Coopers Gap Wind Farm
AGL Energy Limited
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Noise and Vibration Impact Assessment

Noise and Vibration Impact Assessment

Environmental Impact Statement

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Quality Information

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Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
0	06-Apr-2016	Technical report for IAR - Draft Report	Mark Herod Principal Environmental Engineer	
1	22-Apr-2016	Technical report for IAR - Draft Report - Updated Hub Heights	Mark Herod Principal Environmental Engineer	
2	10-Aug-2016	Technical report for EIS - Draft Report	Mark Herod Principal Environmental Engineer	
3	08-Sep-2016	Technical report for EIS - Updated Following Adequacy Review	Mark Herod Principal Environmental Engineer	

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1.0 Noise and Vibration Impact Assessment

This report presents the Noise and Vibration Impact Assessment for the Coopers Gap Wind Farm (the Project).

The assessment was conducted in general accordance with the Queensland Department of Infrastructure, Local Government and Planning (DILGP) *Wind Farm State Code Planning Guideline* (referred to in this report as the QLD Code Planning Guideline), dated July 2016.

The performance outcomes from the *Wind Farm State Code* (referred to in this report as the QLD Code), contained in the *State Development Assessment Provisions* (SDAP), effective 22 July 2016, were used as basis to establish applicable noise limits at sensitive receptors.

Background noise measurements were undertaken at 12 representative locations near the Project Site. The monitoring was carried out across three periods, for approximately one month during each period, between 2010 and 2011. This report presents the analysis of these measurements with respect to wind speeds measured around the Project Site, to specify the applicable environmental noise limits at all the nearest residences to the proposed turbines based on the performance outcomes specified in the QLD Code. Wind speed data measured at the meteorological masts on the Project Site for the duration of the noise monitoring periods was provided by AGL and was combined with the noise data measured by AECOM, to establish the applicable noise limits. As the current baseline monitoring is not in strict accordance with the Wind Farm State Code Planning Guidelines, further supplementary monitoring will be undertaken and an updated background noise analysis will be included in future reports. It is not expected that significant changes will occur to the chosen criteria after an updated background noise analysis is undertaken.

A computational noise model was created to predict the noise levels from the operation of the Project at 87 noise sensitive receptors in the vicinity of the Project. The noise limits proposed in this report are expected to be complied with during operation of the Project, based on the results of noise modelling.

A Preliminary Compliance Management Plan has been developed to assess compliance during operation of the Project, and may be found in Appendix H. Compliance measurements will be undertaken at a number of sensitive receptors adjacent to the Project Site during operation of the Project, to demonstrate that compliance with the relevant criteria has been achieved. A compliance methodology has been proposed in this report in lieu to no specific compliance methodology specified in the QLD Code Planning Guideline.

Construction noise and vibration has been addressed in this report in order to meet the operational requirements for construction management of the QLD Code. Whilst there is no legislation in Queensland that specifically sets construction noise or vibration limits, it is anticipated that construction works may include the use of noisy machinery. As such, a detailed construction noise and vibration assessment may be conducted when construction methods are finalised, as per the Department of State Development *Terms of Reference for an Environmental Impact Statement*, effective August 2016. This will help to quantify the extent of the impacts and to incorporate the proposed mitigation options listed within this document.

It is expected that construction noise impacts can be controlled to acceptable levels and that dwelling occupants at distances of 200 metres and greater from the works area would not be impacted by construction vibration.

Acoustic terminology used in this report is summarised in Appendix A.

2.0 Noise and Vibration Criteria

2.1 Wind Farm Operational Noise Limits

The acoustic amenity performance outcomes listed in the QLD Code, contained in the SDAP, were used as basis to establish the applicable noise limits at sensitive receptors. The acoustic amenity material change of use outcomes as per the QLD Code are presented in Table 1.

The QLD Code outlines acoustic amenity criteria for both host and non-host lots, where a host lot is defined as meaning a parcel of land that accommodates any part of a wind farm development, and a non-host lot means a lot no part of which is used for wind farm or part of a wind farm. The criteria applicable for these are outlined in Table 2 and Table 3.

For sensitive receptors to the Project that are located on either host lots, or non-host lots who have an agreed Deed of Release with AGL, as per the QLD Code, are referred to in this report as “Participating Landowners”. A free-field night-time A-weighted equivalent acoustic level (L_{Aeq}) of 45 dB(A) should not be exceeded at these receptors, as per the QLD Code. For all other sensitive receptors on non-host lots where landowners have not entered a commercial agreement with AGL, (referred to in this report as “Non-Participating Landowners”) a baseline 35 dB(A) L_{Aeq} noise limit is applied. The night-time performance outcomes from Table 2 and Table 3 were used to determine the noise limits from the measured background noise levels (see Section 3.0 for details). The night-time noise limits are the most stringent noise limits for assessment.

As there are no performance outcomes included in the QLD Code for low frequency noise emissions, a low frequency noise limit of 60 dB(C) $L_{Ceq,10}$ was used to assess the potential impacts of any low frequency noise emissions, as per the DILGP *Draft Wind Farm State Code*, *Draft Wind Farm State Code Planning Guideline (2015),* and the NSW Department of Planning and Infrastructure *Draft NSW Planning Guidelines: Wind Farms (2011)*.

In cases where landowners do not agree to sign a Deed of Release allowing the noise level to be above the relevant base noise criteria, then the wind farm proponent is required to relocate or remove turbines from the wind farm in order to meet the base noise criteria compliance at this specific residence.

The project includes 19 participating land owners and 68 non-participating landowners.

Table 1 SDAP Wind Farm Development Wind Farm State Code material change of use performance and acceptable acoustic amenity outcomes

Performance Outcomes	Acceptable Outcomes
PO11 The predicted acoustic level at all noise affected existing or approved sensitive land uses does not exceed the criteria stated in Table 1 of the QLD Code (Table 2).	No acceptable outcome is provided.
PO12 The predicted acoustic levels at all noise affected existing or approved sensitive land uses does not exceed the criteria stated in Table 2 of the QLD Code (Table 3). OR Where the acoustic levels stated in Table 2 of the QLD Code (Table 3) cannot be achieved at noise affected existing or approved sensitive land uses: (1) individual written agreements (deed of releases) from non-host lot owners are provided, and (2) the predicted acoustic level at all noise affected existing or approved sensitive land uses does not exceed the criteria stated in Table 1 of the QLD Code (Table 2).	No acceptable outcome is provided.
PO13 Construction activities associated with the development avoid, or minimise and mitigate, adverse impacts on environmental values, water quality objectives, amenity, local transport networks and road infrastructure.	No acceptable outcome is provided.

Table 2 Acoustic amenity criteria as per Table 1 of the QLD Code

Noise Description	Acoustic Level Does Not Exceed
The outdoor (free-field) night-time (10pm to 6am) A-weighted equivalent acoustic level (LAeq), assessed at all noise affected existing or approved sensitive land uses.	(1) 45dB(A), or (2) the background noise (LA90) by more than 5dB(A), whichever is the greater, for wind speed from cut-in to rated power of the wind turbine and each integer wind speed in between referenced to hub height.

Table 3 Acoustic amenity criteria as per Table 2 of the QLD Code

Noise Description	Acoustic Level Does Not Exceed
The outdoor (free-field) night-time (10pm to 6am) A-weighted equivalent acoustic level (LAeq), assessed at all noise affected existing or approved sensitive land uses.	(1) 35dB(A), or (2) the background noise (LA90) by more than 5dB(A), whichever is the greater, for wind speed from cut-in to rated power of the wind turbine and each integer wind speed in between referenced to hub height.
The outdoor (free-field) day-time (6am to 10pm) A-weighted equivalent acoustic level (LAeq), assessed at all noise affected existing or approved sensitive land uses.	(1) 37dB(A), or (2) the background noise (LA90) by more than 5dB(A), whichever is the greater, for wind speed from cut-in to rated power of the wind turbine and each integer wind speed in between referenced to hub height.

2.2 Infrastructure Associated with the Project

The Project will include an operation and maintenance building and some other minor support infrastructure. Assessment of noise emission from this infrastructure has not been conducted at this stage. It is considered unlikely that noise emission from this equipment will cause any issues at the closest receivers due to the minor nature of the equipment and significant distances to the closest residences. Nevertheless, a requirement for suppliers to provide equipment that achieves the relevant steady-state noise emission criteria will be included in the specification and compliance with the relevant criteria will be confirmed with post construction noise monitoring.

The *Environmental Protection Act 1994* (EPA Act), *Division 3 – Default Noise Standards* has been referred to for the determination of noise limits to specific noise sources, where applicable. The EPA Act provides noise limits for noise sources of steady state nature, which can be applied to establish a noise criterion for steady-state noise emission of infrastructure related to the Project, other than the turbines.

2.3 Wind Farm Construction Noise and Vibration Limits

The QLD Code performance outcome PO13 for construction management is outlined in Table 1. The QLD Code Planning Guideline specifies that a construction management plan is to be prepared by a suitably qualified person, identifying all potential construction impacts and the proposed measures to be undertaken to avoid, manage and mitigate the identified impacts.

This plan should include a:

- description and location of sensitive uses that may be affected by noise, vibration and dust emissions from the construction work
- description of the activities and equipment likely to generate noise, vibration and dust emissions
- description of the noise, vibration and dust impact control measures to be implemented to minimise noise, vibration and dust impacts at sensitive uses
- description of the methods to be used to monitor performance and receive, record and respond to complaints.

Construction of the Project has the potential to cause noise and/or vibration impacts. Criteria and goals relating to construction noise and vibration impacts and mitigation measures are further discussed in Section 7.0.

3.0 Background Noise Monitoring

The acoustic environment in the area was evaluated by undertaking a background noise monitoring program within the vicinity of the Project. Noise monitoring locations were selected to represent areas that are expected to have the greatest noise impact from the Project.

The monitoring was carried out across three periods, for approximately one month during each period, between 2010 and 2011. Both wind speed and noise data was collected as an average for each 10 minute measurement throughout and the monitoring. In all cases, the microphone was located a minimum of 1.2 metres above the ground and at least 5 metres from any reflecting surface, including buildings or significant vegetation such as trees and away from existing significant noise sources where practicable in order to get an indication of the typical acoustic environment at noise sensitive receptors.

In the absence of a Queensland wind farm guideline at the time of measurements, background noise monitoring was undertaken following guidance from the South Australian EPA *Wind farms environmental noise guidelines* (SA 2009) and also in accordance with Australian Standard *AS4959-2010 Acoustics-Measurement, prediction and assessment of noise from wind turbine generators*. Details of measurements conducted previously and where these deviate from the requirements of the QLD Code Planning Guideline are presented in Table 4.

As the current baseline monitoring is not in strict accordance with the Wind Farm State Code Planning Guidelines, supplementary monitoring will be undertaken and an updated background noise analysis will be included in future reports. It is not expected that significant changes will occur to the chosen criteria after an updated background noise analysis is undertaken.

Table 4 Noise measurement details and QLD Wind Farm State Code Planning Guideline

Parameter	Measurement Details	QLD Wind Farm State Code Planning Guideline Requirements	Impact
Instrument noise floor	22 dB(A) or less (manufacturer spec)	No greater than 20 dB(A)	The impact of this difference is expected to be minimal as processed background noise in the assessed turbine wind speed is above 20 dB(A)
Measurement location	Expected to have the greatest noise impact from the Project	On the wind farm side of the dwelling, as far as practicable from potential sources of domestic noise and vegetation noise sources. Should not be screened from the proposed wind farm site. Preferably include receptors in all direction(s) from the wind farm	Minimal impact as measurements at expected most sensitive receptors results in assessment of worst-condition
Best fit regression curves	Single curve for day and night	Separate curves for day and night	It is expected that a single day and night data set will result in a regression curve that is more accurate than producing separate regression curves for day and night. A single curve is expected to be more representative of the general noise environment at each site. Future supplementary monitoring results will be processed in accordance with this requirement.

The background noise data collected at each site was correlated with wind speed data measured at the closest meteorological mast to each location. The data measured by the masts at various heights was extrapolated to a hub height of 84 metres above the ground.

Data from the following masts was correlated with the noise data:

- CG1 – Location G and I
- CG2 – Location O and Y
- CG4 – Location AD
- CG5 – Locations C, F, J, A, BD, AA and CF

The noise monitoring locations and the meteorological mast locations used to correlate wind data with noise are listed in Table 5 and are shown in Appendix B. Photographs of the noise monitors installed at these sites are provided in Appendix C.

Table 5: Background noise monitoring locations

Location and ID	GPS coordinates (GDA 1994 Projection MGA Zone 56 co-ordinate system)	
	Easting	Northing
CG1	347122	7042866
1. G	346205	7042906
2. I	343380	7043809
CG2	345634	7039537
3. O	339757	7041616
4. Y	345865	7038516
CG4	348402	7039566
5. AD	350475	7038587
CG5	336703	7048697
6. C	336802	7049669
7. F	341674	7047086
8. J	341089	7045504
9. A	340109	7046343
10. BD	340438	7049413
11. AA	346822	7038250
12. CF	349763	7038201

The QLD Wind Farm Planning Guideline states that:

> *"The monitoring duration shall be approximately six weeks to provide sufficient noise data for day and night periods. Any shorter duration should be justified."*

Most monitoring locations had monitoring periods of greater than six weeks. It is again noted that supplementary monitoring will be undertaken and the duration of this monitoring will be in accordance with the duration requirement above.

3.1 Instrumentation

Details of the instrumentation used to record noise levels and copies of calibration certificates are provided in Appendix D. All the instruments used carried a current calibration certificate from a National Association of Testing Authorities (NATA) accredited laboratory or by the instrument manufacturer, if the monitor was less than two years old.

Rion NL-21 sound level meters were used to conduct measurements. These monitors are Class 2 instruments suitable for background noise measurements. The instruments were calibrated in the field at the start and end of the measurement periods using a Rion NC-74 acoustic calibrator. No significant drift in calibration was observed.

4.0 Background Noise Levels and Project Noise Limits

From the monitored noise and wind speed data, regression curves were plotted and used to determine $L_{Aeq,10min}$ noise criteria for the wind farm at sensitive receptors. The correlation between wind speed and background noise level was calculated by least-squares regression formulas. Data periods where rain was recorded or where the measurements appear to have been affected by potential sources of domestic noise and/or other extraneous noise have been excluded from the assessment. The regression curves and equations are presented in Appendix E.

The background noise levels determined using the curve of best fit at the measured receptor locations are summarised in Table 6.

Background analysis was based on a hub height of 84 m, however future supplementary measurements will be processed in accordance with the QLD Code, at a hub height of 115 m. It is expected that the impact of this change on limits will be minimal.

The noise limits determined from the measured background noise levels listed in Table 6 and the noise criteria presented in Section 2.0, are presented in Table 7. Where noise limits were obtained from extrapolated values, these have been **bolded** in the table. Further, Table 7 considers the different baseline $L_{Aeq,10min}$ values of 45 dB(A) and 35 dB(A) for participating and non-participating sensitive receptors respectively (see noise criteria discussion in Section 2.0). 10 m/s is a typical rated speed for turbines of similar size to those proposed for this Project.

It is noted that for a majority of noise monitoring locations, no valid data points were collected at high wind speeds (~18 m/s and above). As such, obtaining noise limits based on measured noise levels rather than from extrapolation may not be possible because of the irregularity of higher wind speeds at the Project Site.

The noise limits at receptors where noise monitoring was not conducted were determined from the background noise levels measured at the closest sensitive receptor where noise levels were measured.

In addition to the $L_{Aeq,10min}$ noise limits, a low frequency noise limit of 60 dB(C) $L_{Ceq,10}$ has been applied in order to assess the potential impacts of any low frequency noise emissions.

Table 6: Background noise levels as $L_{A90,10min}$ in dB(A), as per the QLD Wind Farm State Code, hub height of 84 metres.

Location ID	Background $L_{A90,10min}$ versus wind speed (m/s) at hub height of 84 m						
	4	5	6	7	8	9	10
A	30	32	33	35	36	37	39
AA	23	24	25	26	27	28	29
AD	27	28	30	31	32	33	35
BD	31	33	34	35	35	36	37
C	33	33	34	34	35	36	36
CF	21	22	23	24	26	27	28
F	30	31	32	34	35	36	37
G	28	29	30	31	32	34	35
I	33	33	33	34	35	36	37
J	34	34	35	35	35	36	36
O	29	29	30	31	32	34	35
Y	32	32	33	34	35	35	36

Table 7: $L_{Aeq,10min}$ noise limits at all noise sensitive receptors

Location ID	Participating Landowner?	Closest measured receptor	Minimum noise limit, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																
			Base Criterion	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	YES	A	45	45	45	45	45	45	45	45	45	46	47	48	48	49	50	**50**	**51**	**51**
AA	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	**48**	**50**	**52**
AB	YES	CF	45	45	45	45	45	45	45	45	45	45	45	45	45	**45**	**45**	**45**	**46**	**48**
AC	YES	CF	45	45	45	45	45	45	45	45	45	45	45	45	45	**45**	**45**	**45**	**46**	**48**
AD	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AE	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AF	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AG	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AH	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AI	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AJ	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AK	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AL	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AM	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AN	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AO	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AP	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AQ	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	**47**	**47**	**48**
AR	NO	F	35	35	36	37	39	40	41	42	43	43	44	44	45	45	45	**45**	**45**	**44**
AS	NO	F	35	35	36	37	39	40	41	42	43	43	44	44	45	45	45	**45**	**45**	**44**
AT	NO	F	35	35	36	37	39	40	41	42	43	43	44	44	45	45	45	**45**	**45**	**44**

Location ID	Participating Landowner?	Closest measured receptor	Minimum noise limit, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																
			Base Criterion	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AU	NO	F	35	35	36	37	39	40	41	42	43	43	44	44	45	45	45	**45**	**45**	**44**
AV	NO	F	35	35	36	37	39	40	41	42	43	43	44	44	45	45	45	**45**	**45**	**44**
AW	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	**47**	**47**	**48**
AX	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	**54**	**56**	**58**
AY	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	**47**	**47**	**48**
AZ	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	**47**	**47**	**48**
B	YES	A	45	45	45	45	45	45	45	45	45	46	47	48	48	49	50	**50**	**51**	**51**
BA	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	**47**	**47**	**48**
BB	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	**47**	**47**	**48**
BD	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	**47**	**47**	**48**
BE	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	**47**	**47**	**48**
BF	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	**54**	**56**	**58**
BG	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	**54**	**56**	**58**
BH	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	**54**	**56**	**58**
BI	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	**54**	**56**	**58**
BJ	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	**54**	**56**	**58**
BK	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
BL	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
BM	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
BN	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
BO	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
BP	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**

Location ID	Participating Landowner?	Closest measured receptor	Minimum noise limit, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																
			Base Criterion	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
BQ	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BR	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BS	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BT	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BU	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BV	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BW	NO	Y	37	37	37	38	39	40	40	41	42	43	44	45	46	48	49	50	52	53
BX	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52
BY	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52
BZ	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52
C	YES	C	45	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58
CA	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CB	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CC	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CD	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CE	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CF	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CG	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58
CH	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
CHURCH 1	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
CHURCH 2	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
D	YES	C	45	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58

Location ID	Participating Landowner?	Closest measured receptor	Minimum noise limit, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																
			Base Criterion	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
E	YES	F	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	**45**	**45**	**45**
F	YES	F	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	**45**	**45**	**45**
G	YES	G	45	45	45	45	45	45	45	45	45	45	45	47	49	51	53	55	57	60
H	YES	G	45	45	45	45	45	45	45	45	45	45	45	47	49	51	53	55	57	60
I	NO	I	38	38	38	38	39	40	41	42	44	45	47	50	52	**55**	**58**	**62**	**65**	**69**
J	YES	J	45	45	45	45	45	45	45	45	45	45	45	45	45	47	48	**50**	**52**	**55**
K	NO	A	35	35	37	38	40	41	42	44	45	46	47	48	48	49	50	**50**	**51**	**51**
L	NO	A	35	35	37	38	40	41	42	44	45	46	47	48	48	49	50	**50**	**51**	**51**
O	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
P	YES	O	45	45	45	45	45	45	45	45	45	45	45	46	48	50	**52**	**54**	**56**	**58**
Q	YES	O	45	45	45	45	45	45	45	45	45	45	45	46	48	50	**52**	**54**	**56**	**58**
R	YES	O	45	45	45	45	45	45	45	45	45	45	45	46	48	50	**52**	**54**	**56**	**58**
S	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
T	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
U	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
V	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	**52**	**54**	**56**	**58**
W	YES	Y	45	45	45	45	45	45	45	45	45	45	45	45	46	**48**	**49**	**50**	**52**	**53**
X	YES	Y	45	45	45	45	45	45	45	45	45	45	45	45	46	**48**	**49**	**50**	**52**	**53**
Y	YES	Y	45	45	45	45	45	45	45	45	45	45	45	45	46	**48**	**49**	**50**	**52**	**53**
Z	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	**48**	**50**	**52**

5.0 Wind Farm Operational Noise Modelling

A three-dimensional computer noise model of the proposed wind farm site was created in SoundPLAN Version 7.4 acoustic modelling software, in order to predict future noise levels for the project. Environmental noise predictions were carried out using the algorithms from ISO 9613.2:1996 *Acoustics – Attenuation of Sound during propagation outdoors – Part 2: General method of calculation*, as implemented by the SoundPLAN software package and as required by the QLD Wind Farm Planning Guideline. Results from the model are discussed in Section 6.0.

5.1 Noise Model Inputs

The following data was used to create the computer model:

- Topographical ground contours for the wind farm site and surrounding area, received from AGL on 7 December 2010.
- Proposed project layout, developed in July 2016. The wind turbines were entered at hub height of 117 metres above ground level.
- Receiver locations, determined from aerial photograph and cadastral data overlaid on the ground contours. Sensitive receptors were entered in the model at a height of 4 metres above ground level.

An aerial view of the Project showing the location of turbines and sensitive receptors is provided in Appendix B.

The following parameters were entered in the computer model:

- Atmospheric conditions at 10°C and 70% temperature humidity.
- 90% Hard ground (0.1 ground factor). The QLD Code Planning Guideline specifies an input of 50% acoustically hard ground and 50% acoustically soft ground and therefore the modelling takes a conservative approach.
- The noise modelling is undertaken for 'worst case' conditions, which occur when the wind blows from the turbines towards each residence. Noise levels will be lower at the residences when the wind blows upwind, or at cross winds, from the residence. A conservative assumption was made by considering that wind is blowing from each turbine to every receptor.
- No penalty for tonality was applied (0.0 dB penalty): The QLD Wind farm Planning Guideline states that:

  > *"A correctly operating wind turbine may exhibit sound with tonal characteristics. These characteristics can be minimised or avoided by careful design and/or mitigation measures. Wind farm developers should avoid installation of wind turbines which exhibit sound with tonal characteristics by specifying the supply of wind turbines from a manufacturer which guarantees that the supplied wind turbines will not exhibit tonal characteristics at residences."*

  Based on the statement above, it has been assumed that the turbines for the Project will not emit tonal behaviour and that appropriate maintenance will be conducted by the wind farm operator to ensure that the noise emission of the turbines is not adversely affected by turbine wear, resulting in audible tonality. Further, it is expected that tonality would not be an audible feature at the distances separating the turbines from the receptors.
- Barrier attenuation has not been altered in the noise model; however the majority of receptors already experience less than 1 dB of barrier attenuation.
- 4 m receiver height
- The conservative modelling approach and lack of significant concave ground profiles has meant that no application of a 3 dB(A) correction for a concave ground profile has been used. Areas where $h_m \geq (1.5 \times |h_s - h_r| \times 0.5)$ (as outlined in the QLD Code Planning Guideline) were not observed based on the current turbine layout.
- A sound power level (L_W) for a typical 3.6 MW turbine of 107 dB(A) has been assumed. This value was based on a typical 3.6 MW performance specification, for which the maximum sound level for this turbine ranges from 104.9 dB(A) to 108 dB(A). The chosen value is therefore on the conservative end of the range.

A reference sound power spectra from a 3.0 MW Vestas V112 wind turbine with an overall level of 106.5 dB(A) has been used in noise predictions. The reference sound power level, as entered in the model, is presented in Table 7. The reference sound power was adjusted to an overall sound power of 107 dB(A). The sound power spectra used in modelling extends beyond the minimum sound power level reporting requirement between 63 Hz to 4 kHz stated in the QLD Wind Farm Planning Guideline. It is noted that ISO 9613-2 is based on empirical corrections to inverse square law that are generally valid only down to 63 Hz.

Table 8 Sound power level spectra used for the computer model

Overall dB(A)	1/3 octave frequency band (Hz) noise level, in dB(linear)														
	25	31	40	50	63	80	100	125	160	200	250	315	400	500	630
107	114	112	112	110	111	109	107	107	102	100	101	100	97	98	97
	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	
	96	97	97	96	95	94	93	92	89	89	89	88	85	80	

The sound power level presented above is a physical property of a wind turbine, not a sound pressure level as experienced by a listener. At the base of a wind turbine the sound pressure level experienced is approximately 60 – 65 dB(A), depending on the turbine.

The QLD Code Planning Guideline requires noise emissions from a wind turbine development to comply with an L_{Aeq} noise criteria. Wind farm noise emission cannot be measured with an L_{Aeq} descriptor so an L_{A90} descriptor is used for compliance measurements. The QLD Code Planning Guideline has been interpreted such that compliance with an $L_{Aeq} = L_{A90}$ criteria is required.

Therefore, a relationship of $L_{Aeq} = L_{A90}$ was used to model the windfarm Layout.

6.0 Wind Farm Operational Noise Impacts

Appendix F presents the results from the outdoor noise compliance assessment for the proposed turbine layout, during worst-case turbine noise emissions. These predicted noise levels were developed through computational modelling, as outlined in Section 5.0. The noise levels presented are $L_{Aeq,10min}$ noise levels at the receptors, and have been assessed against the noise limits presented in Table 7. The noise predictions comply with the Project noise limits at all receptors.

Appendix F also presents the low frequency noise compliance assessment for the for the turbine layout during worst-case turbine noise emissions. The noise levels presented in the table are free-field $L_{Ceq,10min}$ noise levels at the receptors, assessed against a 60 dB(C) night time limit. The noise predictions comply with this noise limit at all but one receptor. This low frequency noise limit was exceeded by less than 1 dB(C) at receptor G. This receptor is a Participating Landowner and the likelihood of a complaint from this receptor is minimal. Furthermore the conservative assumptions made when building the model mean that the measured noise levels would likely be lower than those predicted as part of this assessment. As such, noise compliance at receptor G with a 60 dB(C) noise limit is expected.

Noise maps showing contours for 35 dB(A) $L_{Aeq,10min}$ and 45 dB(A) $L_{Aeq,10min}$ for non-participating and participating landowners, respectively, are provided in Appendix G. A noise map showing a 60 dB(C) contour is also presented in Appendix G. It is noted that the noise contour maps are generated based on a grid of calculations which are interpolated to generate the contours. Single point calculations shown in Appendix F should be referred to for specific levels at a receptor.

6.1 Cumulative Impacts

No new or proposed developments have been identified within the Study Area that are likely to result in combined or successive noise impacts with the Project. Cumulative noise impacts to sensitive receptors are therefore considered to be unlikely.

7.0 Wind Farm Noise Compliance Measurements

Compliance noise measurements will be undertaken at a number of the sensitive receivers adjacent to the Project Site once the wind farm is operational in order to demonstrate that compliance with the relevant criteria has been achieved.

A Preliminary Compliance Management Plan has been developed to incorporate a compliance measurement methodology. This plan may be found in Appendix H. It is noted that the QLD Wind Farm Planning Guideline does not establish a methodology for conducting compliance noise measurements on wind farms; therefore the compliance measurement methodology was developed following guidance from the following documents:

- NSW Department of Planning & Infrastructure *Draft NSW Planning Guidelines – Wind Farms*, December 2011
- Victoria Department of Planning and Community Development *Policy and Planning Guidelines for development of wind energy facilities in Victoria, July 2012*
- New Zealand Standard NZS6808:2010 *Acoustics – Wind farm noise*

It is proposed that the final Compliance Management Plan is approved by DILGP prior to commencement of construction of the Project. Testing should be undertaken once all noise sources associated with the Project are in operating mode, i.e. all turbines have been commissioned and are operating correctly.

8.0 Wind Farm Construction Noise and Vibration Impacts

This section addresses the noise and vibration impacts related to the construction of the Coopers Gap wind farm, as per the noise and vibration information requirements from the Department of State Development *Terms of Reference for an Environmental Impact Statement*, effective August 2016. A detailed construction noise and vibration assessment may be required by the contractor when construction methods are finalised.

8.1 Construction Activities

This report addresses construction noise and vibration in general terms. Specific details of the construction methodology and equipment are not known at this early stage of the Project.

It is anticipated that the construction work may include excavation, rock hammering, drilling and bulldozing. Noise will be generated by mobile plant such as excavators, bulldozers, mobile cranes and semi-trailers delivering or removing material from construction sites. It is expected that the following typical equipment will be used:

- Excavators
- Tracked bulldozers
- Semi-trailers
- Tractors
- Mobile cranes
- Concrete trucks.

It is recommended that construction plant be selected on the basis of low noise emission. Noise emissions from construction plant can be reduced by fitting exhaust mufflers, using reversing alarms that emit a broadband noise (e.g. white noise) rather than a beep, maintaining plant in good working order and following best practice construction methodologies. A Construction Environment Management Plan (CEMP) should be developed to manage possible noise and vibration impacts from construction.

8.2 Construction Phase Noise Criteria

There is no legislation in Queensland that specifically sets construction noise limits. For construction activity in Queensland, the *Environmental Protection Act 1994* states that:

"A person must not carry out building work in a way that makes an audible noise –

a. On a business day or Saturday, before 6:30am or after 6:30pm; or

b. On any other day, at any time."

Thus noise from construction activity is generally controlled through limiting the hours of operation, and through application of best practice management techniques.

A number of 'good practice' mitigation measures have been outlined below to reduce noise and vibration impacts associated with construction of the Project and to minimise the likelihood of adverse comment from nearby residents. Construction outside of the hours listed above typically requires permission from a governing authority (e.g. the Department of Environment and Heritage Protection) and advance warning to nearby locations.

The CEMP should outline the recommended hours of work and mitigation measures to be implemented.

8.3 Construction Vibration Guideline - Human Response to Vibration

To assess perceptible vibration to humans, AECOM recommends the use of vibration criteria from the Australian Standard AS 2670.2 - 1990 *Evaluation of human exposure to whole-body vibration - Part 2: Continuous and shock induced vibration in buildings (1 to 80Hz).*

These criteria are summarised in Table 9. Both continuous and intermittent vibrations are assessed. Earthmoving construction equipment will typically operate between 6:30am and 6:30pm, Monday to Saturday. Accordingly only daytime criteria have been shown. Where out of hours construction is proposed, consultation with surrounding residences will need to be undertaken.

Table 9: AS2670 Extract - Human Comfort Vibration Limits (8Hz to 80Hz)

Space Occupancy	Time of Day	Peak Vibration Levels in mm/s over the frequency range 8 Hz to 80Hz likely to cause "adverse comment"			
		Continuous Vibration		Intermittent Vibration and Impulsive Vibration excitation with several occurrences per day	
		Vertical	Horizontal	Vertical	Horizontal
Residential	Day	0.6 mm/s	1.6 mm/s	12.6 mm/s	36 mm/s
Workshops	Day	1.2 mm/s	3.2 mm/s	18 mm/s	51 mm/s

8.4 Construction Vibration Guideline - Structural Response to Vibration

International standards exist for vibration-induced damage to structures and can provide guidance on acceptable limits. These documents are commonly used to assess structural response to vibration throughout Australia.

The German standard DIN 4150 Part 3, and British Standards BS 5228 Part 4 and BS 7385 Part 2 recommend vibration criteria relating to structural damage of buildings. These standards are considered to be best practice in Australia. The criteria from the standards are summarised in Table 10 and Table 11.

Table 10: DIN 4150 Vibration Criteria, in PPV (mm/s)

Line	Structure Type	Guideline vibration values			
		Vibration at foundation			
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	Vibration at horizontal plane of highest floor at all frequencies
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design or occupancy	5	5 to 15	15 to 20	15
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 or 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10	8

Table 11: BS 5228-4 Criteria, in PPV (mm/s)

Structure	Intermittent			Continuous		
	<10 Hz	10-50 Hz	> 50 Hz	<10 Hz	10-50 Hz	> 50 Hz
Soundly constructed residential properties	5	10	20	2.5	5	10
Industrial and commercial – light	10	20	40	5	10	20
Industrial and commercial – heavy	15	30	60	7.5	15	30

The criteria in BS 5228-4 are generally more stringent than those in DIN 4150. It is recommended that the Project adopts an objective of complying with the intermittent vibration levels specified in BS 5228-4 (i.e. Table 11), with the levels specified in DIN 4150 (i.e. Table 10) as an upper limit.

8.5 Construction Vibration Criteria Summary

The BS 5228-4 criteria for intermittent vibration in "Soundly constructed residential properties" apply to the construction area and will be used as the construction vibration guideline for this Project.

Table 12: BS 5228-4 Criteria, in PPV (mm/s)

Structure	Intermittent		
	<10 Hz	10-50 Hz	> 50 Hz
Soundly constructed residential properties	5	10	20

A summary of the vibration criterion in relation to human comfort is given below in Table 13.

Table 13: AS2670 Extract - Human Comfort Vibration Limits (8Hz to 80Hz)

Space Occupancy	Time of Day	Peak Vibration Levels in mm/s over the frequency range 8 Hz to 80Hz likely to cause "adverse comment"			
		Continuous Vibration		Intermittent Vibration and Impulsive Vibration excitation with several occurrences per day	
		Vertical	Horizontal	Vertical	Horizontal
Residential	Day	0.6 mm/s	1.6 mm/s	12.6 mm/s	36 mm/s
Workshops	Day	1.2 mm/s	3.2 mm/s	18 mm/s	51 mm/s

8.6 Proposed Mitigation Options: Construction Noise and Vibration

It is noted that there exists the potential for noise impacts to surrounding residents during the construction of the Project. Appropriate techniques need to be implemented to minimise these impacts. The CEMP will outline these measures.

8.7 Noise Mitigation Measures

To minimise the impacts of construction noise the EPC Contractor will prepare a Construction Noise and Vibration Management Plan which outlines the proposed methodology and monitoring procedures to be put in place for the duration of the works. The Construction Noise and Vibration Management Plan will incorporate the following as a minimum:

- Community Noise Consultation
    - Regular consultation with noise sensitive receptors to provide details of the construction plan and duration of predicted construction noise. For example advising noise sensitive receptors of the duration and activities they can expect (e.g. which turbine locations in their vicinity are having the concrete pads laid, expected time until the construction crews will return to commence installing towers, etc.)
    - Advanced notice of road works
    - Advise local councils of planned construction works to assist in complaint management
    - Preparation of a noise complaints procedure and register
    - Letterbox drops.
- Site Management
    - Limit construction hours to Monday to Saturday, 6.30am to 6.30pm, where it is practicable to do so. Construction activities undertaken outside of these hours are to be minimised, particularly those that are likely to have some noise impact such as earthworks activities
    - The contractor should keep residents informed of when any noisy construction works will occur
    - Where practicable, upgrade local roads both before and after the construction of the Project to minimise the effect of heavy vehicle movements

- Selection and location of site access roads as far away from noise-sensitive receptors as possible. The contractor shall work closely with landowners who are affected by site roads and ensure minimal disruption to their operations
- Careful selection of the main site office and turbine component stockpile to minimize disruption to sensitive receivers
- Vehicles and plant should not be left idling unnecessarily
- All engine exhausts should be fitted with suitable and well maintained mufflers / silencers
- Any noisy fixed plant should be located in a suitable acoustic enclosure away from residential locations
- Care should be taken not to drop materials to cause peak noise events, including materials from a height into a truck
- Machines that are used intermittently should be shut down in the intervening periods between works, or throttled down to a minimum
- It is noted that the construction of the Project will involve progressively moving through the area as various construction activities are undertaken. Regularly moving particularly noisy pieces of equipment through the area during construction where practical can reduce the noise impact duration on surrounding residences
- The reversing of vehicles should be minimised to reduce the noise from reversing signals
- Truck operators should ensure that tailgates are cleared and locked at the point of unloading
- Vehicle warning devices such as horns should not be used as signalling devices
- Worksite induction training should be implemented, educating staff on noise sensitive issues and the need to make as little noise as possible
- Workers should avoid shouting and whistling
- When work is complete, the noise of packing up plant and equipment and departing from the site should be minimised.

- Equipment management
  - Selection of low noise plant and equipment
  - Equipment should be well maintained and fitted with adequately maintained silencers which meet the design specifications
  - Silencers and enclosures should be kept intact, rotating plants should be balanced, loose bolts tightened, frictional noise reduced through lubrication and cutting noise reduced by keeping equipment sharp
  - Only necessary power should be used to complete the task
  - Only necessary equipment should be on site
  - Loaders and bobcats fitted with articulated buckets should be rubber lined at the contact points to ensure that noise levels are minimised during the release of materials, where practicable
  - Resonance should be avoided where possible e.g. changing the speed of machines; and
  - Traffic practice controllers should be used to prevent vehicles and equipment queuing, idling or reversing near noise sensitive receivers.
- Noise Monitoring
  - Monitoring of construction noise levels should be undertaken in response to complaints where this is considered an appropriate response. Noise measurements are to be conducted in accordance with the requirements of the *Noise Measurement Manual* (DERM 2013) or other equivalent guideline.

8.8 Vibration Mitigation Measures

Based on typical levels of vibration from construction activities, it is expected that dwelling occupants at distances of 200 metres and greater from the works area would not be able to perceive construction vibration; much less the buildings themselves experience vibration levels resulting in damage. Where adverse comment specifically arising from vibration is received after the commencement of construction it is recommended that the following measures be considered:

- Vibration levels be measured
- If high levels are recorded:
    - Increasing the distance between offending plant equipment
    - Replacing offending plant equipment with equipment that does not produce large levels of vibration
    - Building structure surveys

9.0 Conclusion

9.1 Operational Noise Assessment

A noise impact assessment was conducted for the operation of the Project in general accordance with the requirements of the DILGP Wind Farm State Code Planning Guideline. Operational noise limits were defined from the acoustic amenity operational outcomes of the DILGP SDAP Wind Farm State Code, and background noise levels were measured on site prior to construction of the Project.

A computational noise model was created to predict the noise levels from the operation of the Project at the closest noise sensitive receptors on both host and non-host lots. Based on the results of noise predictions, the Project is expected to comply with the noise limits proposed in this report.

An environmental noise model of the site was created to predict noise levels at the nearest sensitive receptors to the Project. A noise-compliant wind turbine layout was generated for this EIS application, and has formed the basis of the Project Site. The noise limits proposed in this report are expected to be complied with during operation of the wind farm, based on the results of noise predictions. On this basis, the recommended 'noise-compliant' wind turbine layout can be considered to protect the existing environmental values in the area from impacts by noise and vibration from the Project.

It has been assumed that the wind turbines will be properly maintained by the wind farm operator to ensure that the noise emission of the turbines is not adversely affected by turbine wear, resulting in audible tonality. Similarly, should amplitude modulation be detected upon commissioning, the wind farm operator would be required to alter the operating parameters of some turbines to remove this effect.

Compliance measurements will be undertaken at a selected number of the potentially most affected sensitive receivers following the commissioning of the Project. In lieu of a compliance methodology within the Wind Farm State Code, a basic methodology has been proposed in this assessment. A Preliminary Compliance Management Plan has been developed to incorporate the compliance measurement methodology proposed in this report, and may be found in Appendix H. It is proposed that the final Compliance Management Plan is approved by DILGP prior to commencement of construction of the Project. Testing should be undertaken once all noise sources associated with the Project are in operating mode, i.e. all turbines have been commissioned and are operating correctly.

This report has also described how the achievement of the objectives will be monitored, audited through outlining the requirements for post-commissioning measurement and reporting.

9.2 Construction Noise and Vibration

Construction vibration limits were defined from BS 5228-4 and AS 2670.2. Whilst there is no legislation in Queensland that specifically sets construction noise limits, best practice noise and vibration mitigations measures to be adopted during construction of the Project were detailed in this report, as per the QLD Code and QLD Code Planning Guideline for construction management.

Appendix A

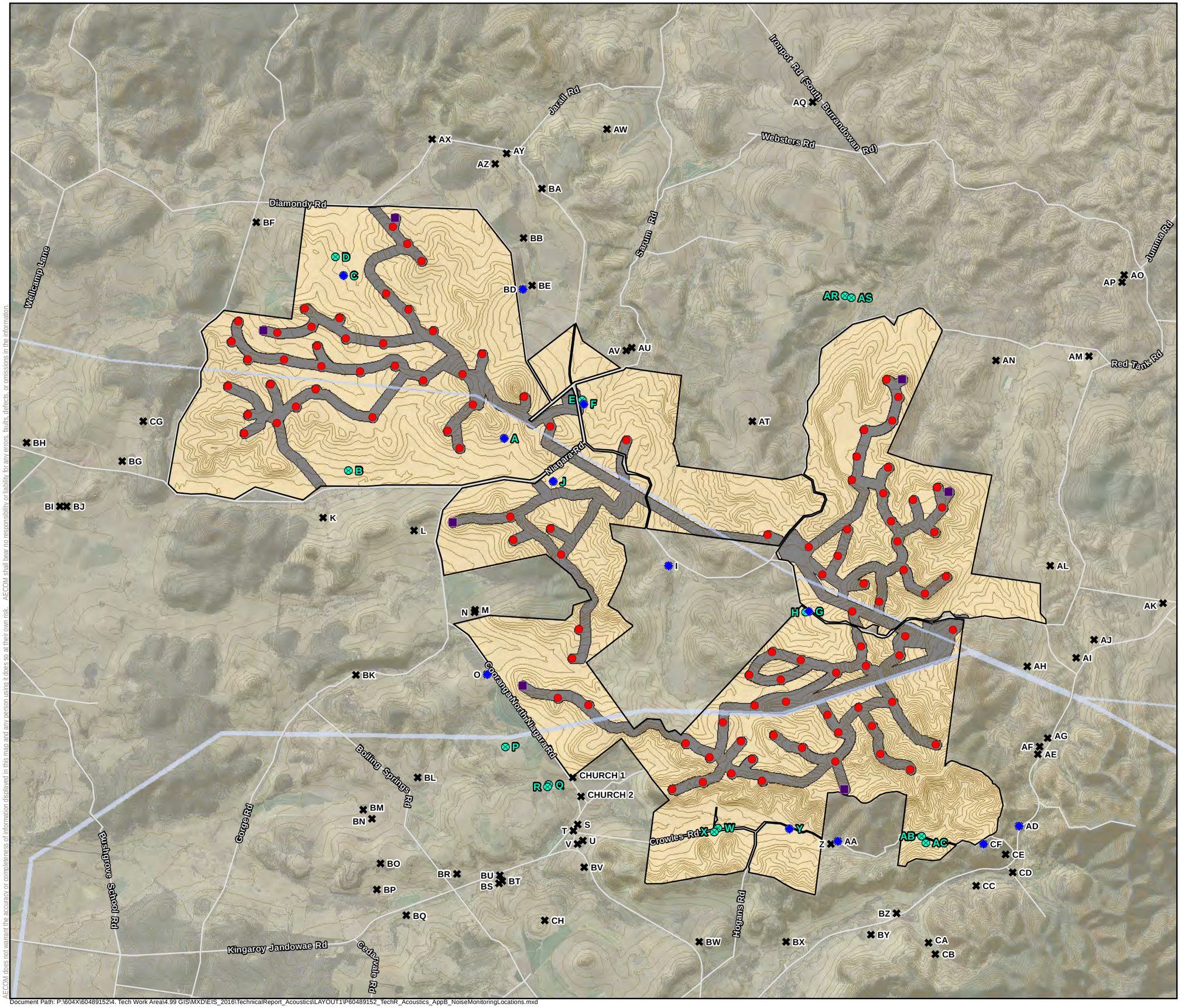
Acoustic Terminology

Appendix A Acoustic Terminology

'A' Weighted	Frequency filter applied to measured noise levels to represent how humans hear sounds.
Ambient Noise	Total noise at a site comprising all sources such as industry, traffic, domestic, and natural noises.
Attended Measurement	Measurements that are attended by a person and measured with a sound level meter.
dB(A)	'A' Weighted overall sound pressure level.
dB(G)	The G-weighting for the determination of weighted sound pressure levels of sound or noise, whose spectrum lies partly or wholly within the frequency range from 1 Hz to 20 Hz, has been standardised in ISO 7196, (1995). G-weighted sound pressure levels are denoted L_{pG} and are measured or estimated in dB(G)
Frequency	The number of cycles per second, where 1 cycle per second is equal to 1Hz. The human ear responds to sounds of frequency 20 Hz to 20,000 Hz.
Impulsiveness	Noise that comprises distinct impulses in the noise (bangs, clicks, clatters, or thumps) etc.
Intermittent	Stopping and starting at irregular intervals.
L_{Aeq}	The 'A' Weighted energy-averaged noise level over the measurement period.
$L_{Aeq,10min}$	The energy-averaged level of the total noise measured without adjustment for the character of the noise (e.g. tonal or impulsive), over a period of 10 minutes.
$L_{Ar,\ 1hour}$	The noise level of the component of the total noise that can be specifically identified by acoustical means which is associated with the noise from mining operations and shall be measured with an adjustment for the character of the noise (tonal or impulsive) over a period of 1 hour.
L_{max}	Maximum noise level of the measurement period.
L_{10}	Noise level exceeded for 10% of the measurement period. The L_{10} represents the intrusive noise level and is often used to represent traffic/ music noise.
L_{90}	Noise level exceeded for 90% of the measurement period. This represents the background noise level excluding nearby sources.
$L_{w(A)}$	'A' Weighted sound power level, measured in dB(A). The sound power level is a measure of the total acoustic energy produced by a source and is independent of distance and source location. The sound power level is expressed as a ratio against a reference level of 10^{-12} watts.
Least-squares regression	The method for finding a line that summarizes the relationship between the two parameters, e.g. wind speed and measured noise level.
Tonality	A characteristic of noise, describing a sound that contains a perceptible pitch or tone. As a general rule, a prominent tonal component may be detected in one-third octave spectra if the level of a one-third octave band exceeds the level of the adjacent bands by 5 dB or more.
Unattended Measurement	Measurements that are taken by a noise logger at a given location unattended.

Appendix B

Wind Farm Layout, Noise Monitoring and Receptor Locations



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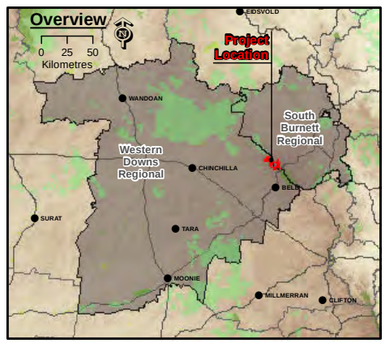
DATUM GDA 1994, PROJECTION MGA ZONE 56

0 1.5 3
Kilometres

1:72,500 (when printed at A3)

Legend

- Project Site
- Study Area
- Met Masts
- Turbines
- Participating Landowners
- Non-Participating Landowners
- Noise Monitoring Locations
- Contours 10m
- Road



Data Sources:
1. Project Site, Turbine Layout © 2016 AECOM Australia Pty Ltd.
2. Surat Basin 40 cm Imagery © SISP, 2013
3. Service Road, Transmission Lines © AGL 2014
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6. Contours 10m © Department of Natural Resources and Mines, 2013.
7. Hillshade, based on the 25m DEM covering the SEQ; DNRM 2005
8. Local Government Area (LGA) boundaries © Australia Bureau of Statistic (ABS), 2011.
9. Vegetation Management Watercourse and Drainage feature map (1:100 000 and 1:250 000) - version 1.4 dataset © State of Queensland (Department of Natural Resources and Mines) 2016

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COOPERS GAP WIND FARM
NOISE AND VIBRATION IMPACT ASSESSMENT

NOISE MONITORING LOCATIONS

PROJECT #:	60489152
CREATED BY:	BM
LAST MODIFIED:	BM: 5/09/2016
VERSION:	1

Appendix B

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A3 size

Appendix C

Noise Monitoring Locations

Appendix C Noise Monitoring Locations

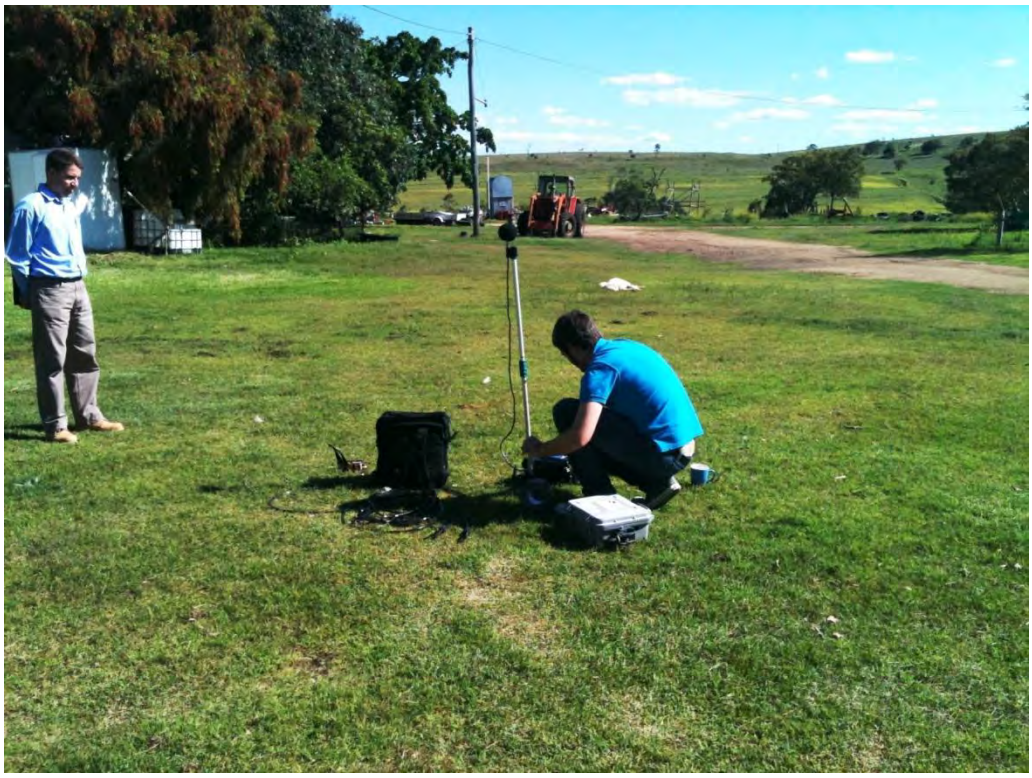

Figure 1: Location G

Figure 2: Location G

Figure 3: Location I

Figure 4: Location I

Figure 5: Location O

Figure 6: Location O

Figure 7: Location Y

Figure 8: Location Y

Figure 9: Location AD

Figure 10: Location AD

Figure 11: Location C

Figure 12: Location C

Figure 13: Location F

Figure 14: Location F

Figure 15: Location J

Figure 16: Location J

Figure 17: Location A

Figure 18: Location A

Figure 19: Location BD

Figure 20: Location BD

Figure 21 – Location AA

Figure 22 – Location AA

Figure 23 – Location CF

Figure 24 – Location CF

Appendix D

Instrumentation Details

Appendix D Instrumentation Details

Details of the instrumentation used to record noise levels at the twelve residential locations are presented summarised in Table 14. RION NL-21 sound level meters were used to measure noise at all sites. The Rion NL-21s are Type 2 instruments suitable for background noise measurements. These instruments were calibrated in the field at the start and end of the measurement periods using a Rion NC-74 acoustic calibrator. No significant drift in calibration was observed.

All the instrumentation used carried a current calibration certificate from a National Association of Testing Authorities (NATA) accredited laboratory, with the exception of logger 598492, which still held a manufacturer's calibration certificate at the time of the measurements, as it was less than 2 years old.

Copies of calibration certificates are provided below.

Table 14: Measurement equipment

Location ID	Equipment make & model	Logger Serial number and calibration dates						Windscreen
		Site Visit 1	Cal. Date	Site Visit 2	Cal. Date	Site Visit 3	Cal. Date	
G	Rion NL-21	276273	17/03/2009	-	-	-	-	Rion 90 mm
I	Rion NL-21	365350	26/02/2010	-	-	-	-	Rion 90 mm
O	Rion NL-21	598492	26/05/2009	-	-	-	-	Rion 90 mm
Y	Rion NL-21	1277353	22/03/2010	00187448	11/05/2010	276273	23/03/2011	Rion 90 mm
AD	Rion NL-21	676782	21/10/2010	00187447	30/03/2010	1043718	18/04/2011	Rion 90 mm
C	Rion NL-21	187446	16/04/2010	-		-	-	Rion 90 mm
F	Rion NL-21	276274	17/03/2009	00465445	19/04/2010	365350	26/02/2010	Rion 90 mm
J	Rion NL-21	487669	07/07/2010	-		-	-	Rion 90 mm
A	Rion NL-21	487697	07/07/2010	00765699	31/07/2010	-	-	Rion 90 mm
BD	Rion NL-21	776886	10/08/2009	00265112	20/01/2010	-	-	Rion 90 mm
AA	Rion NL-21	-	-	-	-	276274	23/03/2011	Rion 90 mm
CF	Rion NL-21	-	-	-	-	487697	7/07/2010	Rion 90 mm
All	Rion NC-74 calibrator	34483785	15/04/2010	34483785	15/04/2010	34483785	19/04/2011	-

Wind speed at microphone

The QLD Wind Farm Planning Guideline dictates that microphones should be protected with wind shields which reduce wind induced noise on the microphone,and establishes a procedure with dealing with the data when affected by wind induced noise; however, it does not establish a procedure to estimate these effects.

In order to determine any wind effects on the measurements, wind speeds were also measured at microphone height at location O and location F. A WindSonic™ ultrasonic anemometer was used. The anemometer has a reported accuracy of 0.1 m/s for wind speeds from 5 m/s to 25 m/s. These locations were considered to be two of the most exposed monitoring locations and therefore most likely to have results influenced by high wind speeds at the microphone. During the measurement period, the maximum wind speed that was exceeded at the microphone location for 90% of any 10-minute period was 5.5 m/s.

The level of wind induced background noise on a microphone fitted with a 90 mm wind shield can be estimated from wind speed measured at the microphone using the following equation[1]:

$$L_{A90wind} = 10 \times \log(v^{6.14}) - 7.6$$

[1] J. Cooper, D. Leclercq, and M. Stead. *'Wind induced aerodynamic noise on microphones from atmospheric measurements'*. International Congress on Acoustics 2010, Sydney, August 23-27 2010.

Where *v* is the wind speed exceeded for 90 % of the time in metres per second.

The estimated wind-induced noise level at the microphone was compared to the measured noise level for each 10-minute period for location O and location F. The measured L_{90} level exceeded the estimated wind-induced L_{90} level by 10 dB(A) or more for all but two of the measurement samples, with the smallest difference between measured and estimated level calculated being 9.1 dB(A). The two data samples where wind-induced noise was within 10 dB(A) of the measured level were corrected by logarithmic subtraction of the estimated wind induced noise level from the measured noise level, as is best practice. Correcting the two data points for wind induced noise made no difference to the calculated noise criteria, due to the low number of affected data points and small correction applied to those points. On this basis, it is considered that wind-induced noise has not significantly influenced the background noise measurements.

Appendix D Calibration Certificates

RTA TECHNOLOGY PTY LTD

Level 9, 418A Elizabeth Street., Surry Hills NSW 2010 AUSTRALIA
Ph: (02) 9281 2222 Fax: (02) 9281 2220 Email: rtatech@rtagroup.com.au
Website: www.rtagroup.com.au ABN 56 003 290 140

Certificate of Calibration
Sound Level Meter

Calibration Date 7/07/2010	**Job No** RA770	**Operator** AL
Client Name ALPHA ACOUSTICS		
Client Address 7 PYLARA CR, FERNY HILLS, 4055		

Test Item

Instrument Make Rion	**Model** NL-21	**Serial No** #00487697
Microphone Make Rion	**Model** UC-52	**Serial No** #118961
Preamplifier Make Rion	**Model** NH-21	**Serial No** #26823
Ext'n Cable Make Nil	**Model** N/A	**Serial No** N/A
Accessories Nil		

SLM Type	2
Filters Class	N/A

Temp deg C	23.0
RH %	41.0
Bar Pressure hPa	1019

Applicable Standards:
Australian Standard AS1259.1 1990 "Sound Level Meters Part 1: Non-integrating"
Australian Standard AS1259.2 1990 "Sound Level Meters Part 2: Integrating-averaging"

Applicable Work Instruction:
RWI-08 SLM Verification.doc

Traceability:
The tests, calibrations or measurements covered by this document have been performed in accordance with NATA requirements which include the requirements of ISO/IEC 17025 and are traceable to Australian national standards of measurement. This document shall not be reproduced, except in full.

Scope:
This certificate is issued on the basis that the instrument complies with the manufacturer's specification. See "Sound Level Meter Verification - Summary of Tests" page for an itemised list of results for each test.

Uncertainty:
Unless otherwise stated, the uncertainty of measurement is +/-0.14dB. The uncertainty is stated at a confidence level of 95% using a k factor of 2.

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory Number 14868

Authorized Signatory:

Print Name: Renzo Tonin Date: 8th July 2010

Template Document Name: RQT-02 (rev 40) SLM Verification

RA770F02 (rev 1) NATA Calibration of Rion NL-21 #00487697 1 of 38 Certificate

RTA TECHNOLOGY PTY LTD

Level 9, 418A Elizabeth Street, Surry Hills NSW 2010 AUSTRALIA
Ph: (02) 9281 2222 Fax: (02) 9281 2220 Email: rtatech@rtagroup.com.au
Website: www.rtagroup.com.au ABN 56 003 290 140

Certificate of Calibration
Sound Level Meter

Calibration Date	7/07/2010	**Job No** RA770	**Operator** AL
Client Name	ALPHA ACOUSTICS		
Client Address	7 PYLARA CR, FERNY HILLS, 4055		

Test Item

Instrument Make	Rion	**Model**	NL-21	**Serial No** #00487669
Microphone Make	Rion	**Model**	UC-52	**Serial No** #118311
Preamplifier Make	Rion	**Model**	NH-21	**Serial No** #26795
Ext'n Cable Make	Nil	**Model**	N/A	**Serial No** N/A
Accessories	Nil			

SLM Type	2
Filters Class	N/A

Temp deg C	23.0
RH %	41.0
Bar Pressure hPa	1018

Applicable Standards:
Australian Standard AS1259.1 1990 "Sound Level Meters Part 1: Non-integrating"
Australian Standard AS1259.2 1990 "Sound Level Meters Part 2: Integrating-averaging"

Applicable Work Instruction:
RWI-08 SLM Verification.doc

Traceability:
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Scope:
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Uncertainty:
Unless otherwise stated, the uncertainty of measurement is +/-0.14dB. The uncertainty is stated at a confidence level of 95% using a k factor of 2.

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NATA Accredited Laboratory
Number 14868

Authorized Signatory:

Print Name: Renzo Tonin Date: 8th July 2010

Template Document Name: ROT-02 (rev 40) SLM Verification

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 36778

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00276274
Microphone Type:	UC-52	**Serial No:**	12909
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	Noise Measurement Services Pty Ltd Suite 2, 90 Vulture Street West End QLD 4101		
Ambient Pressure:	996 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	41 %RH ±5% RH
Date of Calibration:	17/03/2009	**Issue Date:**	18/03/2009

CHECKED BY: AM

AUTHORISED SIGNATORY: ..... Jack Kielt

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web site: www.acu-vib.com.au

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AVCERT1 Rev.2.3 13.03.09

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 36777

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00276273
Microphone Type:	UC-52	**Serial No:**	112905
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	Noise Measurement Services Pty Ltd Suite 2, 90 Vulture Street West End QLD 4101		
Ambient Pressure:	996 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	41 %RH ±5% RH
Date of Calibration:	17/03/2009	**Issue Date:**	18/03/2009

CHECKED BY: A.M.A.

AUTHORISED SIGNATORY: ..... Jack Kidd

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 37365

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00365350
Microphone Type:	UC-52	**Serial No:**	107753
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	Noise Measurement Services Suite 2, 90 Vulture Street West End QLD 4101		
Ambient Pressure:	1012 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	31 %RH ±5% RH
Date of Calibration:	26/02/2010	**Issue Date:**	26/02/2010
Acu-Vib Test Procedure:	AVP05 (SLM)		
CHECKED BY:		**AUTHORISED SIGNATORY:**	Jack Kielt

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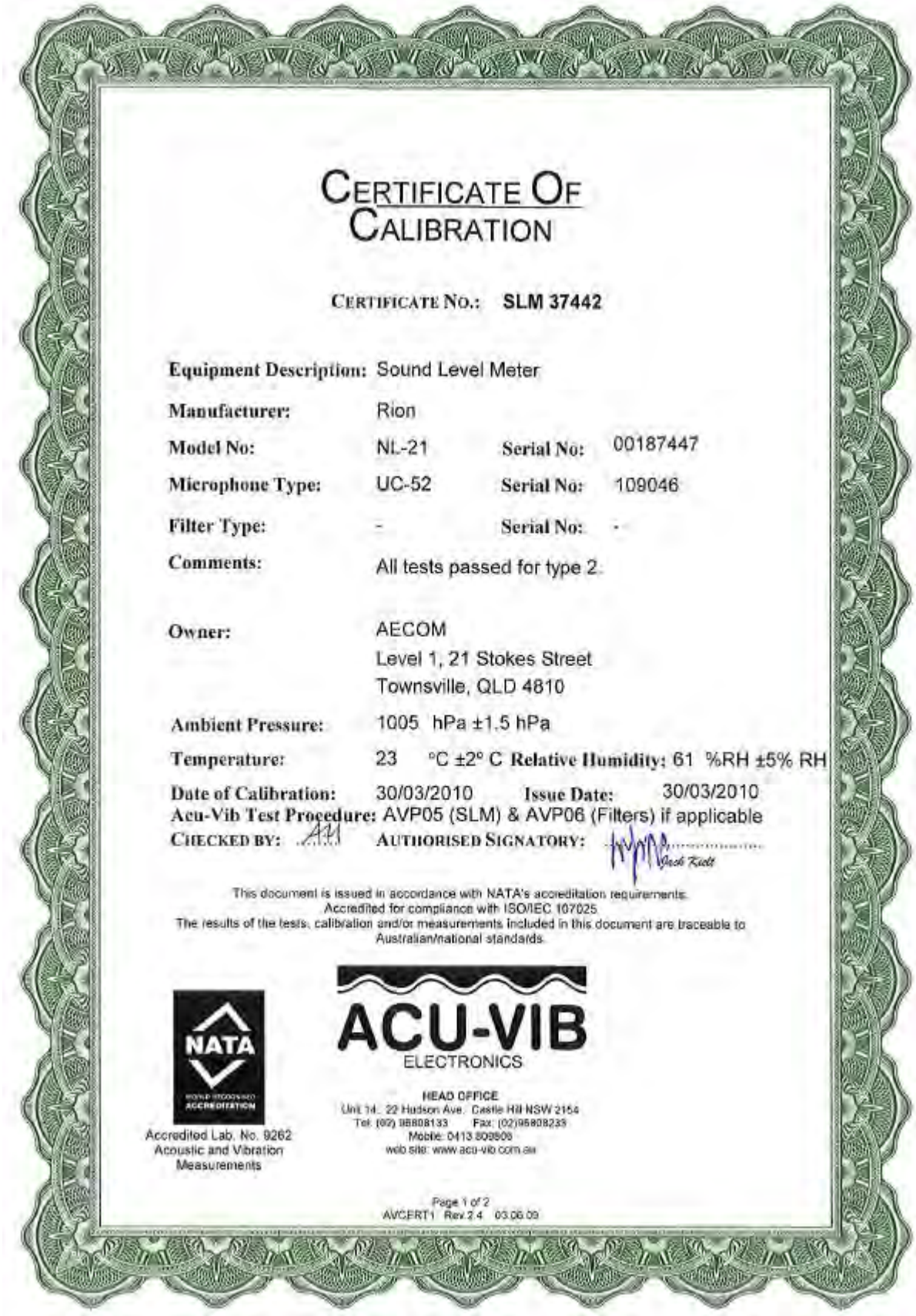

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 37442

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00187447
Microphone Type:	UC-52	**Serial No:**	109046
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	AECOM Level 1, 21 Stokes Street Townsville, QLD 4810		
Ambient Pressure:	1005 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	61 %RH ±5% RH
Date of Calibration:	30/03/2010	**Issue Date:**	30/03/2010

Acu-Vib Test Procedure: AVP05 (SLM) & AVP06 (Filters) if applicable

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 37521

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00187448
Microphone Type:	UC-52	**Serial No:**	116615
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	AECOM Level 11, 44 Market Street Sydney NSW 2000		
Ambient Pressure:	995 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	41 %RH ±5% RH
Date of Calibration:	11/05/2010	**Issue Date:**	12/05/2010

Acu-Vib Test Procedure: AVP05 (SLM) & AVP06 (Filters) if applicable

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Jack Rietz

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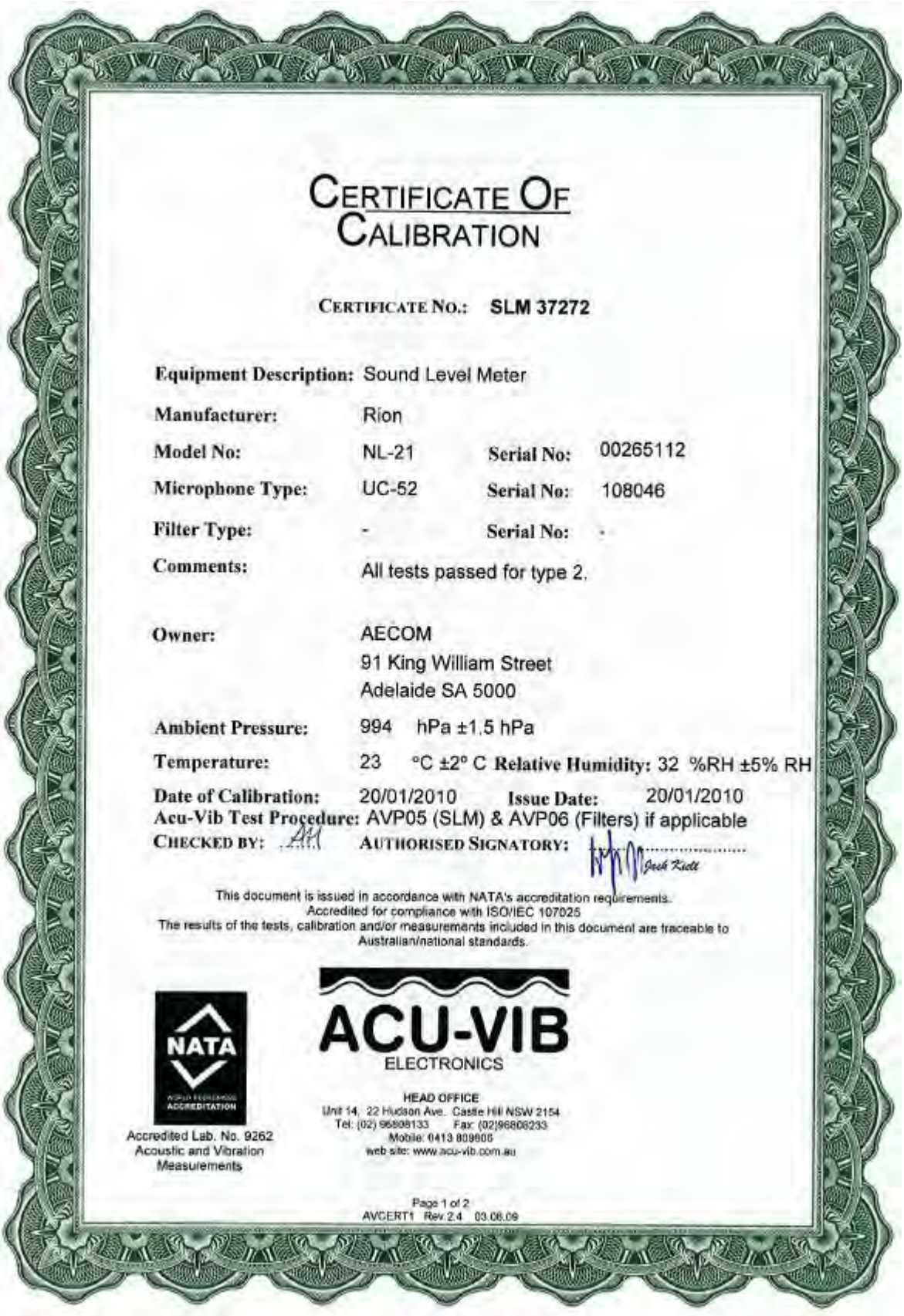

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 37272

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00265112
Microphone Type:	UC-52	**Serial No:**	108046
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	AECOM 91 King William Street Adelaide SA 5000		
Ambient Pressure:	994 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	32 %RH ±5% RH
Date of Calibration:	20/01/2010	**Issue Date:**	20/01/2010

Acu-Vib Test Procedure: AVP05 (SLM) & AVP06 (Filters) if applicable

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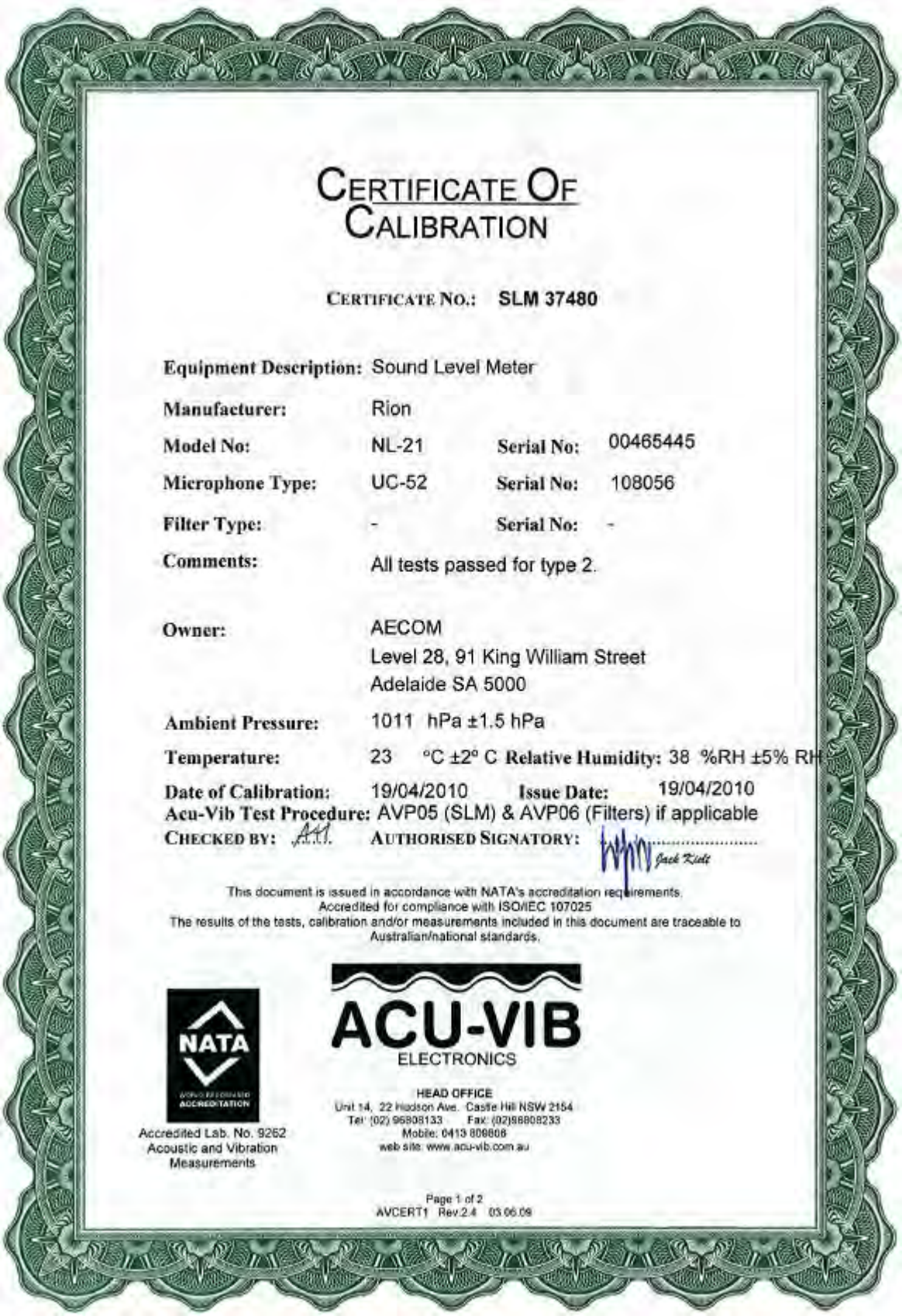

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 37480**

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00465445
Microphone Type:	UC-52	**Serial No:**	108056
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	AECOM Level 28, 91 King William Street Adelaide SA 5000		
Ambient Pressure:	1011 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	38 %RH ±5% RH
Date of Calibration:	19/04/2010	**Issue Date:**	19/04/2010
Acu-Vib Test Procedure:	AVP05 (SLM) & AVP06 (Filters) if applicable		

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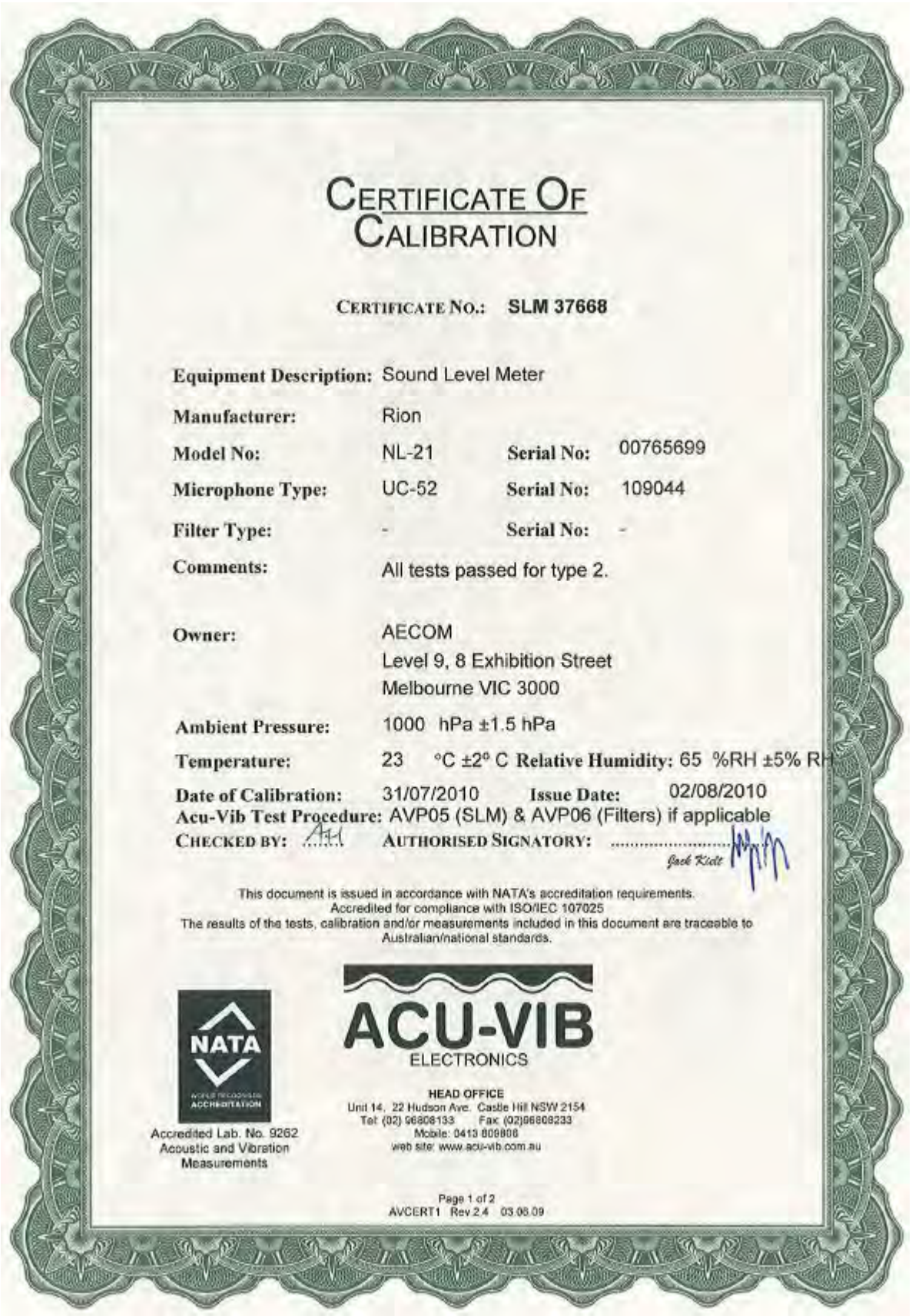

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 37668

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00765699
Microphone Type:	UC-52	**Serial No:**	109044
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	AECOM Level 9, 8 Exhibition Street Melbourne VIC 3000		
Ambient Pressure:	1000 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	65 %RH ±5% RH
Date of Calibration:	31/07/2010	**Issue Date:**	02/08/2010

Acu-Vib Test Procedure: AVP05 (SLM) & AVP06 (Filters) if applicable

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 37044

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00776886
Microphone Type:	UC-52	**Serial No:**	114983
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	Noise Measurement Services Pty Ltd Suite 2, 90 Vulture Street West End QLD 4101		
Ambient Pressure:	1005 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	35 %RH ±5% RH
Date of Calibration:	10/08/2009	**Issue Date:**	10/08/2009

CHECKED BY: .....

AUTHORISED SIGNATORY: ..... Jack Kielt

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 11169

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-74 **Serial No:** 34483785
Owner: AECOM
Level 3, 49 Park Road
Milton. QLD 4064

Tests Performed: Measured output sound pressure level was found to be:
Before adiustment: 94.13 dB re 20 uPa at 1001.0 Hz THD< 1%.
After adiustment: 94.13 dB re 20 uPa at 1001.0 Hz THD< 1%.

Uncertainty (at 95% c.l.) k=2: Output ±0.11dB
Freq. ±0.05 Hz

CONDITION OF TEST:

Ambient Pressure: 1006 hPa ±1.5 hPa **Relative Humidity:** 63 % RH ±5% RH
Temperature: 23 °C ±2° C
Date of Calibration: 15/04/2010 **Issue Date:** 16/04/2010
Acu-Vib Test Procedure: AVP02 (Calibrators)
Test Method: AS IEC 60942 - 2004
CHECKED BY: ..... **AUTHORISED SIGNATORY:** .....
Jack Rietl

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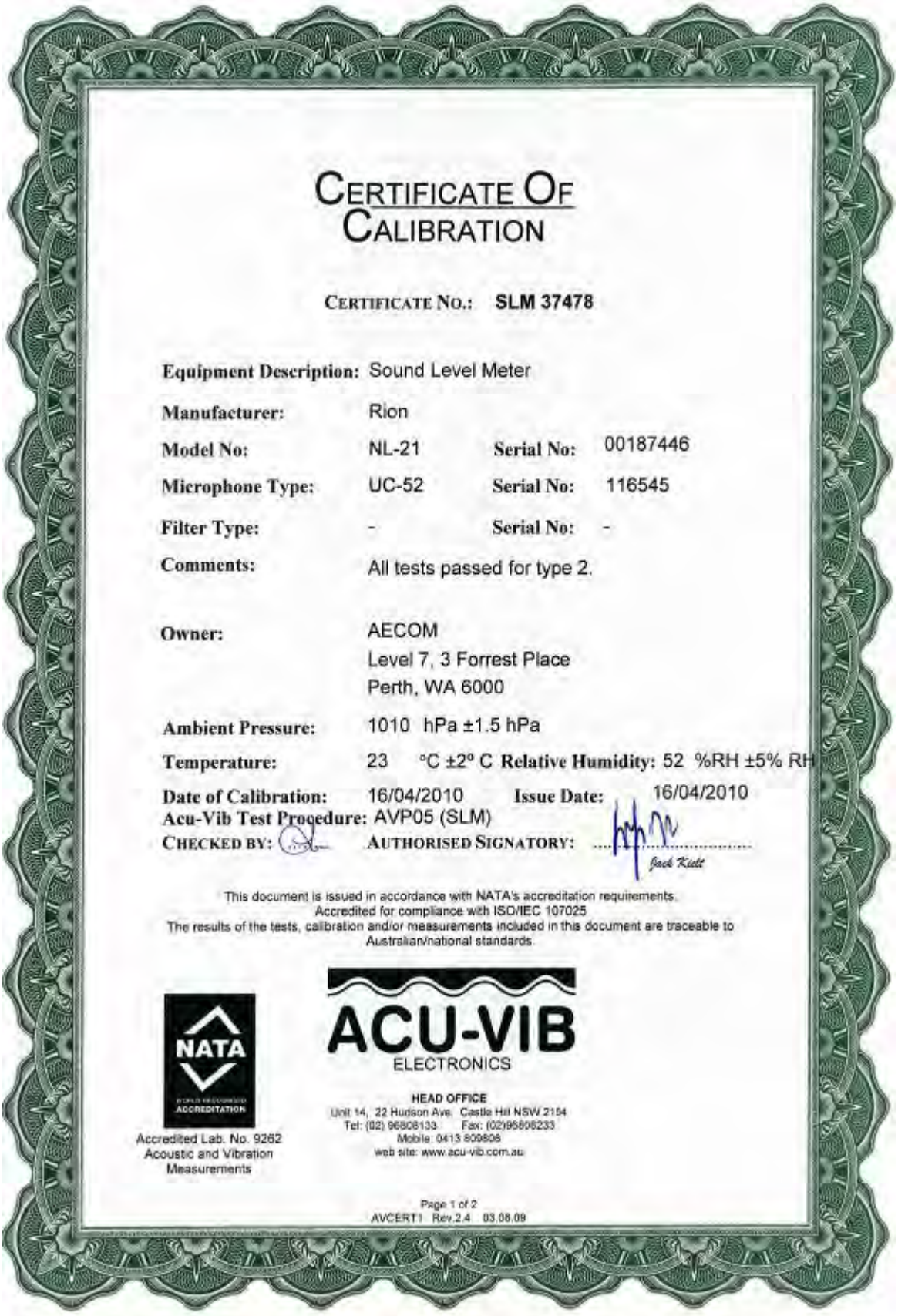
Page 1 of 1 End of Calibration Certificate
AVCERT2 Rev.1.6 24.08.09



CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 37478

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00187446
Microphone Type:	UC-52	**Serial No:**	116545
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	AECOM Level 7, 3 Forrest Place Perth, WA 6000		
Ambient Pressure:	1010 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	52 %RH ±5% RH
Date of Calibration:	16/04/2010	**Issue Date:**	16/04/2010
Acu-Vib Test Procedure:	AVP05 (SLM)		
CHECKED BY:		**AUTHORISED SIGNATORY:**	Jack Kiett

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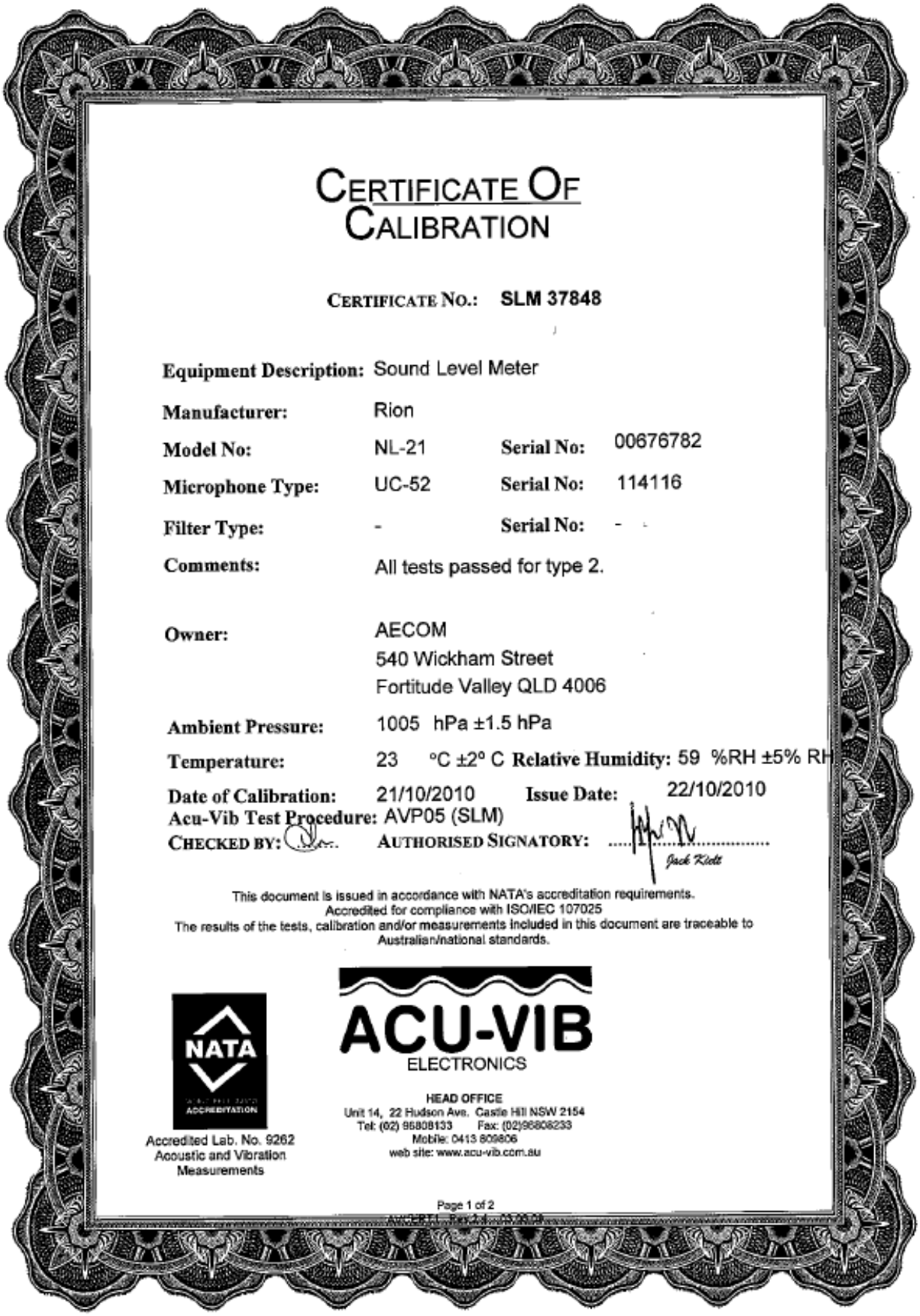

CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: **SLM 37848**

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	00676782
Microphone Type:	UC-52	**Serial No:**	114116
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	AECOM 540 Wickham Street Fortitude Valley QLD 4006		
Ambient Pressure:	1005 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	59 %RH ±5% RH
Date of Calibration:	21/10/2010	**Issue Date:**	22/10/2010
Acu-Vib Test Procedure:	AVP05 (SLM)		
CHECKED BY:		**AUTHORISED SIGNATORY:**	Jack Klatt

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ELECTRONICS

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Mobile: 0413 809806
web site: www.acu-vib.com.au

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 38129

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	01043718
Microphone Type:	UC-52	**Serial No:**	128992
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	Noise Measurement Services 18 Lade Street Enoggera QLD 4051		
Ambient Pressure:	1008 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	54 %RH ±5% RH
Date of Calibration:	18/04/2011	**Issue Date:**	18/04/2011

Acu-Vib Test Procedure: AVP05 (SLM) & AVP06 (Filters) if applicable

CHECKED BY: AH **AUTHORISED SIGNATORY:** ..... Jack Kidd

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CERTIFICATE OF CALIBRATION

CERTIFICATE NO.: SLM 37424

Equipment Description:	Sound Level Meter		
Manufacturer:	Rion		
Model No:	NL-21	**Serial No:**	01277353
Microphone Type:	UC-52	**Serial No:**	116930
Filter Type:	-	**Serial No:**	-
Comments:	All tests passed for type 2.		
Owner:	Noise Measurement Services Suite 2, 90 Vulture Street West End QLD 4101		
Ambient Pressure:	1005 hPa ±1.5 hPa		
Temperature:	23 °C ±2° C	**Relative Humidity:**	49 %RH ±5% RH
Date of Calibration:	22/03/2010	**Issue Date:**	22/03/2010
Acu-Vib Test Procedure:	AVP05 (SLM) & AVP06 (Filters) if applicable		
CHECKED BY:	AM	**AUTHORISED SIGNATORY:**	Jack Kielt

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RION CO., LTD.

3-20-41 Higashimotomachi Kokubunji Tokyo 185-8533
Phone:042(359)7888, Facsimile:042(359)7442

Certificate of Calibration

Name	**: Sound level meter**		
Model	**: NL-21**	**S/No. :**	**00598492**
Microphone	**: UC-52**	**S/No. :**	**125464**
Preamplifier	**: NH-21**	**S/No. :**	**30254**
Date of Calibration	**: May, 26, 2009**		

We hereby certify that the above product was tested and calibrated according to the prescribed Rion procedures, and that it fulfills specification requirements.
The measuring equipment and reference devices used for testing and calibrating this unit are managed under the Rion traceability system and are traceable according to official Japanese standards and official standards of countries belonging to the International Committee of Weights and Measures.

RION CO., LTD.
N. Takeda
Manager, Quality Control Department

Appendix E

Noise Regression Curves

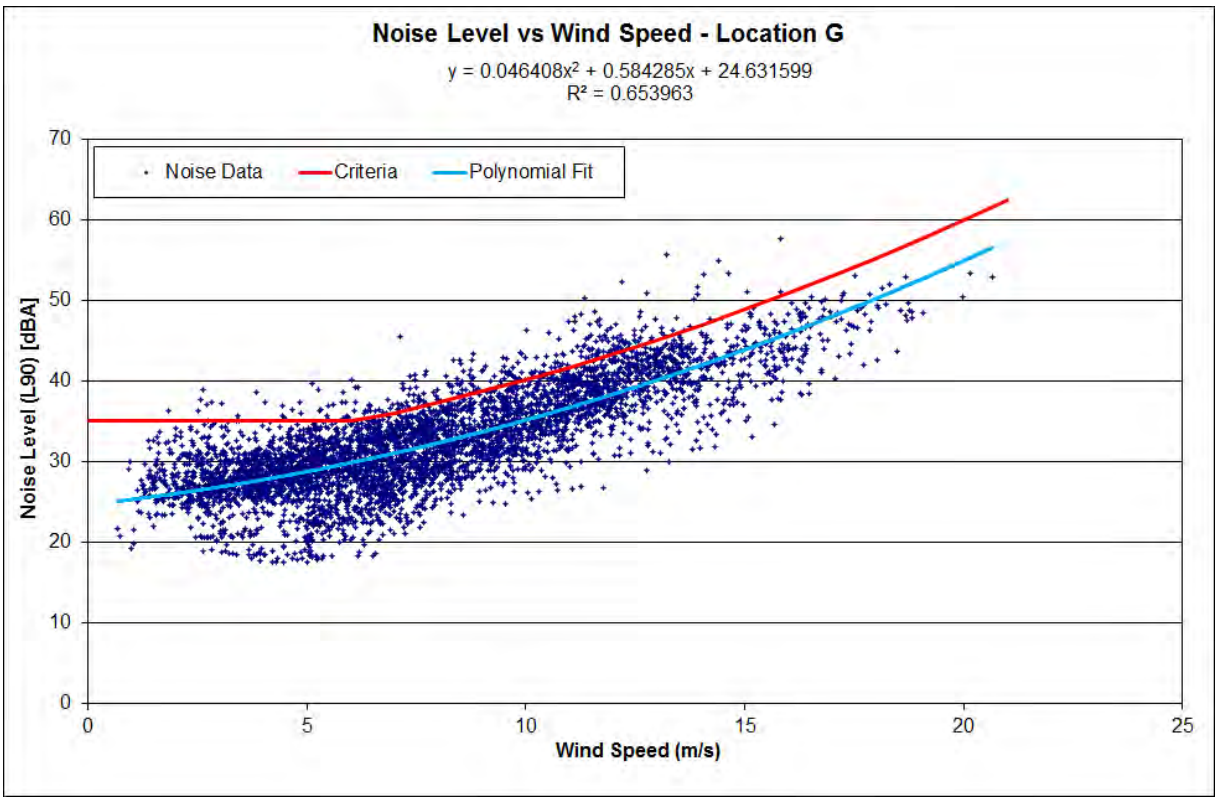
Appendix E Noise Regression Curves

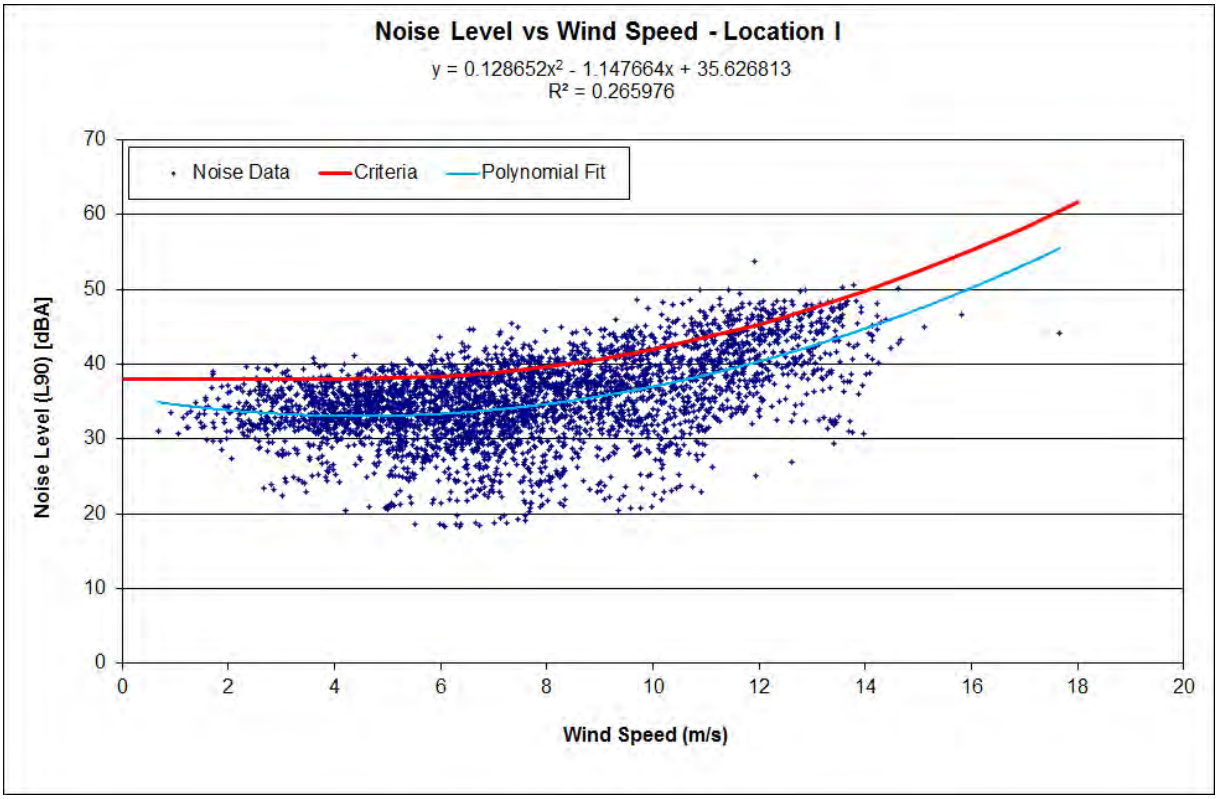
For all the noise monitoring sites, linear equations, second-order and third-order polynomial equations for regression lines were calculated. The coefficients of determination (R^2) for each order of polynomial for each of the residential monitoring locations are presented in Table 15.

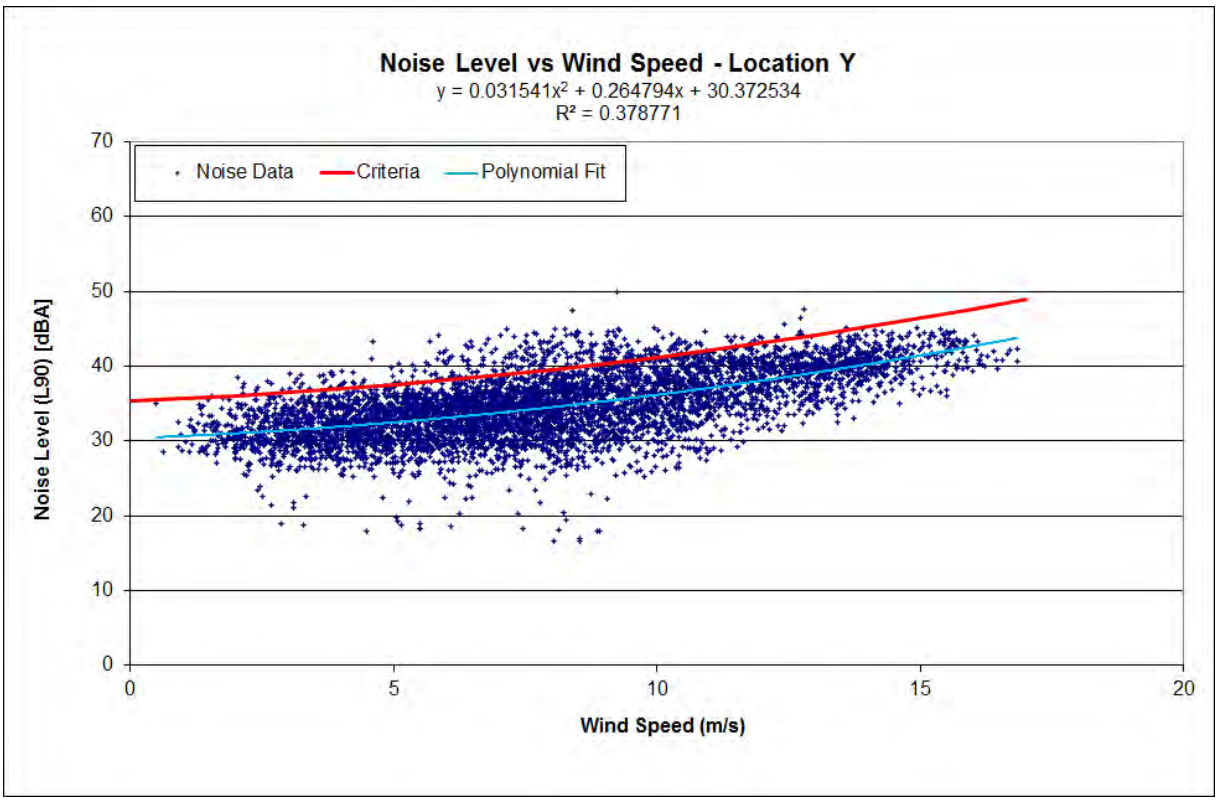
The coefficients in **bold** indicate those curves which provided the "best fit" for the polynomial regression lines. These curves were selected as providing the best fit of the data, defined as the highest coefficient of determination. The exception was where two curves provided a very similar coefficient. Where this occurred, the lowest order curve was selected as being the most sensible fit of the data.

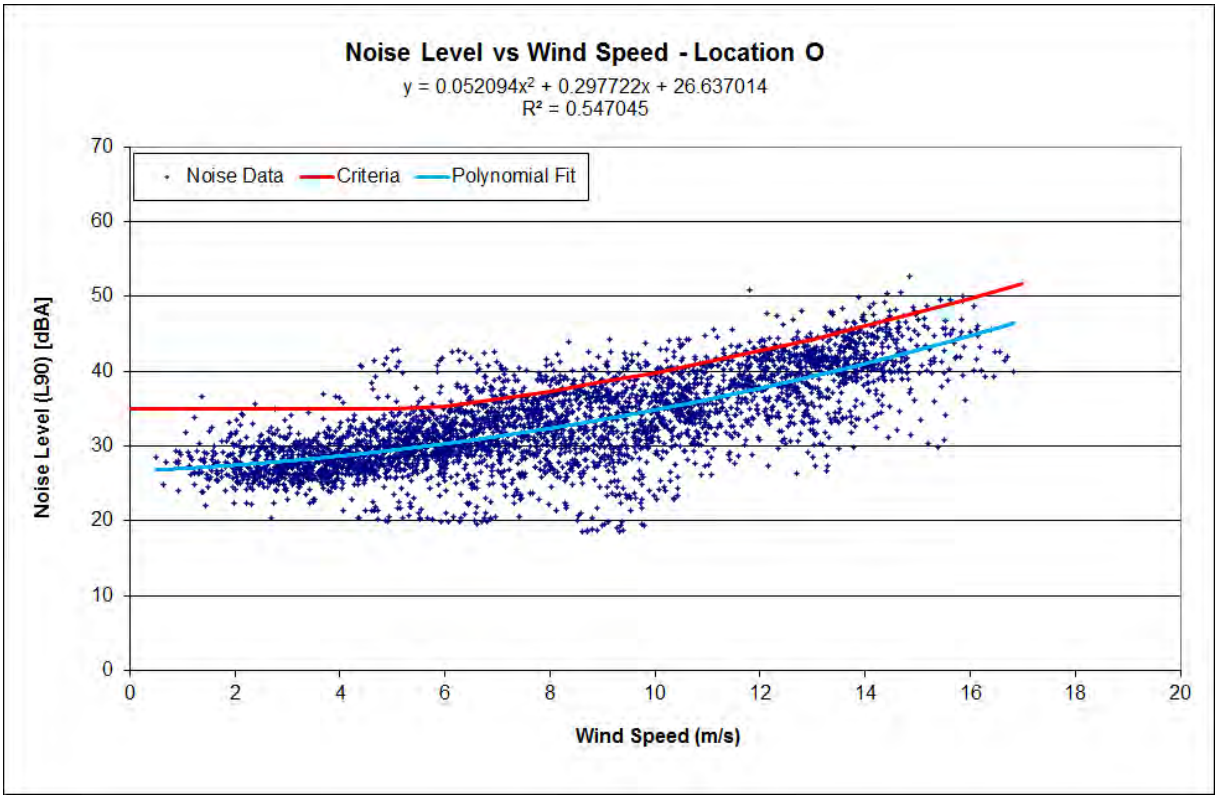
Table 15: Coefficients of determination for polynomial regression lines

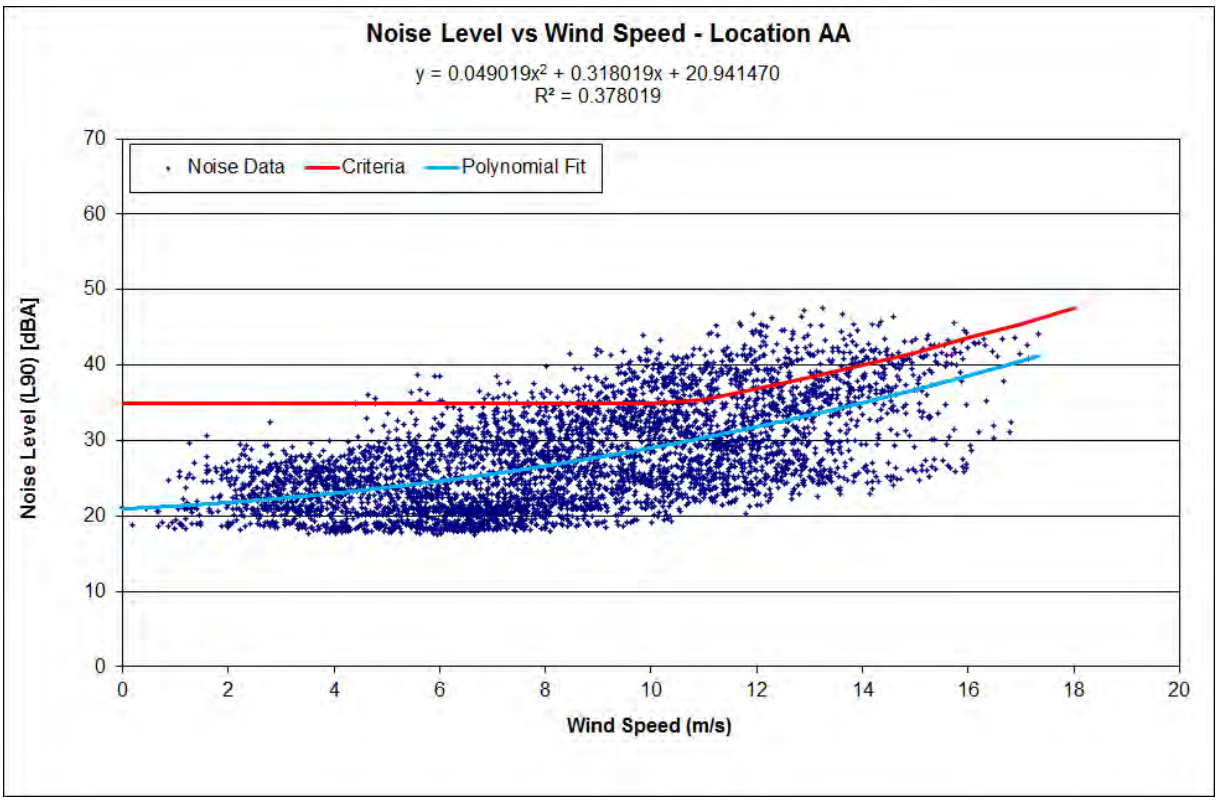
Location	Coefficient of determination (R^2)		
	Linear	Polynomial order 2	Polynomial order 3
G	0.6408	**0.6539**	0.6660
I	0.2440	**0.2659**	0.2564
O	0.5330	**0.5470**	0.5471
Y	0.3703	**0.3787**	0.3791
AD	0.4408	0.4412	0.4428
C	0.2178	**0.2551**	0.2563
F	0.2240	**0.2758**	0.2259
J	0.0738	0.0767	**0.0779**
A	0.4378	**0.4615**	0.4554
BD	0.2311	0.2335	0.2435
AA	0.3683	**0.3780**	0.3845
CF	0.4879	0.4888	0.4925

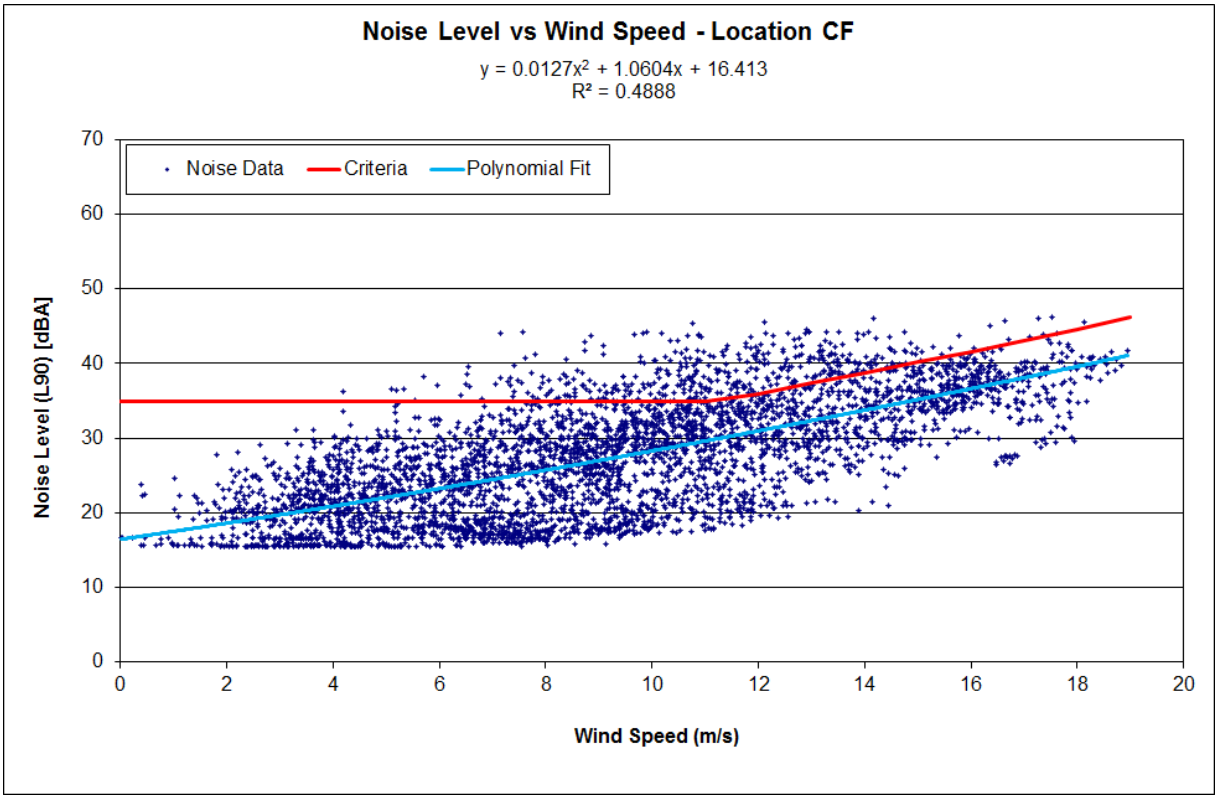

Noise Level vs Wind Speed - Location G
y = 0.046408x² + 0.584285x + 24.631599
R² = 0.653963
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
5
10
15
20
25

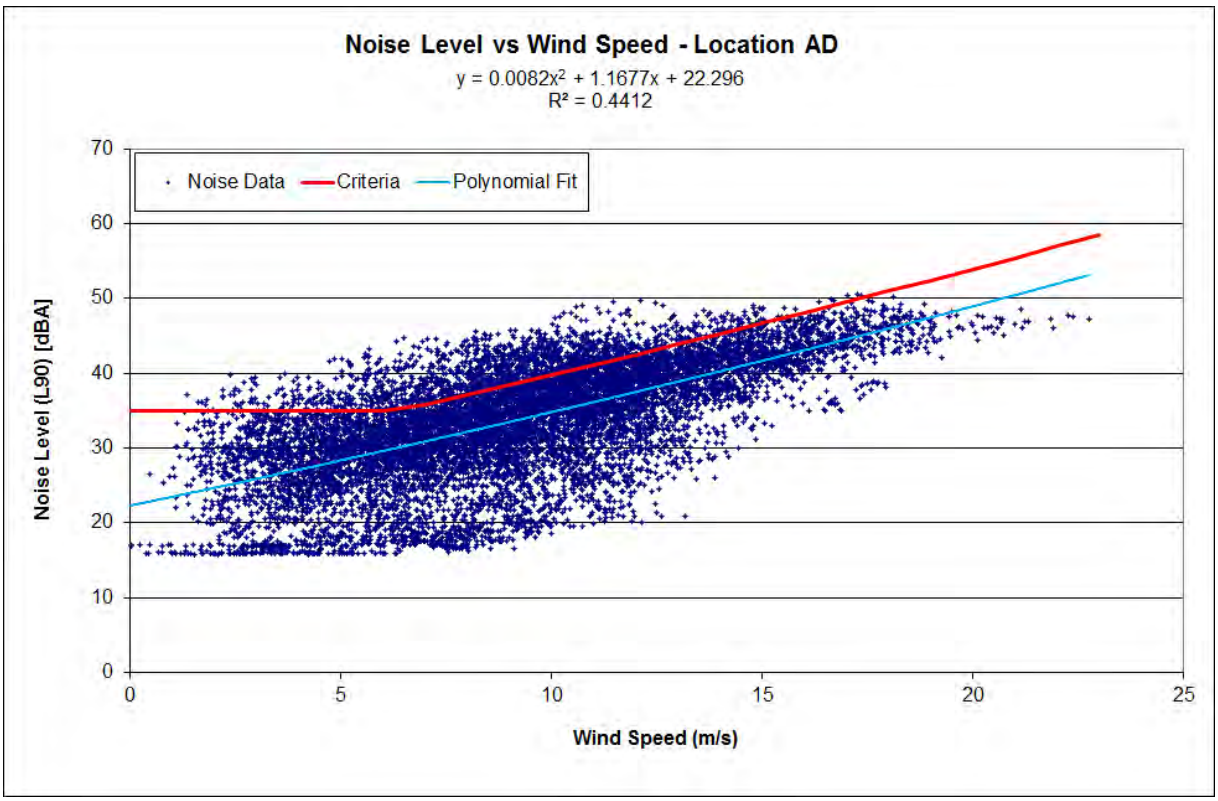

Noise Level vs Wind Speed - Location I
y = 0.128652x² - 1.147664x + 35.626813
R² = 0.265976
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20

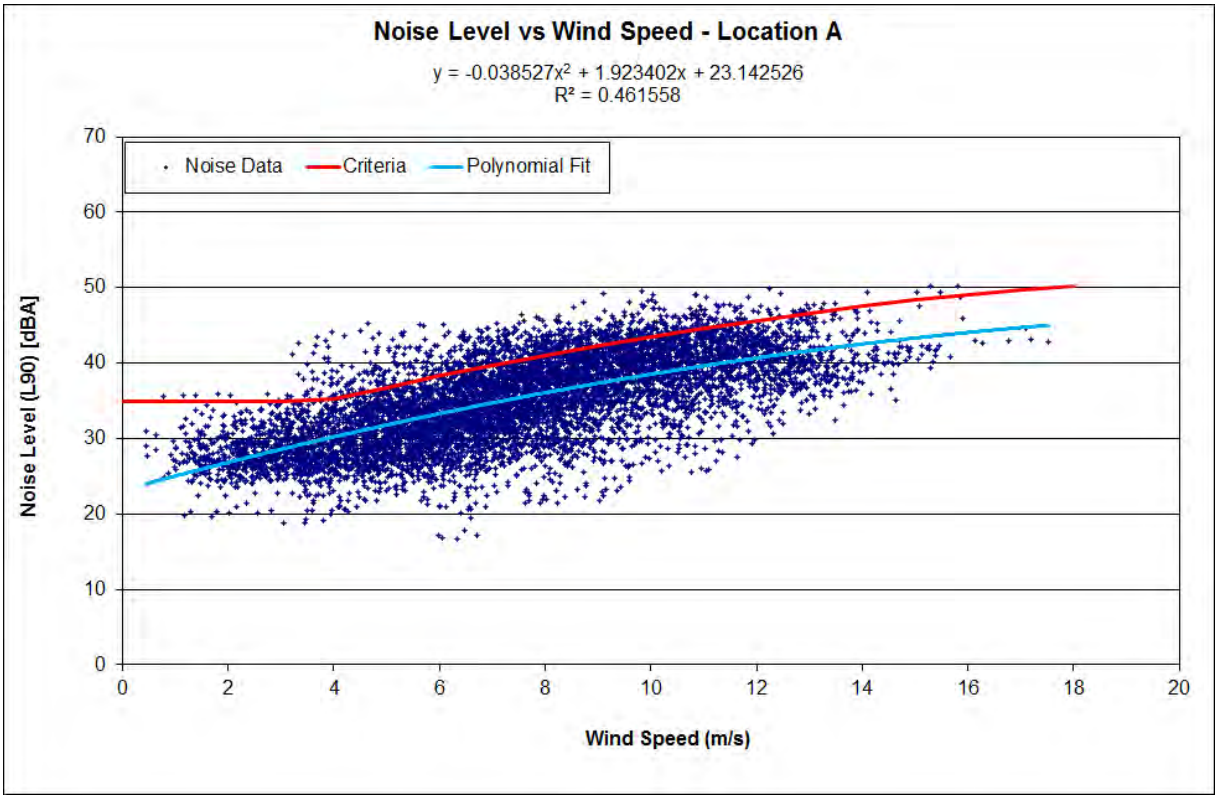

Noise Level vs Wind Speed - Location Y
y = 0.031541x² + 0.264794x + 30.372534
R² = 0.378771
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
5
10
15
20

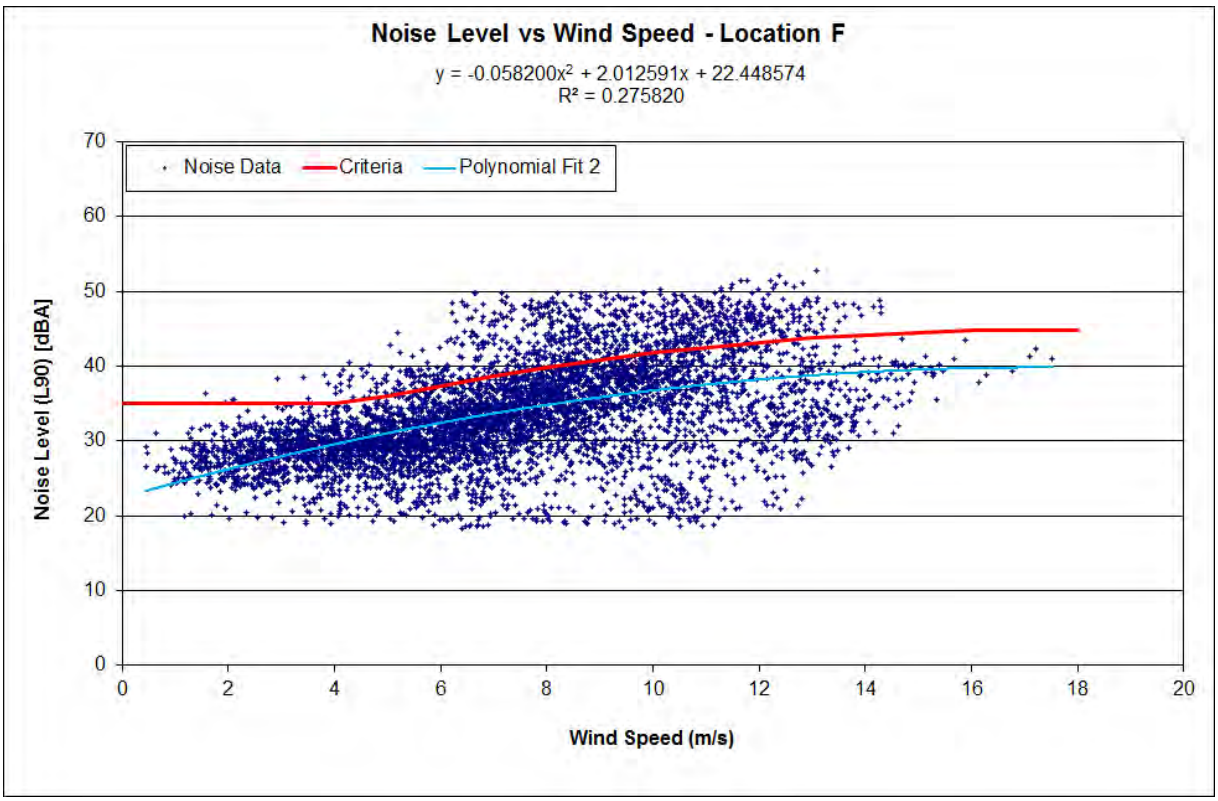

Noise Level vs Wind Speed - Location O
y = 0.052094x² + 0.297722x + 26.637014
R² = 0.547045
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20

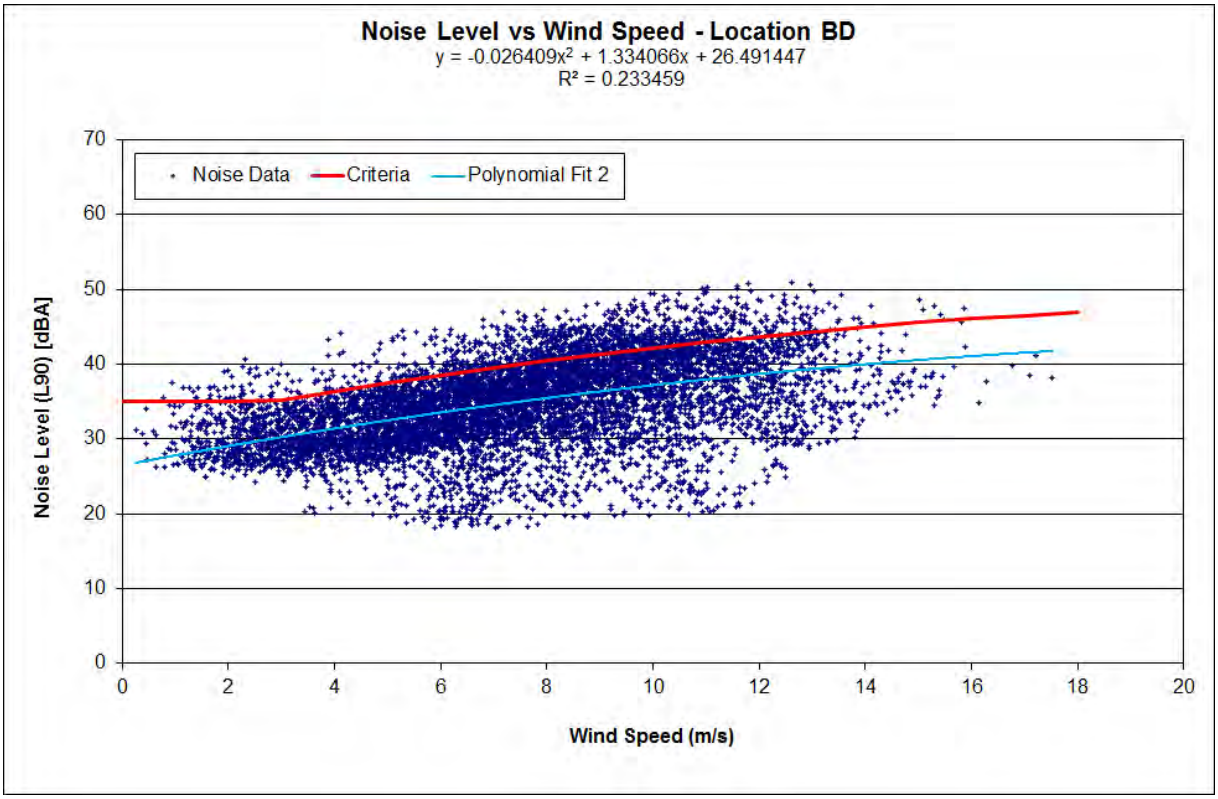

Noise Level vs Wind Speed - Location AA
y = 0.049019x² + 0.318019x + 20.941470
R² = 0.378019
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20

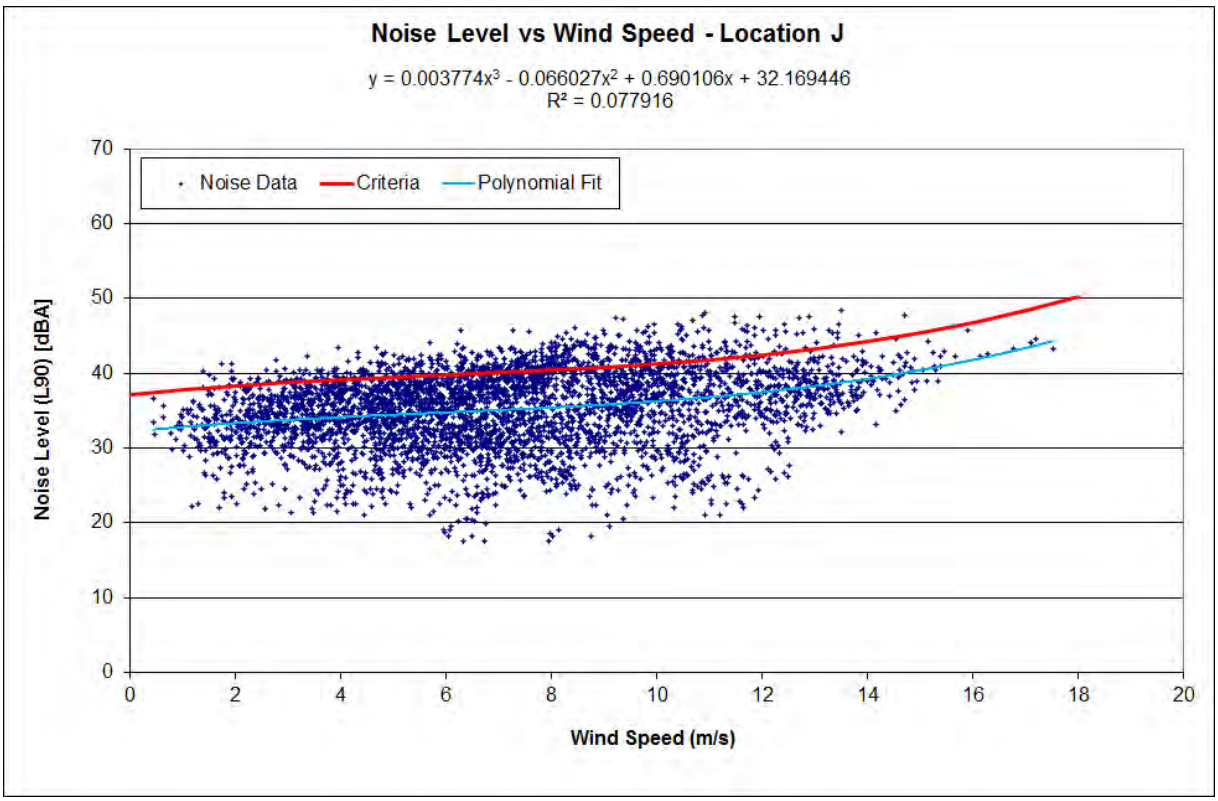

Noise Level vs Wind Speed - Location CF
y = 0.0127x² + 1.0604x + 16.413
R² = 0.4888
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20

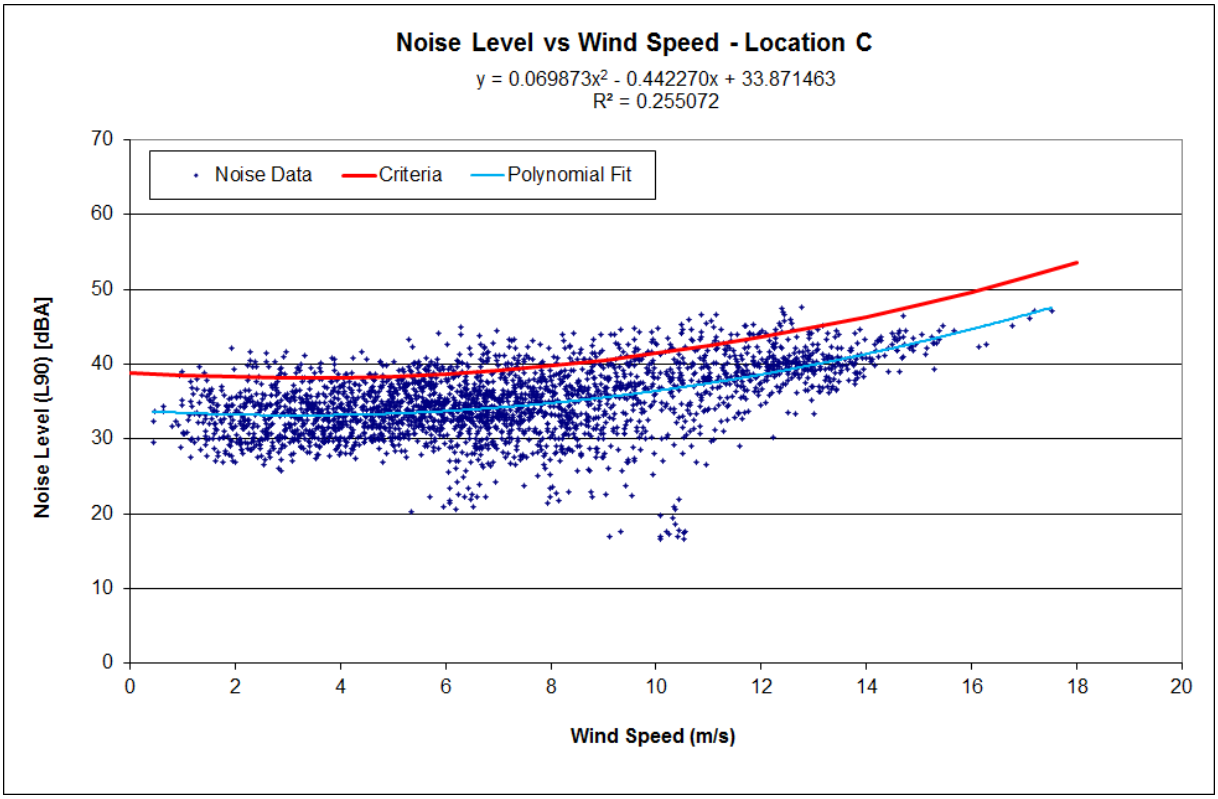

Noise Level vs Wind Speed - Location AD
y = 0.0082x² + 1.1677x + 22.296
R² = 0.4412
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
5
10
15
20
25


Noise Level vs Wind Speed - Location A
y = -0.038527x² + 1.923402x + 23.142526
R² = 0.461558
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20


Noise Level vs Wind Speed - Location F
y = -0.058200x² + 2.012591x + 22.448574
R² = 0.275820
Noise Data
Criteria
Polynomial Fit 2
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20


Noise Level vs Wind Speed - Location BD
y = -0.026409x² + 1.334066x + 26.491447
R² = 0.233459
Noise Data
Criteria
Polynomial Fit 2
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20


Noise Level vs Wind Speed - Location J
y = 0.003774x³ - 0.066027x² + 0.690106x + 32.169446
R² = 0.077916
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20


Noise Level vs Wind Speed - Location C
y = 0.069873x² - 0.442270x + 33.871463
R² = 0.255072
Noise Data
Criteria
Polynomial Fit
Noise Level (L90) [dBA]
Wind Speed (m/s)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20

Appendix F

Noise Prediction Results

Appendix F Noise Prediction Results

Table 16 presents the outdoor noise compliance assessment for the for the project layout during worst-case turbine noise emissions. The noise levels presented in are $L_{Aeq,10min}$ noise levels at the receptors, assessed against the noise limits presented in Table 7. The noise predictions comply with the Project noise limits at all receptors.

Table 17 presents the low frequency noise compliance assessment for the for the Project wind turbine layout during worst-case turbine noise emissions. The noise levels presented in the table are $L_{Ceq,10}$ noise levels at the receptors, assessed against a 60 dB(C) night time limit. The noise predictions comply with this noise limit at all but one receptor. This low frequency noise limit was exceeded by less than 1 dB(C) at receptor G. This receptor is a Participating Landowner and the likelihood of a complaint from this receptor is minimal. Further, the conservative assumptions made when building the model mean that the measured noise levels would be lower than those predicted as part of this assessment. As such, noise compliance at receptor G with the 60 dB(C) noise limit is expected.

Table 16: $L_{Aeq,10min}$ Noise compliance assessment. The $L_{Aeq,10min}$ noise prediction during worst-case wind turbine noise emission is assessed against the hub height wind speeds noise limits

ID	Participating Landowner	Easting[1]	Northing	Predicted noise level, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																Complies at all wind speeds?
					4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
A	YES	340083.6	7046383.8	42	45	45	45	45	45	45	45	45	46	47	48	48	49	50	50	51	51	**YES**
AA	NO	346821.9	7038249.7	33	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52	**YES**
AB	YES	348509.7	7038355.6	33	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	46	48	**YES**
AC	YES	348599.9	7038225.8	32	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	46	48	**YES**
AD	NO	350481.4	7038561.8	25	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	52	54	**YES**
AE	NO	350862.4	7040011.3	26	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	52	54	**YES**
AF	NO	350894.1	7040160.0	27	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	52	54	**YES**
AG	NO	351062.8	7040332.8	26	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	52	54	**YES**
AH	NO	350644.4	7041787.8	30	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	52	54	**YES**
AI	NO	351635.3	7041956.1	30	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	52	54	**YES**
AJ	NO	351992.9	7042313.9	31	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	52	54	**YES**
AK	NO	353390.6	7043055.3	28	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	52	54	**YES**
AL	NO	351111.7	7043812.2	33	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60	**YES**
AM	NO	351892.9	7048035.2	29	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60	**YES**
AN	NO	350015.2	7047959.0	31	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60	**YES**
AO	NO	352602.5	7049683.8	18	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60	**YES**
AP	NO	352560.0	7049534.0	26	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60	**YES**
AQ	NO	346316.4	7053162.1	22	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48	**YES**
AR	NO	346966.6	7049264.7	32	35	36	37	39	40	41	42	43	43	44	44	45	45	45	45	45	44	**YES**

[1] Eastings and Northings are defined based on the GDA 1994 Projection MGA Zone 56 co-ordinate system.

ID	Participating Landowner	Easting[1]	Northing	Predicted noise level, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																Complies at all wind speeds?
					4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
AS	NO	347091.8	7049224.1	33	35	36	37	39	40	41	42	43	43	44	44	45	45	45	45	45	44	**YES**
AT	NO	345095.3	7046725.8	35	35	36	37	39	40	41	42	43	43	44	44	45	45	45	45	45	44	**YES**
AU	NO	342660.6	7048215.9	32	35	36	37	39	40	41	42	43	43	44	44	45	45	45	45	45	44	**YES**
AV	NO	342553.6	7048149.0	33	35	36	37	39	40	41	42	43	43	44	44	45	45	45	45	45	44	**YES**
AW	NO	342159.1	7052618.4	23	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48	**YES**
AX	NO	338631.9	7052421.8	32	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58	**YES**
AY	NO	340135.1	7052136.1	28	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48	**YES**
AZ	NO	339907.2	7051919.0	27	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48	**YES**
B	YES	336940.5	7045734.7	38	45	45	45	45	45	45	45	45	46	47	48	48	49	50	50	51	51	**YES**
BA	NO	340849.5	7051426.7	31	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48	**YES**
BB	NO	340478.0	7050425.2	31	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48	**YES**
BD	NO	340462.5	7049386.3	35	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48	**YES**
BE	NO	340649.3	7049465.3	34	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48	**YES**
BF	NO	335084.1	7050742.3	35	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58	**YES**
BG	NO	332375.0	7045921.4	25	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58	**YES**
BH	NO	330442.9	7046291.9	20	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58	**YES**
BI	NO	331115.8	7045011.2	20	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58	**YES**
BJ	NO	331254.8	7045013.4	21	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58	**YES**
BK	NO	337093.1	7041604.1	25	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BL	NO	338340.1	7039540.2	27	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BM	NO	337241.9	7038885.3	24	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BN	NO	337415.0	7038704.7	24	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**

ID	Participating Landowner	Easting[1]	Northing	Predicted noise level, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																Complies at all wind speeds?
					4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
BO	NO	337588.7	7037802.7	18	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BP	NO	337518.7	7037277.6	20	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BQ	NO	338111.0	7036755.8	20	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BR	NO	339132.3	7037598.6	24	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BS	NO	339984.9	7037397.7	26	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BT	NO	340047.0	7037449.3	27	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BU	NO	339999.6	7037566.9	27	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BV	NO	341701.8	7037728.3	27	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
BW	NO	344024.3	7036226.3	26	37	37	38	39	40	40	41	42	43	44	45	46	48	49	50	52	53	**YES**
BX	NO	345776.4	7036220.8	27	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52	**YES**
BY	NO	347491.7	7036362.8	27	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52	**YES**
BZ	NO	348008.2	7036796.9	27	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52	**YES**
C	YES	336840.4	7049667.4	43	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58	**YES**
CA	NO	348654.2	7036210.0	24	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48	**YES**
CB	NO	348791.8	7035972.5	24	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48	**YES**
CC	NO	349614.7	7037357.7	25	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48	**YES**
CD	NO	350349.7	7037619.1	23	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48	**YES**
CE	NO	350211.4	7037982.8	24	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48	**YES**
CF	NO	349763.0	7038200.9	30	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48	**YES**
CG	NO	332797.7	7046721.7	28	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58	**YES**
CH	NO	340905.8	7036659.6	24	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
CHURCH 1	NO	341470.9	7039535.1	34	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**

ID	Participating Landowner	Easting[1]	Northing	Predicted noise level, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																Complies at all wind speeds?
					4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
CHURCH 2	NO	341636.5	7039151.3	34	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
D	YES	336677.1	7050047.0	41	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58	**YES**
E	YES	341658.5	7047167.5	40	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	**YES**
F	YES	341691.4	7047075.2	40	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	**YES**
G	YES	346234.3	7042890.4	45	45	45	45	45	45	45	45	45	45	45	47	49	51	53	55	57	60	**YES**
H	YES	346167.6	7042874.8	44	45	45	45	45	45	45	45	45	45	45	47	49	51	53	55	57	60	**YES**
I	NO	343404.3	7043808.6	34	38	38	38	39	40	41	42	44	45	47	50	52	55	58	62	65	69	**YES**
J	YES	341073.2	7045511.1	41	45	45	45	45	45	45	45	45	45	45	45	45	47	48	50	52	55	**YES**
K	NO	336432.3	7044775.9	35	35	37	38	40	41	42	44	45	46	47	48	48	49	50	50	51	51	**YES**
L	NO	338266.8	7044523.4	33	35	37	38	40	41	42	44	45	46	47	48	48	49	50	50	51	51	**YES**
O	NO	339739.2	7041619.4	34	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
P	YES	340106.3	7040162.1	34	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58	**YES**
Q	YES	340984.4	7039395.2	34	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58	**YES**
R	YES	340958.4	7039353.9	34	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58	**YES**
S	NO	341571.1	7038592.5	34	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
T	NO	341484.2	7038469.5	34	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
U	NO	341675.2	7038266.3	32	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
V	NO	341567.5	7038197.2	32	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58	**YES**
W	YES	344403.2	7038524.5	32	45	45	45	45	45	45	45	45	45	45	45	46	48	49	50	52	53	**YES**
X	YES	344326.0	7038445.7	32	45	45	45	45	45	45	45	45	45	45	45	46	48	49	50	52	53	**YES**
Y	YES	345841.2	7038503.0	40	45	45	45	45	45	45	45	45	45	45	45	46	48	49	50	52	53	**YES**
Z	NO	346682.0	7038195.6	40	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52	**YES**

Table 17: $L_{Ceq,10}$ noise compliance assessment. The $L_{Ceq,10}$ noise prediction during worst-case turbine noise emission is assessed against a 60 dB(C) night time noise limit.

ID	Participating Landowner	Easting[2]	Northing	Predicted noise level, dB(C) (rounded)	Noise limit, dB(C)	Complies at all wind speeds
A	YES	340083.6	7046383.8	57	60	**YES**
AA	NO	346821.9	7038249.7	51	60	**YES**
AB	YES	348509.7	7038355.6	49	60	**YES**
AC	YES	348599.9	7038225.8	50	60	**YES**
AD	NO	350481.4	7038561.8	45	60	**YES**
AE	NO	350862.4	7040011.3	47	60	**YES**
AF	NO	350894.1	7040160.0	47	60	**YES**
AG	NO	351062.8	7040332.8	47	60	**YES**
AH	NO	350644.4	7041787.8	49	60	**YES**
AI	NO	351635.3	7041956.1	48	60	**YES**
AJ	NO	351992.9	7042313.9	51	60	**YES**
AK	NO	353390.6	7043055.3	48	60	**YES**
AL	NO	351111.7	7043812.2	51	60	**YES**
AM	NO	351892.9	7048035.2	50	60	**YES**
AN	NO	350015.2	7047959.0	50	60	**YES**
AO	NO	352602.5	7049683.8	38	60	**YES**
AP	NO	352560.0	7049534.0	47	60	**YES**
AQ	NO	346316.4	7053162.1	37	60	**YES**
AR	NO	346966.6	7049264.7	51	60	**YES**

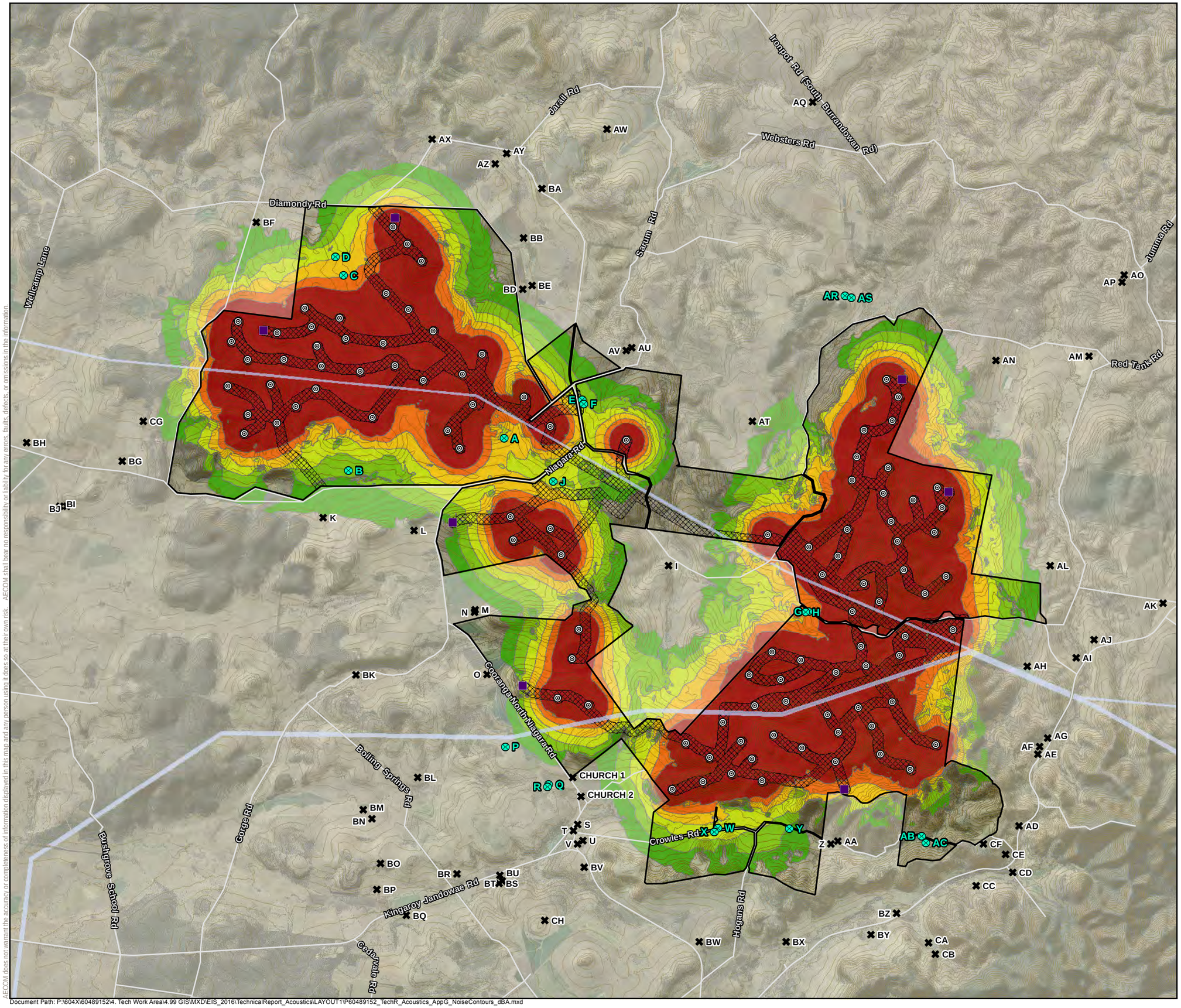
ID	Participating Landowner	Easting[2]	Northing	Predicted noise level, dB(C) (rounded)	Noise limit, dB(C)	Complies at all wind speeds
AS	NO	347091.8	7049224.1	51	60	**YES**
AT	NO	345095.3	7046725.8	55	60	**YES**
AU	NO	342660.6	7048215.9	50	60	**YES**
AV	NO	342553.6	7048149.0	51	60	**YES**
AW	NO	342159.1	7052618.4	42	60	**YES**
AX	NO	338631.9	7052421.8	51	60	**YES**
AY	NO	340135.1	7052136.1	47	60	**YES**
AZ	NO	339907.2	7051919.0	46	60	**YES**
B	YES	336940.5	7045734.7	55	60	**YES**
BA	NO	340849.5	7051426.7	50	60	**YES**
BB	NO	340478.0	7050425.2	48	60	**YES**
BD	NO	340462.5	7049386.3	52	60	**YES**
BE	NO	340649.3	7049465.3	52	60	**YES**
BF	NO	335084.1	7050742.3	52	60	**YES**
BG	NO	332375.0	7045921.4	45	60	**YES**
BH	NO	330442.9	7046291.9	41	60	**YES**
BI	NO	331115.8	7045011.2	41	60	**YES**
BJ	NO	331254.8	7045013.4	41	60	**YES**
BK	NO	337093.1	7041604.1	45	60	**YES**
BL	NO	338340.1	7039540.2	47	60	**YES**
BM	NO	337241.9	7038885.3	44	60	**YES**
BN	NO	337415.0	7038704.7	44	60	**YES**
BO	NO	337588.7	7037802.7	38	60	**YES**

ID	Participating Landowner	Easting[2]	Northing	Predicted noise level, dB(C) (rounded)	Noise limit, dB(C)	Complies at all wind speeds
BP	NO	337518.7	7037277.6	41	60	**YES**
BQ	NO	338111.0	7036755.8	38	60	**YES**
BR	NO	339132.3	7037598.6	44	60	**YES**
BS	NO	339984.9	7037397.7	45	60	**YES**
BT	NO	340047.0	7037449.3	47	60	**YES**
BU	NO	339999.6	7037566.9	47	60	**YES**
BV	NO	341701.8	7037728.3	47	60	**YES**
BW	NO	344024.3	7036226.3	45	60	**YES**
BX	NO	345776.4	7036220.8	46	60	**YES**
BY	NO	347491.7	7036362.8	46	60	**YES**
BZ	NO	348008.2	7036796.9	47	60	**YES**
C	YES	336840.4	7049667.4	59	60	**YES**
CA	NO	348654.2	7036210.0	44	60	**YES**
CB	NO	348791.8	7035972.5	44	60	**YES**
CC	NO	349614.7	7037357.7	45	60	**YES**
CD	NO	350349.7	7037619.1	44	60	**YES**
CE	NO	350211.4	7037982.8	45	60	**YES**
CF	NO	349763.0	7038200.9	48	60	**YES**
CG	NO	332797.7	7046721.7	47	60	**YES**
CH	NO	340905.8	7036659.6	44	60	**YES**
CHURCH 1	NO	341470.9	7039535.1	52	60	**YES**
CHURCH 2	NO	341636.5	7039151.3	52	60	**YES**
D	YES	336677.1	7050047.0	58	60	**YES**

ID	Participating Landowner	Easting[2]	Northing	Predicted noise level, dB(C) (rounded)	Noise limit, dB(C)	Complies at all wind speeds
E	YES	341658.5	7047167.5	56	60	**YES**
F	YES	341691.4	7047075.2	56	60	**YES**
G	YES	346234.3	7042890.4	61	60	**NO**
H	YES	346167.6	7042874.8	60	60	**YES**
I	NO	343404.3	7043808.6	53	60	**YES**
J	YES	341073.2	7045511.1	57	60	**YES**
K	NO	336432.3	7044775.9	54	60	**YES**
L	NO	338266.8	7044523.4	51	60	**YES**
O	NO	339739.2	7041619.4	52	60	**YES**
P	YES	340106.3	7040162.1	52	60	**YES**
Q	YES	340984.4	7039395.2	52	60	**YES**
R	YES	340958.4	7039353.9	52	60	**YES**
S	NO	341571.1	7038592.5	53	60	**YES**
T	NO	341484.2	7038469.5	52	60	**YES**
U	NO	341675.2	7038266.3	51	60	**YES**
V	NO	341567.5	7038197.2	51	60	**YES**
W	YES	344403.2	7038524.5	51	60	**YES**
X	YES	344326.0	7038445.7	51	60	**YES**
Y	YES	345841.2	7038503.0	57	60	**YES**
Z	NO	346682.0	7038195.6	56	60	**YES**

Appendix G

Noise Contour Maps



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AGL Energy in action.

AECOM

DATUM GDA 1994, PROJECTION MGA ZONE 56

0 1.5 3
Kilometres

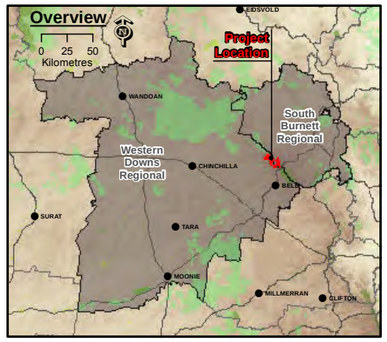
1:72,500 (when printed at A3)

Legend

- Project Site
- Study Area
- Met Masts
- Turbines
- Participating Landowners
- Non-Participating Landowners
- Contours 10m
- Road

$L_{Aeq,10min}$ *noise levels at 4 m above the ground (reference wind speed: 10 m/s at hub height)*

- ≤ 37 dB(A)
- ≤ 39 dB(A)
- ≤ 41 dB(A)
- ≤ 43 dB(A)
- ≤ 45 dB(A)
- >45 dB(A)



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1. Project Site, Turbine Layout © 2016 AECOM Australia Pty Ltd.
2. Surat Basin 40 cm Imagery © SISP, 2013
3. Service Road, Transmission Lines © AGL 2014
4. Locality, Roads © StreetPro 2011
5. Cadastral Data (DCDB) © State of Queensland (Department of Natural Resources and Mines) 2016
6. Contours 10m © Department of Natural Resources and Mines, 2013.
7. Hillshade, based on the 25m DEM covering the SEQ, DNRM 2005
8. Local Government Area (LGA) boundaries © Australia Bureau of Statistic (ABS), 2011.
9. Vegetation Management Watercourse and Drainage feature map (1:100 000 and 1:250 000) - version 1.4 dataset © State of Queensland (Department of Natural Resources and Mines) 2016
10. Noise Contours @ AECOM, 2016

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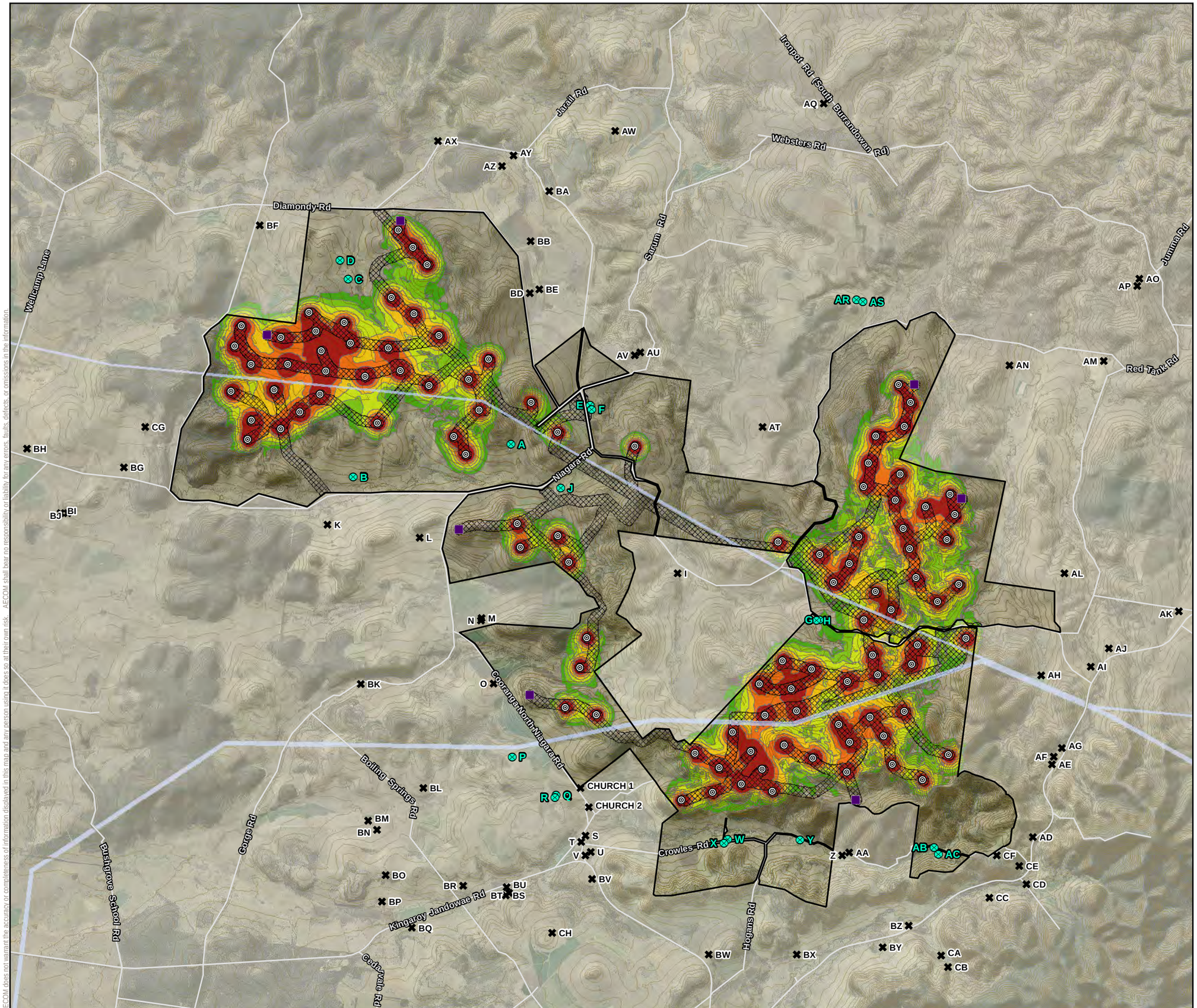
COOPERS GAP WIND FARM
NOISE AND VIBRATION IMPACT ASSESSMENT

$L_{Aeq,10MIN}$ NOISE CONTOUR MAP

PROJECT #:	60489152
CREATED BY:	BM
LAST MODIFIED:	BM: 7/09/2016
VERSION:	1

Appendix G

A3 size



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DATUM GDA 1994, PROJECTION MGA ZONE 56

0 1.5 3
Kilometres

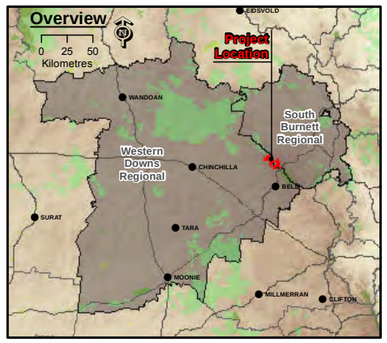
1:72,500 (when printed at A3)

Legend

- Project Site
- Study Area
- Met Masts
- Turbines
- Participating Landowners
- Non-Participating Landowners
- Contours 10m
- Road

$L_{Ceq,10min}$ noise levels at 4 m above the ground (reference wind speed: 10 m/s at hub height)

- ≤ 61 dB(C)
- ≤ 62 dB(C)
- ≤ 63 dB(C)
- ≤ 64 dB(C)
- ≤ 65 dB(C)
- > 65 dB(C)



Data Sources:
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2. Surat Basin 40 cm Imagery © SISP, 2013
3. Service Road, Transmission Lines © AGL 2014
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9. Vegetation Management Watercourse and Drainage feature map (1:100 000 and 1:250 000) - version 1.4 dataset © State of Queensland (Department of Natural Resources and Mines) 2016
10. Noise Contours @ AECOM, 2016

COOPERS GAP WIND FARM
NOISE AND VIBRATION IMPACT ASSESSMENT

$L_{Ceq,10MIN}$ NOISE CONTOUR MAP

PROJECT #:	60489152
CREATED BY:	BM
LAST MODIFIED:	BM: 7/09/2016
VERSION:	1

Appendix G

A3 size

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Appendix H

Preliminary Compliance Management Plan

AECOM

Coopers Gap Wind Farm
AGL Energy Limited
10-Aug-2016
Doc No. 60489152-AC-RP-0003- Preliminary Compliance Management Plan

Preliminary Compliance Management Plan

Wind Farm Noise Compliance

Preliminary Compliance Management Plan

Wind Farm Noise Compliance

Client: AGL Energy Limited

ABN: 74 115 061 375

Prepared by

AECOM Australia Pty Ltd
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10-Aug-2016

Job No.: 60489152

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

Quality Information

Document Preliminary Compliance Management Plan

Ref 60489152

Date 10-Aug-2016

Prepared by Rodrigo Olavarría, Holly Bryce

Reviewed by Michael Smith, Rhys Brown

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	31-May-2016	Draft Doc.	Mark Herod Principal Environmental Engineer	
2	29-Jun-2016	Final	Mark Herod Principal Environmental Engineer	
3	27-Jul-2016	Updated name - changed from Coopers Gap Compliance Noise Measurement Plan to Preliminary Compliance Management Plan	Mark Herod Principal Environmental Engineer	
4	10-Aug-2016	Final - Updated for final QLD Wind Farm Code	Mark Herod Principal Environmental Engineer	

Table of Contents

1.0 Introduction

AGL Energy Limited (AGL) is seeking approval to construct the Coopers Gap Wind Farm located at Cooranga North, approximately 60 km northeast the town of Dalby, in Queensland. The wind farm will be built along the western side of the Bunya Highway.

This Preliminary Compliance Management Plan (CMP) has been developed to define the methodology for undertaking post-construction noise monitoring, which is required to demonstrate whether the wind farm achieves compliance with the noise limits determined in the Noise and Vibration Impact Assessment (NVIA). This CMP will be updated once the final wind farm layout is determined and submitted for approval.

The applicable noise criterion for the operation of wind farms in Queensland is defined in the Queensland Department of Infrastructure, Local Government and Planning (DILGP) *Wind Farm State Code* (referred to in this report as the QLD Code), contained within the Queensland State Development Assessment Provisions (SDAP) Version 1.9 effective 22 July 2016. The noise limits for the Coopers Gap Wind Farm were determined from noise measurements of background noise as part of the NVIA by following guidance from the DILGP *Wind Farm State Code Planning Guideline* (referred to in this report as the QLD Code Planning Guideline), dated July 2016. Additional background noise measurements will be undertaken prior to the construction of the wind farm.

The QLD Code Planning Guideline does not prescribe a methodology to assess compliance during construction and/or operation of wind farms. The QLD Code Planning Guideline only provides guidance on the measurement of background noise before construction for the purpose of establishing operational noise limits. As such, in developing this CMP, the principles from the QLD Code Planning Guideline for conducting background measurements were used as the basis for conducting compliance noise measurements with reference to the following documents for aspects specific to compliance testing:

- AS4959-2010 Acoustics – *Measurement, prediction and assessment of noise from wind turbine generators* (AS4959).
- South Australia Environmental Protection Authority – Wind Farms – *Environmental Noise Guidelines* (SA2009).
- New Zealand Standard NZS6808:2010 *Acoustics – Wind farm noise* (NZS6808).
- NSW Department of Planning & Infrastructure *Draft NSW Planning Guidelines – Wind Farms*, December 2011 (NSW2011). This guideline follows methodologies and practices presented in the SA2009 and AS4959-2010.
- Victoria Department of Planning and Community Development *Policy and Planning Guidelines for development of wind energy facilities in Victoria, July 2012 (VIC2012)*, which refers to NZS6808:2010 for the assessment of wind farm noise impacts

Where a specification has been derived from any of the above documents, a reference has been made to the relevant document in this report.

Specifically, this CMP defines:

- A procedure to audit compliance with the limits during operation of the wind farm
- Proposed post-construction noise monitoring locations
- Appropriate noise monitoring and analysis procedures
- A general methodology for the assessment of ‘special audible characteristics’.

A Noise Compliance Report should be prepared and submitted within 12 months of the commencement of the operation of the wind farm (NSW2011).

2.0 Noise Criteria

The performance outcomes from the QLD Code, contained in the State Development Assessment Provisions (SDAP), were used as a basis to establish the applicable noise limits at sensitive receptors.

As detailed in the QLD Code, the following noise limits apply to this project:

- The outdoor (free-field) day-time (6am to 10pm) A-weighted equivalent acoustic level (L_{Aeq}), assessed at all noise affected existing or approved sensitive land uses, does not exceed 37dB(A), or the background noise (L_{A90}) by more than 5dB(A), whichever is greater.
- The outdoor (free-field) night-time (10pm to 6am) A-weighted equivalent acoustic level (L_{Aeq}), assessed at all noise affected existing or approved sensitive land uses, does not exceed 45dB(A), or the background noise (L_{A90}) by more than 5dB(A), whichever is the greater.
- The outdoor (free-field) night-time (10pm to 6am) A-weighted equivalent acoustic level (L_{Aeq}), assessed at all noise affected existing or approved sensitive land uses, does not exceed 35dB(A), or the background noise (L_{A90}) by more than 5dB(A), whichever is the greater.

For sensitive receptors to the Project that are located on either host lots, or non-host lots who have an agreed Deed of Release with AGL, as per the QLD Code, are referred to in this report as “Financial Landowners”. A free-field night-time A-weighted equivalent acoustic level (L_{Aeq}) of 45 dB(A) should not be exceeded at these receptors, as per the QLD Code. For all other sensitive receptors on non-host lots where landowners have not entered a commercial agreement with AGL, (referred to in this report as “Non-Financial Landowners”) a baseline 35 dB(A) L_{Aeq} noise limit is applied.

The QLD Code outlines performance outcomes for construction management, The QLD Code Planning Guideline specifies that a construction management plan is to be prepared by a suitably qualified person, identifying all potential construction impacts and the proposed measures to be undertaken to avoid, manage and mitigate the identified impacts. Wind farm construction noise limits are not defined in the QLD Code, nor does any legislation in Queensland specifically set construction noise limits. In lieu of no specific noise limits for construction of the wind farm and the requirement to development of a Construction Environment Management (CEMP) that will be required to mitigate potential construction noise impacts and demonstrate compliance, construction noise compliance is not addressed further within this document.

3.0 General Noise Compliance Assessment Procedure

3.1 Noise monitoring locations

Once operational, compliance noise measurements will be undertaken at a number of the sensitive receptors adjacent to the wind farm in order to demonstrate that compliance with the relevant criteria has been achieved.

The following criteria will apply at the selected the noise monitoring locations:

1. Post-construction noise monitoring equipment will be located as near as practically possible to the same location as the pre-construction background measurement locations (AS4659 & VIC2012).
2. Noise monitoring will be conducted where free-field noise levels predicted in the NVIA are close to the 35 dB(A) noise limit for non-financial land owners, or 45 dB(A) for financial land owners. It is noted that the NVIA determined that noise levels at all receptors would comply with these noise limits.
3. Noise levels will be measured at outdoor locations with the microphone at a height of 1.2 m - 1.5 m above ground level, within 20 m of the receptor dwelling and at least 5 m from any significant vertical reflecting surfaces. The monitoring locations will be on the wind farm side of a dwelling and as far away as possible from potential sources of domestic noise (e.g. air conditioners, water pumps, dog kennels, etc.) and vegetation noise from trees and shrubs (QLD2016). The microphone will be facing upwards.
4. All monitoring locations will be located using GPS and photographic images will be taken of the location of the noise monitor and the surroundings in multiple directions (QLD2016).

Based on criteria 1 and 2 above, proposed compliance noise monitoring locations are provided in Table 1 to assess the general compliance of the Coopers Gap Wind Farm against the applicable noise limits. These locations are representative of worst-case noise monitoring locations, due to their closeness to the Coopers Gap Wind Farm.

Sensitive receptors and locations where background noise was monitored during the NVIA process are provided in Appendix C.

Dominant winds on site are north-easterly and south-westerly. As such, collecting a large data sample for downwind directions at sites located east and west of the wind farm may not be possible.

Table 1 Noise monitoring locations

Background noise monitoring locations	Recommended monitoring locations for noise compliance assessment	Approximate worst-case[1] wind directions
A	A	Northerly and North-easterly
AA	AA	Northerly
AD	AL[2]	Westerly
BD	BD	South-westerly
C	C	South-easterly to Easterly
CF	CF	North-westerly
F	F	Southerly and South-westerly
G	G	All but Westerly
I	I	All but Northerly
J	J	All
O	K[2]	North-easterly
Y	Y	Northerly

[1] Worst-case wind is defined in Section 3.3

[2] Receptor AL and K are proposed as alternative locations as they are closer to the 35 dB(A) noise contour than receptor AD and O, respectively, based on the noise predictions conducted as part of the NVIA.

3.2 Monitoring equipment

The following monitoring equipment will be used:

1. Wind farm noise will be measured using Class 1 or Class 2 sound level meters in accordance with AS IEC−61672.1-2004 *Electroacoustics – Sound level meters*. All noise monitoring equipment must have an inherent noise floor no greater than 20 dB(A) (QLD2016).
2. The $L_{Aeq,10min}$ and $L_{A90,10min}$ will be measured to assess noise compliance, at 10 minute intervals, as a minimum. The $L_{A50,10min}$, $L_{A10,10min}$ and $L_{A1,10min}$ will also be measured to describe the ambient noise environment surrounding the wind farm (QLD2016).
3. The sound level meters will be suitably calibrated before and after measurements and if the difference is greater than 1 dB, the data will be discarded (QLD2016).
4. Where possible, the microphones will be protected with windshields which reduce wind induced noise on the microphone to 10 dB(A) or more below the monitored background noise levels.
5. All noise measurements will be synchronised with the data collected from either the closest meteorological mast (corrected to hub height) to the measurement location, or the wind speeds logged at the closest Wind Turbine Generator (WTG). The WTG power generation, nacelle angle, and rotational speed (RPM) will also be logged.
6. The wind shear factor used for extrapolation to hub height will be measured directly by a hub height ultrasonic anemometer or estimated from the measured wind speeds at two heights on a meteorological mast (QLD2016).
7. Meteorological monitoring at ground level shall be conducted simultaneously with the noise monitoring at selected locations near the noise monitoring locations to register rainfall during the noise monitoring period so that rain affected noise samples are discarded from the noise data set (QLD2016). This will be done by analysing data from a portable weather station installed near a representative noise monitoring location, or by analysing data downloaded from the closest Bureau of Meteorology weather station. The former method is preferred.
8. Noise and weather data will be obtained at 10-minute averages logged continuously over 24 hour periods.

3.3 Measurement duration

Noise measurements shall be conducted for a duration that allows to:

1. Conduct noise measurements for the operational range of the wind turbines, from the WTG cut-in speed to the maximum 'rated' power wind speed (NZS6808).
2. Measure for a duration of approximately six weeks. Any shorter duration should be justified (QLD2016).

3.4 Data processing and compliance assessment

The following steps will be followed in processing the measured data:

Wind speed reference

1. All wind data related to the wind environment at the site and the operating performance of the wind turbines will be expressed in terms of the hub height of the turbines (QLD2016). Formulae are specified in QLD2016 to extrapolate wind data measured at heights other than hub height.

Microphone wind induced noise

2. Where wind induced noise on the microphone is 10 dB(A) to 4 dB(A) below the monitored background noise levels, the potentially wind affected noise data will be retained with the wind induced noise logarithmically subtracted from the measured background noise levels. Where wind-induced noise on the microphone is within 4 dB(A) of the measured noise levels, the potentially wind affected noise data shall be discarded from the analysis.

   Wind induced noise on the microphone can be estimated following the procedure from Cooper *et al* [1].

Extraneous noise

3. Data that is affected by extraneous noise will be excluded from the final data set. Screening tools which develop a relationship between L_{Aeq} and L_{A90} noise descriptors, such as a difference greater than 5 dB(A) can be useful in identifying potentially contaminated data. If available, audio recordings can be used to subjectively analyse the presence of extraneous noise (NSW2011).

Corrections for special audible characteristics

4. If a tone is suspected at a monitoring location, an assessment using either a simplified or reference method will be performed.

   The simplified method applies a 5 dB(A) correction when the level of one-third octave band measured in the equivalent noise level $L_{eq,10min}$ exceeds the arithmetic mean level of the adjacent bands by:

   - 5 dB or more if the centre frequency of the band containing the tone is above 400Hz
   - 8 dB or more if the centre frequency of the band containing the tone is 160Hz to 400Hz inclusive
   - 15 dB or more if the centre frequency of the band containing the tone is below 160Hz (NSW2011 and NZS6808).

   If tonality is found to be a repeated characteristic of the wind turbine noise, 5 dB(A) should be added to the measured noise level from the wind farm (NSW2011).

   The reference method using narrow-band analysis may also be conducted to confirm the presence of tones, in accordance with Annex C of ISO 1996-2:2007 – Acoustics – *Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels*.

5. Amplitude Modulation (AM) is an expected characteristic of wind turbine noise (commonly described as a 'swish'), and this character has been included when determining appropriate noise limits. Under normal circumstances, no assessment of AM is required. If there is concern that AM is excessive at receptors, further analysis will be conducted. AM will only be considered to be a special audible characteristic if the measured A-weighted Peak to through levels exceed 5 dB on a regularly varying basis, or if the measured

[1] J. Cooper, D. Leclercq, and M. Stead. *'Wind induced aerodynamic noise on microphones from atmospheric measurements'*. International Congress on Acoustics 2010, Sydney, August 23-27 2010.

third-octave band peaks to through levels exceed 6 dB on a regular basis in respect to the blade pass frequency. AM occurs when there is a greater than normal degree of fluctuation as a function of the blade passing frequency (typically about one per second) (NZS6808).

If excessive AM is found to be a repeated characteristic of the wind turbine noise, 5 dB(A) correction should be added to the measured noise level from the wind farm (NSW2011).

6. Impulsiveness is not commonly experienced in wind farms and is not addressed by Australian guidelines and standards. No assessment or penalty will be applied to the measured data.
7. Wind turbine noise levels with special audible characteristics (i.e. tonality and AM) will be adjusted by arithmetically adding up to +6 dB to the measured noise level. Cumulative adjustments for multiple special audible characteristics will not exceed +6 dB regardless of how many special audible characteristics exist (NZS6808).
8. Where special audible characteristics are confirmed, the value of the adjustment will apply to that specific sample (NZS6808) and will apply only if these are audible at the relevant receptor (NSW2011).

It is noted that *criteria do not usually include consideration of special audible characteristics that are not a normal characteristic of a correctly functioning WTG* (AS4959). As such, prior to conducting the noise measurements, it is recommended that the WTGs are audited to confirm that they are operating normally so that penalties for special audible characteristics are avoided.

Regression curves

9. Scatter plots will be drawn of the post-installation sound levels against measured wind speeds and a best fit regression analysis will be carried out separately on the day and night background noise-hub height wind speed data. Polynomials (from linear up to third order) will be used to present the fitted regression line to calculate the wind farm noise level. A ‘bin analysis’ such as that outlined in IEC 61400-11 - Wind Turbines - Part 11: *Acoustic noise measurement techniques* may be used for this purpose (NZS6808).

Noise compliance

10. To identify the contribution of the wind farm to the total noise level (i.e. the wind farm's equivalent noise level (L_{Aeq})), the background L_{A90} noise level will be logarithmically subtracted from the total measured noise L_{Aeq}. While a simple energy subtraction of background and post-installation noise levels is not mathematically correct for the L_{A90} noise descriptor, the difference may be taken as the L_{A90} wind farm noise levels (NZS6808). This is based on the assumption that wind farm noise is constant noise and therefore the L_{A90} and L_{Aeq} noise levels produced by the wind farm are equivalent (i.e. $L_{Aeq} = L_{A90}$).

    The total noise levels and the background noise levels will be determined from the best fit regression curves for the relevant integer wind speeds.

11. The wind farm noise level per integer wind speed will be assessed against the noise criteria specified in the NVIA to determine compliance.

3.5 Background noise levels

Where noise measurements are conducted at receptors where background noise levels have not been determined, the background noise levels at integer wind speeds can be defined by either:

1. Using the best fit curve determined for the closest receptor where background noise is specified in the NVIA (specified in the 'closest measured receptor' column of Table 2 in Appendix B). This method assumes that the background noise measured previously at the closest receptor is 'representative' of the background noise at the alternative complainants location; or
2. By measuring background noise levels specific to the site. This may be achieved with the wind turbines parked/offline or with the wind turbine rotor revolutions below 2 RPM (NSW2011). Relevant WTGs to be parked/offline can be confirmed via acoustic modelling.

When possible, it is desirable that background noise measurements and compliance noise measurements be conducted during the same time of the year, particular when monitoring is adjacent deciduous vegetation. In addition, there may be significant changes in dominant wind directions.

3.6 Noise compliance report

An acoustic report will be provided to detail the following information:

1. Description of the noise monitoring equipment used, including any ancillary equipment
2. Description of the wind monitoring equipment and met mast sensor heights
3. Frequency and time-weightings used during measurements
4. Noise monitoring locations and surrounding area description
5. Make and model of the wind turbines
6. Operational wind turbines at the time of measurement
7. Time and duration of monitoring period
8. Averaging period for both sound and wind speed measurements
9. Atmospheric conditions: the wind speed and direction at the wind farm position and rainfall recorded
10. Number of data sample pairs measured (wind speed and noise data pairs)
11. Description of the regression analysis
12. Plots showing the data scatter and regression lines
13. Plots showing regression lines for total noise, wind farm noise, background noise, and noise limits
14. Assessment of special audible characteristics
15. A statement that the wind farm complies with relevant limits, or exceeds them, as determined from the best fit regression analysis.

4.0 Noise Monitoring for Noise Complaints

Where noise monitoring is required in response to complaints, a combination of attended and unattended monitoring can be used.

Attended monitoring

Attended noise monitoring can be used to verify a complaint before committing to extensive noise monitoring. Wind forecast should be obtained from the wind farm meteorological mast control system to assist in determining the most suitable monitoring days, based on the worst case wind direction for the complainant site (worst case wind is defined in Section 3.3) and at maximum sound power level. Monitoring will generally be required to be performed at night where background sound levels are lowest.

Unattended monitoring

Should complaints arise from the operation of the Coopers Gap Wind Farm, noise monitoring at the noise complainant receptors should be conducted following the process described in Section 3.0 of this report. Background noise levels at integer wind speeds can be obtained by the method explained in Section 3.5.

Appendix A

Acoustic Terminology

Appendix A Acoustic Terminology

'A' Weighted	Frequency filter applied to measured noise levels to represent how humans hear sounds.
Ambient Noise	Total noise at a site comprising all sources such as industry, traffic, domestic, and natural noises.
Attended Measurement	Measurements that are attended by a person and measured with a sound level meter.
dB(A)	'A' Weighted overall sound pressure level.
dB(G)	The G-weighting for the determination of weighted sound pressure levels of sound or noise, whose spectrum lies partly or wholly within the frequency range from 1 Hz to 20 Hz, has been standardised in ISO 7196, (1995). G-weighted sound pressure levels are denoted L_{pG} and are measured or estimated in dB(G)
Frequency	The number of cycles per second, where 1 cycle per second is equal to 1Hz. The human ear responds to sounds of frequency 20 Hz to 20,000 Hz.
Impulsiveness	Noise that comprises distinct impulses in the noise (bangs, clicks, clatters, or thumps) etc.
Intermittent	Stopping and starting at irregular intervals.
L_{Aeq}	The 'A' Weighted energy-averaged noise level over the measurement period.
$L_{Aeq,10min}$	The energy-averaged level of the total noise measured without adjustment for the character of the noise (e.g. tonal or impulsive), over a period of 10 minutes.
$L_{Ar,\ 1hour}$	The noise level of the component of the total noise that can be specifically identified by acoustical means which is associated with the noise from mining operations and shall be measured with an adjustment for the character of the noise (tonal or impulsive) over a period of 1 hour.
L_{max}	Maximum noise level of the measurement period.
L_{10}	Noise level exceeded for 10% of the measurement period. The L_{10} represents the intrusive noise level and is often used to represent traffic/ music noise.
L_{90}	Noise level exceeded for 90% of the measurement period. This represents the background noise level excluding nearby sources.
$L_{w(A)}$	'A' Weighted sound power level, measured in dB(A). The sound power level is a measure of the total acoustic energy produced by a source and is independent of distance and source location. The sound power level is expressed as a ratio against a reference level of 10^{-12} watts.
Least-squares regression	The method for finding a line that summarizes the relationship between the two parameters, e.g. wind speed and measured noise level.
Tonality	A characteristic of noise, describing a sound that contains a perceptible pitch or tone. As a general rule, a prominent tonal component may be detected in one-third octave spectra if the level of a one-third octave band exceeds the level of the adjacent bands by 5 dB or more.
Unattended Measurement	Measurements that are taken by a noise logger at a given location unattended.

Appendix B

Coopers Gap L_{Aeq} Noise Limits (Source: NVIA)

Appendix B Noise Limits

Table 2: NVIA $L_{Aeq,10min}$ noise limits at all identified Coopers Gap Wind Farm noise sensitive receptors. Where noise limits are the result of extrapolation, the values have been bolded (Source: NVIA report)

Location ID	Financial landowner	Closest measured receptor	Minimum noise limit, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																
			Base criterion	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	YES	A	45	45	45	45	45	45	45	45	45	46	47	48	48	49	50	**50**	**51**	**51**
AA	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	**48**	**50**	**52**
AB	YES	CF	45	45	45	45	45	45	45	45	45	45	45	45	45	**45**	**45**	**45**	**46**	**48**
AC	YES	CF	45	45	45	45	45	45	45	45	45	45	45	45	45	**45**	**45**	**45**	**46**	**48**
AD	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AE	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AF	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AG	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AH	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AI	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AJ	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AK	NO	AD	35	35	35	35	36	37	38	40	41	42	44	45	47	48	50	51	**52**	**54**
AL	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AM	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AN	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AO	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AP	NO	G	35	35	35	35	36	37	39	40	42	43	45	47	49	51	53	55	57	60
AQ	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	**47**	**47**	**48**
AR	YES	F	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	**45**	**45**	**45**

Location ID	Financial landowner	Closest measured receptor	Minimum noise limit, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																
			Base criterion	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AS	YES	F	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
AT	NO	F	35	35	36	37	39	40	41	42	43	43	44	44	45	45	45	45	45	44
AU	NO	F	35	35	36	37	39	40	41	42	43	43	44	44	45	45	45	45	45	44
AV	NO	F	35	35	36	37	39	40	41	42	43	43	44	44	45	45	45	45	45	44
AW	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48
AX	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58
AY	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48
AZ	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48
B	YES	A	45	45	45	45	45	45	45	45	45	46	47	48	48	49	50	50	51	51
BA	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48
BB	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48
BD	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48
BE	NO	BD	36	36	38	39	40	40	41	42	43	44	44	45	46	46	47	47	47	48
BF	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58
BG	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58
BH	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58
BI	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58
BJ	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58
BK	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BL	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BM	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BN	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58

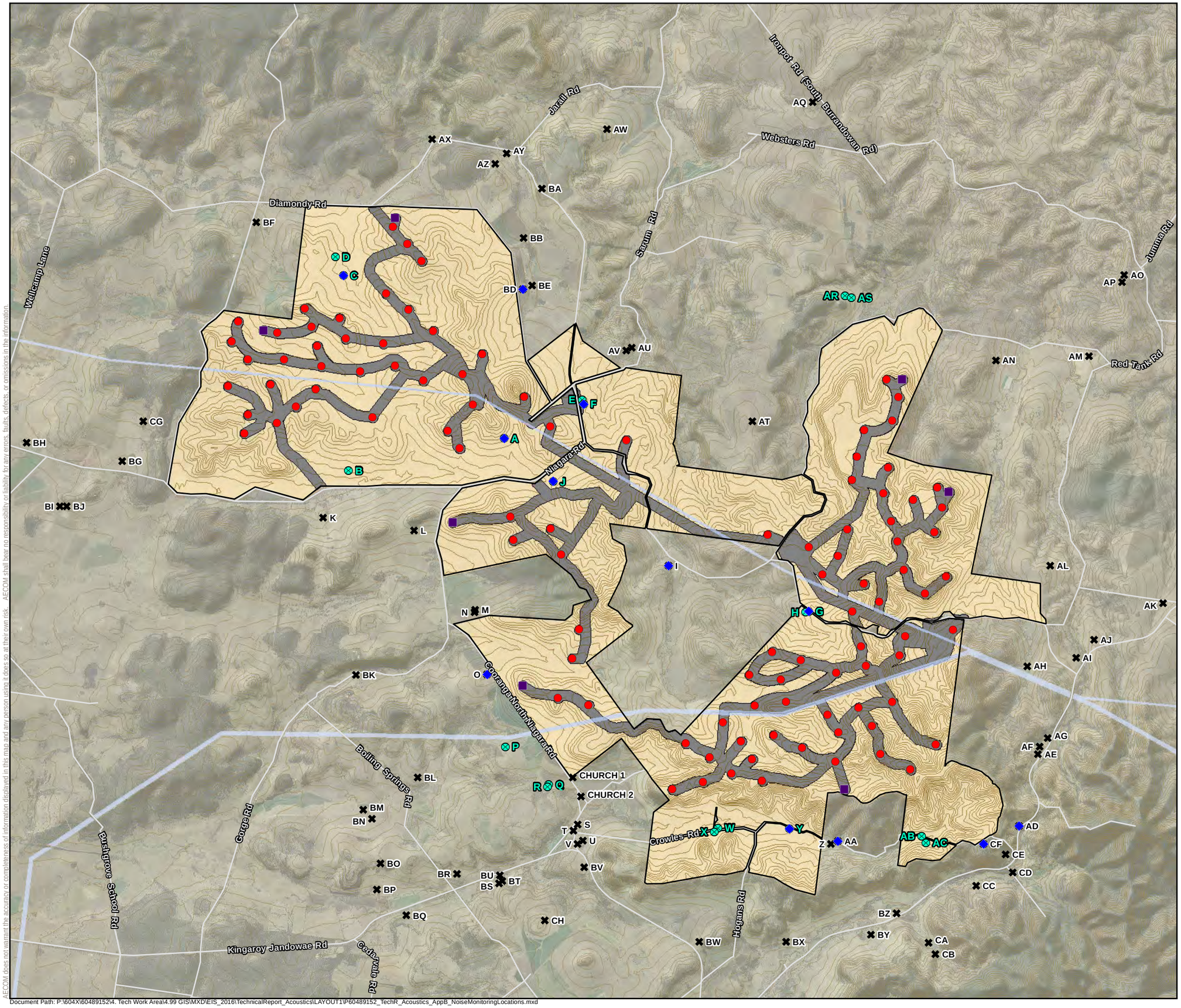
Location ID	Financial landowner	Closest measured receptor	Minimum noise limit, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																
			Base criterion	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
BO	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BP	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BQ	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BR	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BS	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BT	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BU	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BV	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
BW	NO	Y	37	37	37	38	39	40	40	41	42	43	44	45	46	48	49	50	52	53
BX	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52
BY	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52
BZ	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	48	50	52
C	YES	C	45	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58
CA	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CB	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CC	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CD	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CE	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CF	NO	CF	35	35	35	35	35	35	35	35	35	36	37	39	40	42	43	45	46	48
CG	NO	C	38	38	38	39	39	40	41	41	42	44	45	46	48	50	52	54	56	58
CH	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
CHURCH 1	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58

Location ID	Financial landowner	Closest measured receptor	Minimum noise limit, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																
			Base criterion	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CHURCH 2	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
D	YES	C	45	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58
E	YES	F	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
F	YES	F	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
G	YES	G	45	45	45	45	45	45	45	45	45	45	45	47	49	51	53	55	57	60
H	YES	G	45	45	45	45	45	45	45	45	45	45	45	47	49	51	53	55	57	60
I	NO	I	38	38	38	38	39	40	41	42	44	45	47	50	52	55	58	62	65	69
J	YES	J	45	45	45	45	45	45	45	45	45	45	45	45	45	47	48	50	52	55
K	NO	A	35	35	37	38	40	41	42	44	45	46	47	48	48	49	50	50	51	51
L	NO	A	35	35	37	38	40	41	42	44	45	46	47	48	48	49	50	50	51	51
M	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
N	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
O	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
P	YES	O	45	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58
Q	YES	O	45	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58
R	YES	O	45	45	45	45	45	45	45	45	45	45	45	46	48	50	52	54	56	58
S	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
T	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
U	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
V	NO	O	35	35	35	35	36	37	39	40	41	43	44	46	48	50	52	54	56	58
W	YES	Y	45	45	45	45	45	45	45	45	45	45	45	45	46	48	49	50	52	53
X	YES	Y	45	45	45	45	45	45	45	45	45	45	45	45	46	48	49	50	52	53

Location ID	Financial landowner	Closest measured receptor	Minimum noise limit, dB(A)	$L_{Aeq,10min}$ noise limit in dB(A) versus wind speed (m/s) at hub height of 84 m																
			Base criterion	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Y	YES	Y	45	45	45	45	45	45	45	45	45	45	45	45	46	**48**	**49**	**50**	**52**	**53**
Z	NO	AA	35	35	35	35	35	35	35	35	35	37	38	40	42	44	46	**48**	**50**	**52**

Appendix C

Coopers Gap Wind Farm Sensitive Receptors (Source: NVIA)



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AGL Energy in action.

AECOM

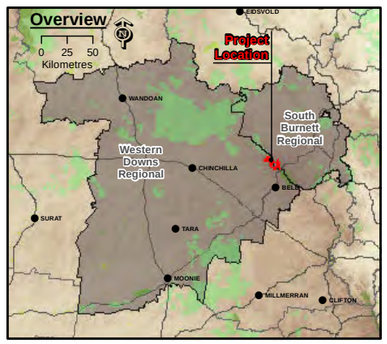
DATUM GDA 1994, PROJECTION MGA ZONE 56

0 1.5 3
Kilometres

1:72,500 (when printed at A3)

Legend

- Project Site
- Study Area
- Met Masts
- Turbines
- Participating Landowners
- Non-Participating Landowners
- Noise Monitoring Locations
- Contours 10m
- Road



Data Sources:
1. Project Site, Turbine Layout © 2016 AECOM Australia Pty Ltd.
2. Surat Basin 40 cm Imagery © SISP, 2013
3. Service Road, Transmission Lines © AGL 2014
4. Locality, Roads © StreetPro 2011
5. Cadastral Data (DCDB) © State of Queensland (Department of Natural Resources and Mines) 2016
6. Contours 10m © Department of Natural Resources and Mines, 2013.
7. Hillshade, based on the 25m DEM covering the SEQ; DNRM 2005
8. Local Government Area (LGA) boundaries © Australia Bureau of Statistic (ABS), 2011.
9. Vegetation Management Watercourse and Drainage feature map (1:100 000 and 1:250 000) - version 1.4 dataset © State of Queensland (Department of Natural Resources and Mines) 2016

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COOPERS GAP WIND FARM
NOISE AND VIBRATION IMPACT ASSESSMENT

NOISE MONITORING LOCATIONS

PROJECT #:	60489152
CREATED BY:	BM
LAST MODIFIED:	BM: 5/09/2016
VERSION:	1

Appendix B

Document Path: P:\604X\60489152\4. Tech Work Area\4.99 GIS\MXD\EIS_2016\TechnicalReport_Acoustics\LAYOUT1\P60489152_TechR_Acoustics_AppB_NoiseMonitoringLocations.mxd

A3 size