme (Version 1/2007) notes the following:

*(2) The overall outcomes sought for the Rural zone code are to achieve an area:*
- *(a) that caters for a range of primary industries including forestry and aquaculture to contribute to the economic well being of the Mareeba Shire;*

## D2 Atherton Shire council

Similarly, the 2002 Atherton Shire Planning Scheme shows the relevant sections of the MEWF and surrounding area which fall within the Atherton Shire zoned as Rural (GQAL). Part C, 1.1 of the planning scheme notes the following:

*The Rural Areas include all Good Quality Agricultural Land (GQAL) in the Shire and other rural areas.*
*The Structure Plan Map illustrates the preferred settlement pattern for the Shire. This pattern provides for urban and rural residential development in a manner that minimises the impact of these land uses on agriculture.*
*Maintaining efficient rural production is critical to the social and economic well-being of the Shire*

## D3 Tablelands Regional Council

The TRC Draft Planning Scheme (downloaded 27 April 2003) shows the MEWF and surrounding area zoned as Rural, General Rural and Rural, Good Quality Agricultural Land. In relation to these zones, Section 6.2.1.2 Item (1) of the draft plan notes the following:

*The purpose of the Rural zone code is to:*
- *(a) provide for a wide range of rural uses including cropping, intensive horticulture, intensive animal industries, animal husbandry, animal keeping and other primary production activities;*

## APPENDIX E A-WEIGHTED NOISE PREDICTION MODEL

Environmental noise levels associated with wind farms are predicted using engineering methods. The international standard ISO 9613 *Acoustics – Attenuation of sound during propagation outdoors* has been chosen as the most appropriate method to calculate the level of broadband A-weighted wind farm noise expected to occur at surrounding receptor locations. This method is considered to be the most robust and widely used international method for the prediction of wind farm noise.

The use of this standard is supported by international research publications, measurement studies conducted by Marshall Day Acoustics and direct reference to the standard in the South Australian EPA 2009 wind farm noise guidelines, AS4959:2010 *Acoustics – Measurement, prediction and assessment of noise from wind turbine generators* and NZS6808:2010 *Acoustics – Wind farm noise*.

The standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the source 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 the ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion. In this respect, it is noted that at the wind speeds relevant to noise emissions from wind turbines, atmospheric conditions do not favour the development of thermal inversions throughout the propagation path from the source to the receiver.

To calculate far-field noise levels according to the ISO 9613, the noise emissions of each turbine are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

- Geometric divergence
- Air absorption
- Reflecting obstacles
- Screening
- Vegetation
- Ground reflections

The octave band attenuation factors are then applied to the noise emission data to determine the corresponding octave band and total calculated noise level at receiver locations.

Calculating the attenuation factors for each effect requires a relevant description of the environment into which the sound propagation such as the physical dimensions of the environment, atmospheric conditions and the characteristics of the ground between the source and the receiver.

Wind farm noise propagation has been the subject of considerable research in recent years. These studies have provided support for the reliability of engineering methods such as ISO 9613 when a certain set of input parameters are chosen in combination. Specifically, the studies to date tend to support that the assignment of a ground absorption factor of G=0.5 for the source, middle and receiver ground regions between a wind farm and a calculation point tends to provide a reliable representation of the upper noise levels expected in practice, when modelled in combination with other key assumptions; specifically all turbines operating at identical wind speeds, emitting sound levels equal to the test measured levels plus a margin for uncertainty (or guaranteed values), at a temperature of 10 degrees and relative humidity of 70% to 80%, with specific adjustments for screening and ground effects as a result of the ground terrain profile.

In support of the use of ISO 9613 and the choice of G=0.5 as an appropriate ground characterisation, the following references are noted:

- A factor of G=0.5 is frequently applied in Australia for general environmental noise modelling purposes as a way of accounting for the potential mix of ground porosity which may occur in regions of dry/compacted soils or in regions where persistent damp conditions may be relevant
- NZS6808:2010 refers to ISO 9613 as an appropriate prediction methodology for wind farm noise, and notes that soft ground conditions should be characterised by a ground factor of G=0.5
- In 1998, a comprehensive study[16] (commonly cited as the *Joule Report*), part funded by the European Commission found that the ISO 9613 model provided a robust representation of upper noise levels which may occur in practice, and provided a closer agreement between predicted and measured noise levels than alternative standards such as CONCAWE and ENM. Specifically, the report indicated the ISO 9613 method generally tends to marginally over-predict noise levels expected in practice
- The UK Institute of Acoustics journal dated March/April 2009 published a joint agreement between practitioners in the field of wind farm noise assessment (the *2009 joint IoA agreement*), including consultants routinely employed on behalf of both developers and community opposition groups, and indicated the ISO 9613 method as the appropriate standard and specifically designated G=0.5 as the appropriate ground characterisation. It is noted that this publication specifically referred to predictions made to receiver heights of 4m in the interest of representing 2-storey dwellings which are more common in the UK. Predictions in Australia are generally based on a lower prediction height of 1.5m which tends to result in higher ground attenuation factors for a given ground absorption factor, however conversely, predictions in Australia do not generally incorporate a -2dB factor (as applied in the UK) to represent the relationship between $L_{Aeq}$ and $L_{A90}$ noise levels. The result is that these differences tend to balance out to a comparable approach and thus supports the use of G=0.5 in the context of Australian prediction methodologies.

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

- A range of comparative measurement and prediction studies[17, 18, 19] for wind farms in which Marshall Day Acoustics' staff have been involved in have provided further support for the use of ISO 9613 and G=0.5 as an appropriate representation of typical upper noise levels expected to occur in practice.

The key findings of these studies demonstrated the suitability of the ISO 9613 method to predict the propagation of wind turbine noise for:

- the types of noise source heights associated with a modern wind farm, extending the scope of application of the method beyond the 30m maximum source heights considered in the original ISO 9613;
- the types of environments in which wind farms are typically developed, and the range of atmospheric conditions and wind speeds typically observed around wind farm sites. Importantly, this supports the extended scope of application to wind speeds in excess of 5m/s.

In addition to the choice of ground absorption factor referred to above, the ISO 9613 standard has also been used with due regard to the recommended adjustments for terrain recommended in the Joule Report. The following adjustments have been made:

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

These methodologies are also supported by the UK Institute of Acoustics document *A Good Practice Guide to the application of ESTU-R-97 for the Assessment and Rating of Wind Turbine Noise.*

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[17] Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions: The Risks of Conservatism*; Presented at the Second International Meeting on Wind Turbine Noise in Lyon, France September 2007

[18] Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions and Comparisons with Measurements*; Presented at the Third International Meeting on Wind Turbine Noise in Aalborg, Denmark June 2009

[19] Delaire, Griffin, & Walsh – *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*; Presented at the Fourth International Meeting on Wind Turbine Noise in Rome, April 2011

## APPENDIX F NOISE CONTOUR MAPS

Operational noise levels from the proposed Mount Emerald Wind Farm have been predicted using the implementation of ISO9613-2:1996 in SoundPLAN version 7.2 with due consideration of recommendations from the Joule Report.

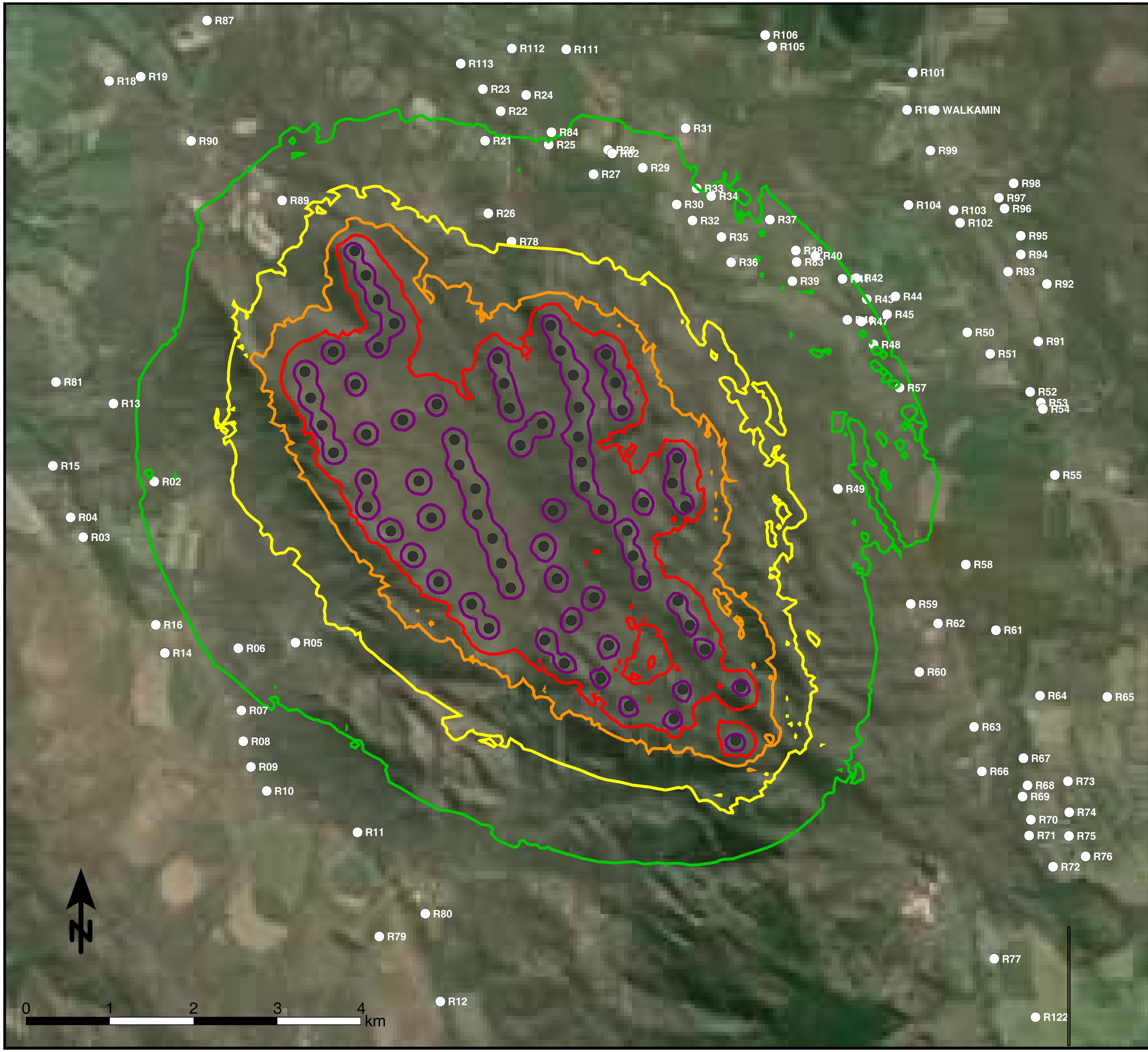
Assessing the Joule Report recommendations requires exporting ISO 9613-2:1996 predicted levels from SoundPLAN for post-processing. The post-processing involves consideration of each source-receiver pair and the intervening terrain between the source (wind turbine) and the receiver as well as consideration of the extent of barrier attenuation at each receiver. The Joule Report corrected noise levels will vary from those calculated according to ISO 9613-2:1996 alone, typically by 0dB to 3dB, though potentially up to 5dB in some cases[20].

It is not currently possible to directly apply Joule Report adjustments in the noise modelling software. The noise contour maps generated by SoundPLAN can therefore only relate to ISO 9613-2:1996 predicted levels and do not reflect the Joule Report adjustments.

In order for the contour maps included in this appendix to broadly agree with the predicted levels presented in Section 5.0, the calculations for the noise contours maps have been adjusted. Specifically, the noise contour maps have been calculated using a ground attenuation factor of G=0 in lieu of the ground attenuation factor of G = 0.5 documented in Section 5.0. Despite this adjustment, the noise level contours presented may vary from the levels reported in Section 5.0 by an amount in the range 0dB to 5dB.

The noise contour maps should therefore be considered as **indicative only**. Each map includes the note that the contours presents 'representative noise levels only'. For the predicted noise level calculated with direct allowance for the Joule Report recommendations, please refer to Section 5.0.

[20] Please refer to Appendix E for details regarding the recommendations of the Joule Report.




MARSHALL DAY Acoustics

# Mt Emerald Wind Farm

## 70 x 3XM104 turbines

Predictions in accordance with ISO9613-2
Calculated at 1.5m above ground level

Representative noise levels only
100% hard ground, Joule effects not applied.
Refer to body of report for further details.

**Legend**

- ○ Receiver
- ● Turbine

Noise level (dB $L_{Aeq}$)

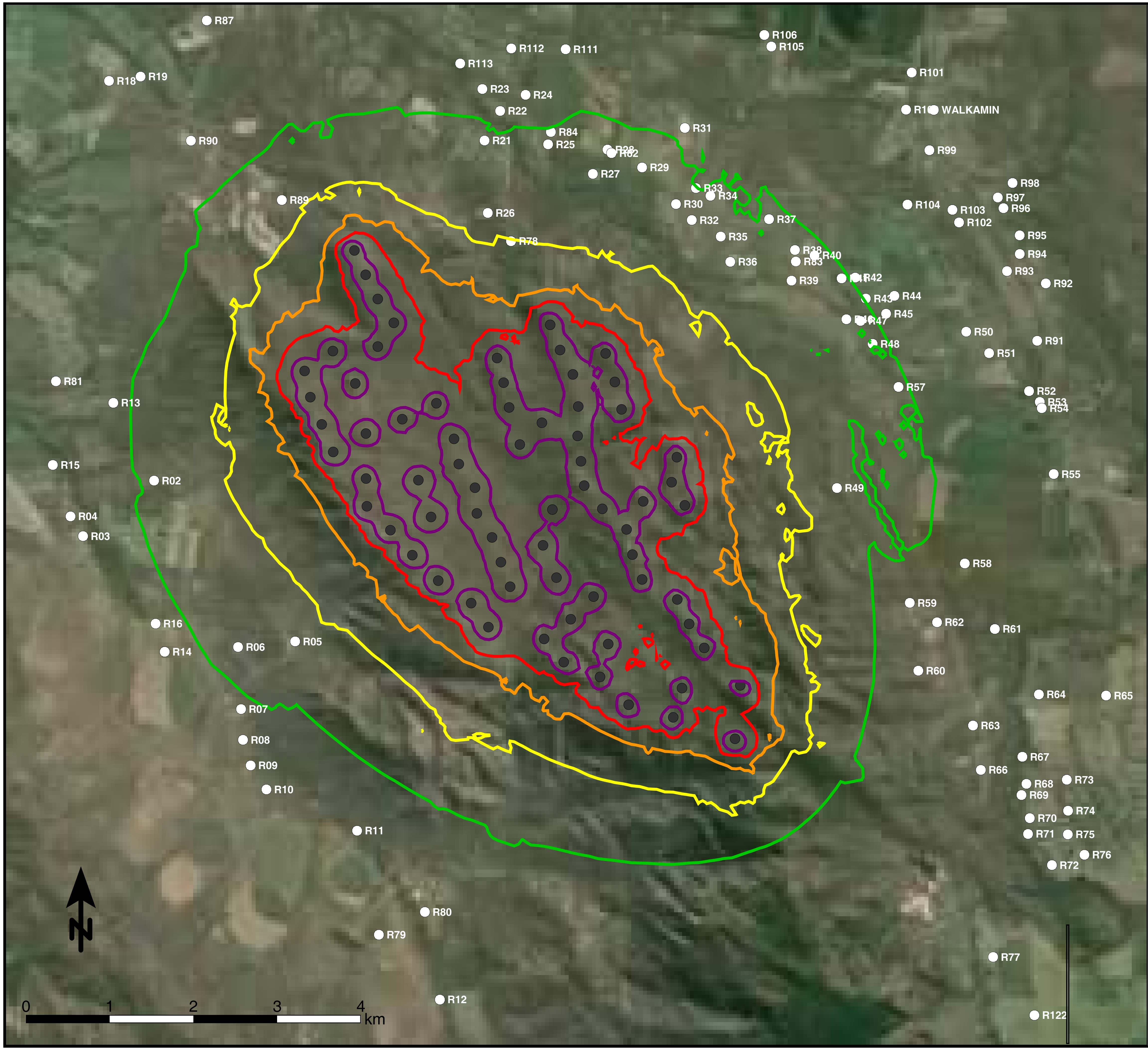
- 35 (green)
- 40 (yellow)
- 45 (orange)
- 50 (red)
- 55 (purple)

26 November 2013

Project Number: 2012376ML

Run details:

401 - 15/11/2013:
70 x 3XM104 Hub height Eq12 Dz-2 G 0_AM




MARSHALL DAY Acoustics

# Mt Emerald Wind Farm

## 70 x SWT101 turbines

Predictions in accordance with ISO9613-2
Calculated at 1.5m above ground level

Representative noise levels only
100% hard ground, Joule effects not applied.
Refer to body of report for further details.

**Legend**

- Receiver
- Turbine

Noise level (dB $L_{Aeq}$)

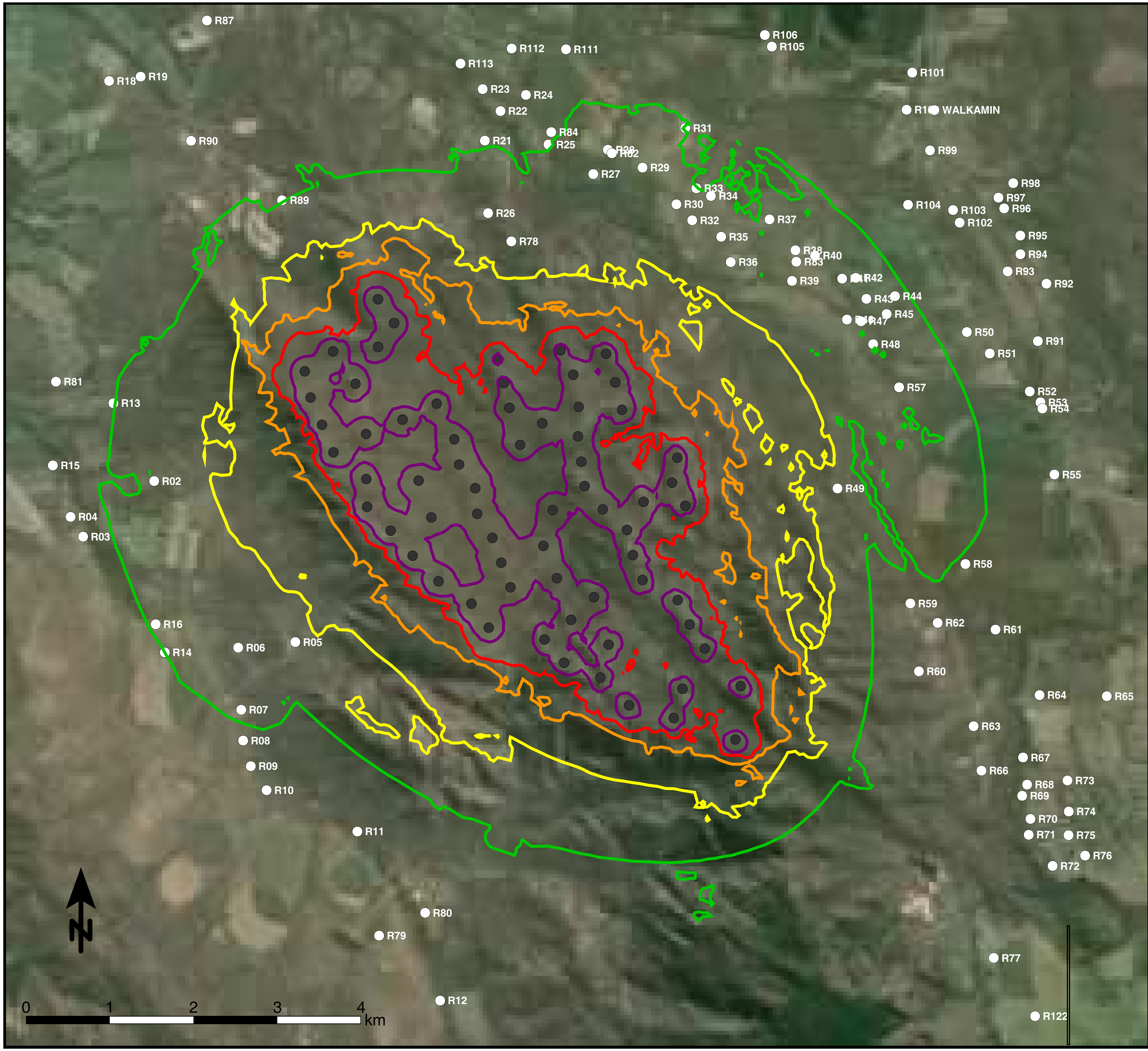
- 35
- 40
- 45
- 50
- 55

26 November 2013

Project Number: 2012376ML

Run details:

007 - 15/11/2013:
70 x SWT 101 Hub height Eq12 dz=0 G 0




MARSHALL DAY Acoustics

# Mt Emerald Wind Farm

## 67 x SWT108 turbines

Predictions in accordance with ISO9613-2
Calculated at 1.5m above ground level

Representative noise levels only
100% hard ground, Joule effects not applied.
Refer to body of report for further details.

**Legend**

Receiver

Turbine

Noise level (dB $L_{Aeq}$)

35
40
45
50
55

26 November 2013

Project Number: 2012376ML

Run details:

400 - 15/11/2013:
67xSWT-3.0-108 Hub height -5dB curtailed Dz=2 Eq12_AM

# APPENDIX G NOISE PREDICTIONS AT LOW FREQUENCIES

## G1 Discussion

In common with many other sources of noise, wind turbines emit infrasound, low frequency sound. These types of sounds are, however, a feature of the everyday environment and arise from a wide range of natural sources such as the wind and the ocean as well as man-made sources such as domestic appliances, transportation and agricultural equipment.

These types of emissions have been the subject of considerable misrepresentation in media commentary. Notably, the work of Dr Geoff Leventhall, a prominent UK consultant in the field of acoustics and vibration, and researcher in the field of low frequency noise is often cited in some documents which continue to claim concerns about infrasound and low frequency noise from wind turbines. However, Dr Leventhall has regularly made clear statements to assert that there is no significant infrasound from current designs of wind turbines and very little low frequency sound, neither of which are anywhere near the sorts of levels which would represent a direct health risk for neighbouring residents of modern wind farms. An example such publication, co-authored by Dr Leventhall, was published in the UK Institute of Acoustics Bulletin in March 2009[21.] This publication was prepared as an agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments. The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. On the subject of infrasound and low frequency noise, the article notes:

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

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

## G2 Predictions methods

The ISO9613-2:1996 prediction method used here for assessment of broadband A-weighted noise levels, has been developed using octave-band algorithms for octave band centre frequencies from 63 Hz to 8 kHz. The nominal lower frequency limit for the method therefore does not encompass the low frequency noise region of the sound spectrum, defined by the LFN Guideline as 20 Hz to 200 Hz for low frequency noise and below 20 Hz for infrasound. Moreover, the method does not extend to the prediction of noise levels inside residential dwellings whereas the LFN Guideline nominates assessment of such levels indoors. On this basis, ISO9613-2:1996 is not preferred for prediction of either $L_{pAL,F}$ noise levels for the low frequency noise region nor $L_{pG}$ noise levels for the infrasound region.

Alternatively, guidance provided in the Danish EPA 1284 document has been developed specifically to provide a suitable planning stage assessment of low frequency wind farm noise inside dwellings, using the $L_{pAL,F}$ descriptor. The Danish EPA method is therefore used here to assess predicted levels of low frequency noise.

Regarding prediction of G-weighted noise levels we are not currently aware of any reliable, validated methods for predicting how infrasound levels propagate away from any particular source, including wind turbines. However, while the Danish EPA method has not been developed specifically for assessment of G-weighted noise levels, the indoor one-third octave band noise levels predicted using the method for the frequency range 10 Hz to 160 Hz can be used to estimate indicative levels of G-weighted noise. In the absence of a suitable prediction method tailored to G-weighted noise levels, results of the Danish method are used here to provide estimates of G-weighted noise levels.

## G3 Sound power level data

For the prediction of both G-weighted and $L_{pAL,F}$ noise levels it is important to note that predictions carry a greater margin of uncertainty than A-weighted predictions, owing to the greater uncertainty associated with the measured or reported sound power level data for the nominated turbines. Test standard IEC 61400-11[22], which is the common reference for sound power level data reported by manufacturers, details a method for measuring wind turbine sound power levels at frequencies of 20-50 Hz and greater. The standard does not provide any detailed methodology for measuring within the frequency regions for infrasound or low frequency noise.

One-third octave band sound power level test data for the REpower 3XM104 turbine is available at low frequencies, from 10 Hz upwards, for standardised 10m AGL wind speeds in the range 6 m/s to 10 m/s.

Sound power level data for the SWT-3.0-101 and SWT-3.0-108 turbines is reported for one-third octave band centre frequencies of 10 Hz and greater.

[22] *Wind Turbine Generator Systems – Part 11 Acoustic Noise Measurement Techniques*

Quoted uncertainty values for one-third octave band sound levels are not provided in the manufacturers' literature. In our experience, reported uncertainty values at low frequencies can range from +/-1dB up to approximately +/-6dB at frequencies below 63Hz. These uncertainty values are considered typical of the range likely to apply for other similar size turbines, depending on the specific circumstances in which the sound power test is carried out.

To provide a conservative appraisal of sound power levels for the 3XM104 turbine below 100 Hz, for each one-third octave band the highest sound power level has been selected from the quote range of wind speeds. For one-third octave bands of 100 Hz and greater, warranted levels have been used, consistent with the approach detailed in Section 5.4.

Sound power level data between 10 Hz and 160 Hz for the candidate turbines is presented in Table 17 below.

**Table 17: Sound power level data in the low frequency region**

| | One-third octave band centre frequency (Hz) A-weighted | | | | | | |
|---|---|---|---|---|---|---|---|
| **$L_{WA}$ (dB)** | **10** | **12.5** | **16** | **20** | **25** | **31.5** | **40** |
| Repower 3XM104 | 44.8 | 52.4 | 54.5 | 63.9 | 66.9 | 70.6 | 75.9 |
| Siemens SWT-3.0-101 | 46.4 | 51.0 | 56.7 | 61.9 | 66.7 | 71.7 | 78.1 |
| Siemens SWT-3.0-108 | 52.5 | 56.2 | 59.9 | 63.6 | 67.3 | 69.8 | 73 |
| **$L_{WA}$ (dB)** | **50** | **63** | **80** | **100** | **125** | **160** | |
| Repower 3XM104 | 78.8 | 81.5 | 83.6 | 87.2 | 88 | 91.8 | |
| Siemens SWT-3.0-101 | 78.9 | 81.4 | 85.2 | 87.1 | 89.7 | 89.9 | |
| Siemens SWT-3.0-108 | 76.9 | 80.8 | 82.7 | 86.2 | 88.2 | 89.5 | |

## G4 Low frequency tones

For the data in Table 17, the level in any given one-third octave band is not more than 5 decibels greater than the average of the levels in the adjacent two one-third octave bands. On this basis, it is considered that the test for low frequency tones as outlined in the LFN Guidelines is not triggered.

## G5 Low frequency noise predictions

In common with the ISO 9613-2:1996 methodology, to calculate far-field noise levels according to the Danish EPA 1284 method the noise emissions of each turbine are firstly characterised, in the form of one-third octave band frequency levels. A series of one-third octave band attenuation factors are then calculated for the following effects:

- Geometric divergence
- Air absorption
- Ground reflections
- Sound reduction from outdoors to indoors

The octave band attenuation factors are then applied to the noise emission data to determine the corresponding one-third octave band and total calculated noise level at receiver locations. The Danish EPA 1284 document details specific values for each of the above attenuation factors, which are applied directly in the calculations presented here. According to the guideline, the air absorption attenuation factors relate to humidity of 80% and an air temperature of 10%, consistent with the conditions used for A-weighted predicted noise levels as detailed in Section 5.0.

The attenuation factors for sound reduction have been developed for typical Danish building constructions. It's possible that the thermal insulation standards of Danish dwellings may to result in higher sound reduction levels than those that could be expected in Queensland. To account for this possibility, alternative sound reduction levels have been used in the predictions for this assessment. The available sound reduction levels are detailed in Table 18.

**Table 18: Outdoor to Indoor sound reduction levels for calculations of low frequency noise**

| Data Source | One-third octave band centre frequency (Hz) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 12.5 | 16 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | 100 | 125 | 160 |
| Danish EPA 1284 | 4.9 | 5.9 | 4.6 | 6.6 | 8.4 | 10.8 | 11.4 | 13.0 | 16.6 | 19.7 | 21.2 | 20.2 | 21.2 |
| Hoffmeyer & Jakobsen[23]* | 1.2 | 3.2 | 2.1 | 3.6 | 4.6 | 6.7 | 7.6 | 10.3 | 14.2 | 17.5 | 18.4 | 17.5 | 18.6 |
| **For assessment** | **1.2** | **3.2** | **2.1** | **3.6** | **4.6** | **6.7** | **7.6** | **10.3** | **14.2** | **17.5** | **18.4** | **17.5** | **18.6** |

* Level difference in dB expected to be exceeded in 80%-90% of typical Danish dwellings

## G6 Estimated G-weighted noise levels

Table 19 below details estimated G-weighted noise levels inside dwellings for the set of receiver locations detailed in Table 5. It is important to note that these predictions do not predict noise levels across the full G-weighted frequency range[24] and therefore may under-represent that G-weighted noise levels that could occur in practice.

[23] Hoffmeyer, D. & Jakobsen, J., 2010, 'Sound insulation of dwellings at low frequencies', *Journal of low frequency noise and vibration*, **Vol.29** No 1 pp 15-23.

[24] As detailed in International Standard 7196:1995 *Acoustics – Frequency-weighting characteristic for infrasound measurements*, the G-weighting applies to frequencies in the range 0.25 Hz t 315 Hz.

Moreover, while the derivation of sound power level data for the candidate turbines in the low frequency region, as detailed above, is considered conservative, additional prediction tolerances may be necessary to account for the unknown extent of measurement uncertainties for the sound power data and propagation uncertainties for the prediction method.

The highest predicted G-weighted noise level in Table 19 is approximately 72 dB $L_{Geq}$. This allows for a prediction tolerance of more than 10 dB, to account for the uncertainties outlined above, without expected G-weighted noise levels exceeding the LFN Guideline 85 dB criterion.

**Table 19: *Estimated*** G-weighted noise levels from the Mount Emerald Wind Farm, $L_{pG}$ dB**

| House | Turbine model (Hub height wind speed (m/s)) | | | Satisfies the LFN Guideline? |
|---|---|---|---|---|
| | 3XM104 (11 m/s) | SWT-3.0-101 (11 m/s) | SWT-3.0-108 (11 m/s) | |
| R78 | 68 | 68 | 72 | ✓ |
| R26 | 67 | 67 | 71 | ✓ |
| R05 | 67 | 67 | 70 | ✓ |
| R49 | 66 | 66 | 70 | ✓ |
| R89 | 66 | 66 | 70 | ✓ |
| R36 | 66 | 66 | 69 | ✓ |
| R32 | 65 | 65 | 69 | ✓ |
| R30 | 65 | 65 | 69 | ✓ |
| R35 | 65 | 65 | 69 | ✓ |
| R27 | 65 | 65 | 69 | ✓ |
| R06 | 65 | 65 | 69 | ✓ |
| R02 | 65 | 65 | 69 | ✓ |
| R29 | 65 | 65 | 68 | ✓ |
| R33 | 65 | 64 | 68 | ✓ |
| R82 | 65 | 65 | 68 | ✓ |
| R25 | 65 | 65 | 69 | ✓ |
| R39 | 65 | 65 | 68 | ✓ |
| R34 | 64 | 64 | 68 | ✓ |
| R28 | 65 | 65 | 68 | ✓ |
| R84 | 65 | 64 | 68 | ✓ |
| R21 | 65 | 65 | 69 | ✓ |

| House | Turbine model (Hub height wind speed (m/s)) | | | Satisfies the LFN Guideline? |
|---|---|---|---|---|
| | 3XM104 (11 m/s) | SWT-3.0-101 (11 m/s) | SWT-3.0-108 (11 m/s) | |
| R83 | 64 | 64 | 68 | ✓ |
| R46 | 64 | 64 | 68 | ✓ |
| R37 | 64 | 64 | 68 | ✓ |
| R38 | 64 | 64 | 68 | ✓ |
| R40 | 64 | 64 | 68 | ✓ |
| R13 | 64 | 64 | 68 | ✓ |
| R48 | 64 | 64 | 67 | ✓ |
| R47 | 64 | 64 | 67 | ✓ |
| R57 | 64 | 63 | 67 | ✓ |
| R22 | 64 | 64 | 68 | ✓ |
| R07 | 64 | 64 | 68 | ✓ |
| R16 | 64 | 64 | 67 | ✓ |
| R41 | 64 | 63 | 67 | ✓ |
| R24 | 64 | 64 | 67 | ✓ |
| R59 | 64 | 64 | 68 | ✓ |
| R14 | 64 | 63 | 67 | ✓ |

** G-weighted noise levels are estimated here using available data and assessment methods for the frequency range 10 Hz to 160 Hz. Estimated levels are likely to under predict actual G-weighted noise levels.

## APPENDIX H SUMMARY OF MODELING PARAMETERS[25]

### H1 Predictions

(a) Map of the site showing topography, turbines and residential properties: Refer to Appendix A (note the coordinates are referenced to GDA94 Zone 55)

(b) Noise sensitive locations: See Section 4.2 and Appendix A

(c) Wind turbine sound power levels, $L_{WA}$ dB: Refer to Section 3.1.2

(d) Wind turbine models: REpower 3XM104, Siemens SWT-3.0.101 & SWT-3.0-108, details provided in Table 1

(e) Turbine hub height: 80m

(f) Distance of noise sensitive locations from the wind turbines: Refer to Table 5

(g) Calculation procedure used: A-weighted noise modelled developed in SoundPLAN v7.2 using ISO9613-2:1996 prediction algorithm, with adjustments as noted in Section 5.0.

(h) Meteorological conditions assumed:

- Temperature: 10°C
- Relative humidity: 70%
- Atmospheric pressure: 101.325 kPa

(i) Air absorption parameters:

| | Octave band mid frequency (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Description** | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** | **8k** |
| Atmospheric attenuation (dB/km) | 0.12 | 0.41 | 1.04 | 1.93 | 3.66 | 9.66 | 32.8 | 116.9 |

(j) Ground attenuation: G=0.5 (See Appendix E)

(k) Topography/screening: Screening effects in accordance with ISO9613-2:1996 prediction algorithm and the Joule Report as detailed in Appendix E

(l) Predicted far-field wind farm sound levels: Refer to Section 5.0 and Appendix F.

[25] Consistent with information to be reported as detailed in Section 8 of NZS6808:2010.