BORG PANELS

TIMBER PANEL PROCESSING FACILITY

OBERON NSW

Noise and Vibration Impact Assessment

May 2016

Prepared for

Borg Manufacturing

Global Acoustics

Noise and Vibration Analysis and Solutions

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Borg Panels, Timber Panel Processing Facility, Oberon NSW

Noise and Vibration Impact Assessment
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EXECUTIVE SUMMARY

Global Acoustics was engaged by Borg Manufacturing Pty Ltd (Borg) to carry out a noise and vibration impact assessment for a proposed expansion of their panel manufacturing facility, located approximately 1.5kms from the centre of Oberon at 124 Lowes Mount Road. This assessment considered impacts associated with noise emission from the existing site, and, the proposed expansion. Potential impact from operational noise, low frequency noise, sleep disturbance, cumulative noise, construction noise and road traffic noise were assessed. A model validation assessment was undertaken to provide an estimate of model prediction accuracy.

Validation Assessment

A model of the existing site was developed, and refined to represent the operational configuration in effect during attended monitoring on the night of 14 October 2015. Results of attended monitoring at Oberon Caravan Park were compared with model predictions for the same location under meteorological conditions in effect at the time of monitoring. An exact correlation resulted, indicating the model of the existing site provides a good estimate of actual noise emission. Compliance with the current EPL night period operational noise criterion was demonstrated.

Operational Noise

Modelling of the existing situation indicated the site currently operates close to EPL criteria during periods of enhancing meteorological conditions. Management measures and noise control for some plant were recommended to both manage and reduce noise emission from the existing site. Compliance with existing EPL criteria was predicted for the existing site for all receivers during non-enhancing meteorological conditions, and all receivers during the evening and night periods during prevailing (enhancing) meteorological conditions. Minor to moderate exceedances were predicted for receivers south of site for the day period when mobile chipping plant is operational during prevailing (enhancing) meteorological conditions.

A model of the proposed expansion was developed, which included all existing plant (with noise control where required) and proposed infrastructure. Mobile chipping plant will be phased out from permanent use and replaced with three enclosed electric chippers (one of which currently exists). Sound power data was not available for plant proposed for the expansion; Borg provided sound pressure level (SPL) data at 1 metre for acoustically significant plant. Sound power for proposed infrastructure was estimated using a relationship derived for each item between the SPL provided by Borg, SPL measured by Global Acoustics for similar plant items at 1 metre, and calculated sound power for similar plant items. Initial model iterations indicated noise control will be required for some plant. For critical plant, limiting sound powers were derived to reduce model predictions to within compliance levels. In some cases, a significant degree of noise control may be required. Full details regarding sound power derivation and recommendations are included in Section 3.4 of this report.

Model predictions indicate the proposed expansion could generally comply with existing EPL operational noise criteria, when recommended management strategies are implemented, and if limiting sound powers for proposed infrastructure and recommended noise controls for existing plant are achieved. The exception is 15-19 Albion Street, for which a minor 1 dB exceedance is predicted for the day period during enhancing meteorological conditions if a mobile chipper is operational. Compliance was predicted for all receivers for 'normal' operations when no mobile chipping plant is operated.

A low frequency noise assessment was undertaken in accordance with INP guidelines. Low frequency modifying factor penalties were applicable in some instance; however, none caused an exceedance of operational noise criteria not previously indicated in the operational noise assessment. Total C-weighted noise predictions remained within desirable limits suggested in *A Simple Method for Low Frequency Noise Emission Assessmen*t (Broner, 2010).

A sleep disturbance assessment was undertaken for the proposed expansion, considering maximum impact noise generated by mobile plant. The current license does not include sleep disturbance criteria. Maximum noise level increases above predicted steady state noise emissions were considered acceptable, and not likely to cause sleep disturbance.

Predictions for the proposed expansion are typically the same as, or slightly lower than, predictions for the existing site. As no significant change is predicted relative to the existing situation, no significant change to cumulative noise levels should result.

Construction Noise

A construction period of approximately 24 months is proposed. Construction activities will be undertaken in conjunction with regular operation of the existing site. Borg propose to generally restrict site noise emission from both construction and operational tasks combined to comply with operational noise criteria conditioned in EPL 3035.

Rock or concrete breaking, earthworks, and, infrastructure installation were assessed. Model predictions for the earthworks and installation scenarios indicate general compliance with the day period operational noise criterion at all receivers, with the exception of 15-19 Albion Street. At this location, exceedances were predicted during prevailing wind conditions if a mobile chipper is operated concurrently with construction plant. Exceedance of the evening period operational noise criterion is predicted at R02, R03, R06, R08, R09 and R10. These exceedances are predicted during calm and prevailing wind conditions when a mobile chipper is operated concurrently with construction plant. Construction noise can be managed through monitoring weather conditions, restricting use of the mobile chipper during enhancing conditions if a large amount of construction plant is operating, and restricting construction activities to the standard ICNG construction hours where possible.

Rock breaking was assessed against the "highly affected" construction noise criterion of $L_{Aeq,15minute}$ 75 dB, as the duration would be relatively short compared with other construction tasks, and few options are available to mitigate noise from this activity. Predictions were well below this criterion.

Vibration

Due to the distance to sensitive receivers from operational and construction areas, no vibration impact is expected.

Road Traffic Noise

Construction and operational road traffic noise impacts were assessed for North Street and Albion Street, the roads indicated in the Traffic Impact Assessment report to receive the greatest traffic flows. The majority of both construction and operational project traffic generated by the project will occur outside of general peak hour traffic flows. Increases to road traffic noise relative to the existing situation were found to be insignificant, and less than 1 dB. Such an increase is unlikely to be either measurable, or perceptible to the human ear.

Closure

In general, operation of both the existing site and the proposed expansion are predicted to comply with current EPL operational noise criteria when recommended management strategies are implemented. A minor 1 dB exceedance is predicted at R09 when a mobile chipper is operated during enhancing meteorological conditions. Operation of mobile chippers does not form part of 'normal' operations, as they will typically be only used during breakdown of electric plant. Exceedances can be avoided through monitoring weather and restricting use of mobile chipping plant during periods of meteorological enhancement.

Results of this assessment are dependent upon limiting sound powers for proposed infrastructure, and recommended noise controls for existing plant, being achieved. Borg has committed to including sound power limits in tender documents to ensure required targets are achieved.

Global Acoustics Pty Ltd

Table of Contents

Appendices

1 INTRODUCTION

1.1 Background

Global Acoustics was engaged by Borg Manufacturing Pty Ltd (Borg) to carry out a noise and vibration impact assessment for a proposed expansion of their panel manufacturing facility, located approximately 1.5kms from the centre of Oberon at 124 Lowes Mount Road.

The subject land is currently developed for the purpose of manufacturing Medium Density Fibre board (MDF). This existing development includes:

- A number of large industrial scale buildings which contain various processes involved with the manufacture of MDF and MDF products;
- Concrete hard stand areas between the buildings;
- An existing two-storey administration/amenities building with associated staff car parking;
- Various necessary items of infrastructure including venting and conveyors;
- Other facilities/buildings associated with the use of the land (including maintenance areas, security entry/exit gates and weigh bridges; and
- Fencing, landscaping and other site facilities.

The proposed expansion (the Project) involves enlargement of the existing timber manufacturing and processing facility. The major change to the existing approval for the site is to provide for a facility to manufacture particle board. Particle board manufacturing involves both the processing of virgin wood, residual wood waste from sawmills, and the recycling and processing of appropriate used wood to create suitable sized particles. These are then processed to form particle board. In addition to this, expansion to existing MDF and laminating operations are to be undertaken. These are largely to be located within existing structures on site.

The primary objectives of the Project are to:

- Allow for the construction of a dedicated particle board manufacturing line;
- Provide additional capacity within existing buildings to expand production capacity;
- Modernise the existing facility;
- Allow for expansion to Lot 1 and 2 DP 1085563 and consolidation into Lot 26 DP1200697 for the purposes of processing and storage;
- Rationalise the current Conditions of Consent that apply to a number of different lots, all under

fragmented ownership and operation; and

- Allow for an increase in production, with a commensurate increase in staff levels.

The works associated with the Project will run in parallel with existing MDF processing lines, laminating building (including press and paper treatment) and ancillary cranes, storage and administration building which are to be retained. No changes to these existing approved facilities, with the exception of demolition of the administration block, are proposed. Existing and proposed infrastructure are illustrated in Figure 1.

This assessment has been prepared in accordance with the relevant guidelines contained in the NSW Industrial Noise Policy (INP), NSW Interim Construction Noise Guideline (ICNG), NSW Road Noise Policy (RNP) and NSW Assessing Vibration: a Technical Guideline.

The primary purpose of this assessment is to determine potential noise and vibration impact at the nearest residential receptors to the site, and considers construction, operational and transport noise impacts. This assessment has been based on plans and information provided by Borg.

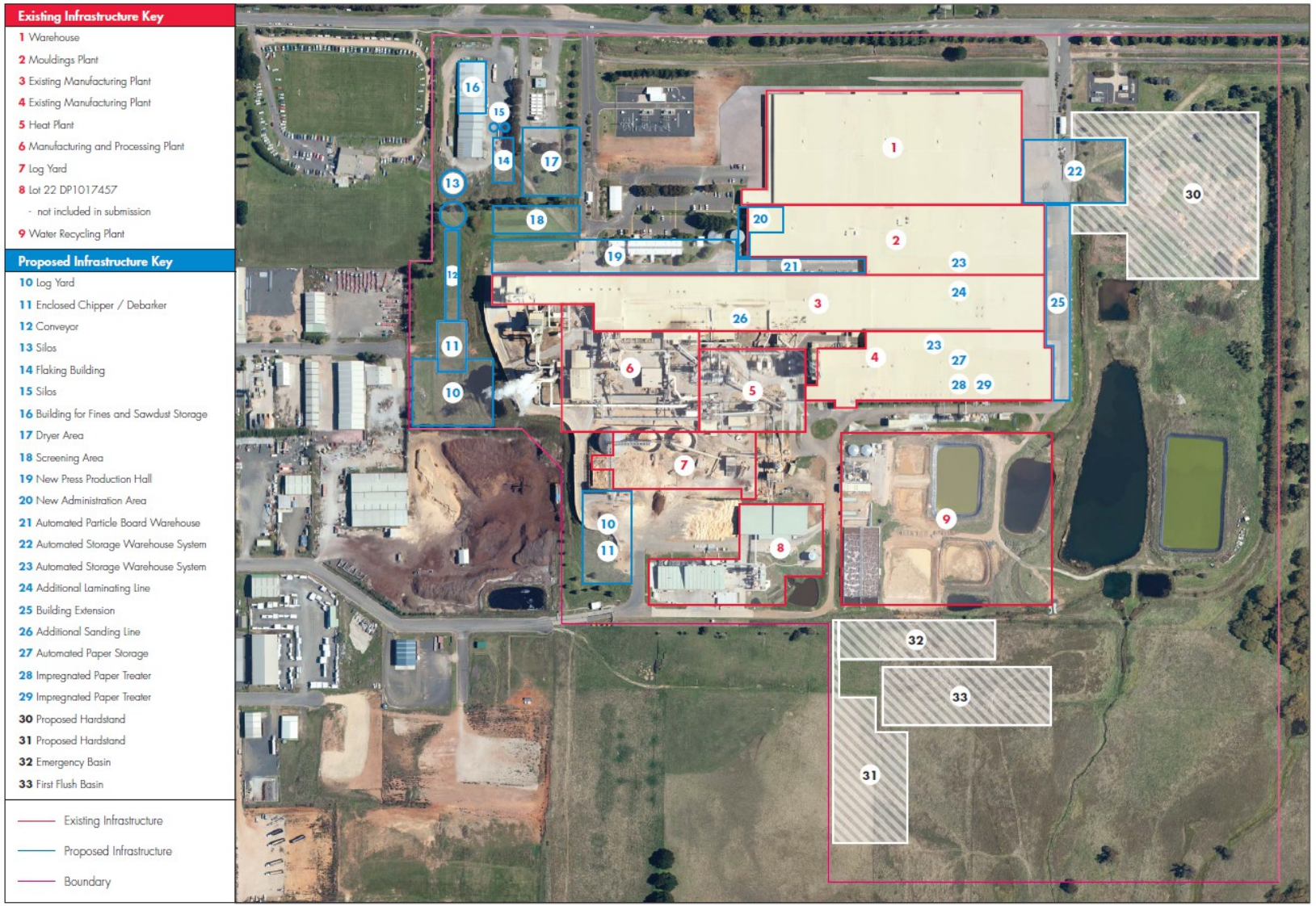


Figure 1: Existing and Proposed Infrastructure (Source: Borg Panels, 16 May 2016)

1.2 Terminology & Abbreviations

Some definitions of terminology and abbreviations, which may be used in this report, are provided in Table 1.

Table 1: TERMINOLOGY & ABBREVIATIONS

Descriptor	Definition
L_A	The A-weighted root mean squared (RMS) noise level at any instant
L_{A10}	The noise level which is exceeded for 10 percent of the time, which is approximately the average of the maximum noise levels
L_{A90}	The level exceeded for 90 percent of the time, which is approximately the average of the minimum noise levels. The L_{A90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes
L_{Aeq}	The average noise energy during a measurement period
dB(A)	Noise level measurement units are decibels (dB). The "A" weighting scale is used to describe human response to noise
SPL	Sound pressure level (SPL), fluctuations in pressure measured as 10 times a logarithmic scale, the reference pressure being 20 micropascals
SEL	Sound exposure level (SEL), the A-weighted noise energy during a measurement period normalised to one second
ABL	Assessment background level (ABL), the 10^{th} percentile background noise level for a single period (day, evening or night) of a 24 hour monitoring period
RBL	Rating background level (RBL), the background noise level for a period (day, evening or night) determined from ABL data
Hertz (Hz)	Cycles per second, the frequency of fluctuations in pressure, sound is usually a combination of many frequencies together
VTG	Vertical temperature gradient in degrees Celsius per 100 metres altitude. Estimated from wind speed and sigma theta data
SC	Stability Class. Estimated from wind speed and sigma theta data
Day	This is the period 7:00am to 6:00pm
Evening	This is the period 6:00pm to 10:00pm
Night	This is the period 10:00pm to 7:00am
VPH	Vehicles per hour; the number of vehicles travelling on a section of road per hour.

2 CRITERIA

2.1 Existing Environment

The subject land is located on the northern outskirts of Oberon, to the east of Lowes Mount Road. As per the Oberon Council Local Environmental Plan (LEP) 2013, the land zone classification of the subject site is IN1 General Industrial. The Borg operations are part of a larger industrial precinct operated by a number of separate companies, which generally involve timber product manufacture. Land use north, east and west of the subject site is generally agricultural.

2.2 Unattended Monitoring

An unattended noise monitoring survey was undertaken around the subject site from 14 October 2015 to 21 October 2015 inclusive. Monitoring was undertaken at three locations, as listed in Table 2. Logging locations are shown in Figure 5.

Table 2: UNATTENDED MONITORING LOCATIONS

Location ID	Monitoring Location
NM1	Oberon Caravan Park, adjacent reception building
NM2	Corner of O'Connell Road and Albion Street
NM3	127 Hazelgrove Road

2.2.1 Unattended Monitoring Equipment

The equipment used to measure and record environmental noise levels are listed in Table 3, copies of calibration certificates are provided in Appendix A. The loggers were configured to provide a statistical noise data summary every 15 minutes.

Table 3: MONITORING EQUIPMENT

Model	Serial Number	Calibration Due Date
ARL Ngara Noise Data Logger	878017	28/11/2016
ARL Ngara Noise Data Logger	878041	20/01/2016
ARL Ngara Noise Data Logger	87801F	13/12/2015
Pulsar Sound Level Calibrator	57813	08/07/2017

2.2.2 Background Monitoring Results

Table 4 to Table 6 provide summaries of noise logger data. Graphs are provided in Appendix B. Bureau of Meteorology (BOM) data from the Mount Boyce AWS was used for processing logger data.

Table 4: AVERAGE LOGGED NOISE LEVELS – NM1

Site	Period	L_{Aeq} dB	L_{A10} dB	L_{A90} dB	RBL dB[1]
Location NM1	Day	57	60	47	39
	Evening	49	50	41	39
	Night	47	48	44	41

Notes *1: Rating Background Level(RBL).*
2: L_{Aeq} are logarithmic average; and
3: Day: 7:00am to 6:00pm ~ Evening: 6:00pm to 10:00pm ~ Night: 10:00pm to 7:00am

Table 5: AVERAGE LOGGED NOISE LEVELS – NM2

Site	Period	L_{Aeq} dB	L_{A10} dB	L_{A90} dB	RBL dB[1]
Location NM2	Day	55	58	43	39
	Evening	52	55	46	40
	Night	53	54	47	44

Notes *1: Rating Background Level(RBL).*
2: L_{Aeq} are logarithmic average; and
3: Day: 7:00am to 6:00pm ~ Evening: 6:00pm to 10:00pm ~ Night: 10:00pm to 7:00am

Table 6: AVERAGE LOGGED NOISE LEVELS – NM3

Site	Period	L_{Aeq} dB	L_{A10} dB	L_{A90} dB	RBL dB[1]
Location NM3	Day	53	55	41	36
	Evening	44	45	39	35
	Night	44	46	40	36

Notes *1: Rating Background Level(RBL).*
2: L_{Aeq} are logarithmic average; and
3: Day: 7:00am to 6:00pm ~ Evening: 6:00pm to 10:00pm ~ Night: 10:00pm to 7:00am

2.3 Attended Noise Monitoring

Attended noise monitoring was conducted at three locations during the night period to determine noise levels from existing site operations. These measurements were used to determine compliance with current licence criteria, and also to calibrate the noise model used to predict post expansion noise levels.

Measurements were performed in accordance with the Environment Protection Authority (EPA) 'Industrial Noise Policy' (INP) guidelines and Australian Standard AS1055 ' Acoustics, Description and Measurement of Environmental Noise'. Atmospheric condition measurement was also undertaken during attended monitoring. The duration of each measurement was 15 minutes.

Attended measurement results are included in the following sections. Meteorological conditions on the night of monitoring were generally consistent with the prevailing wind condition used for the modelling assessment. Compliance with licence criteria resulted at all three locations.

2.3.1 NM1 – Oberon Caravan Park

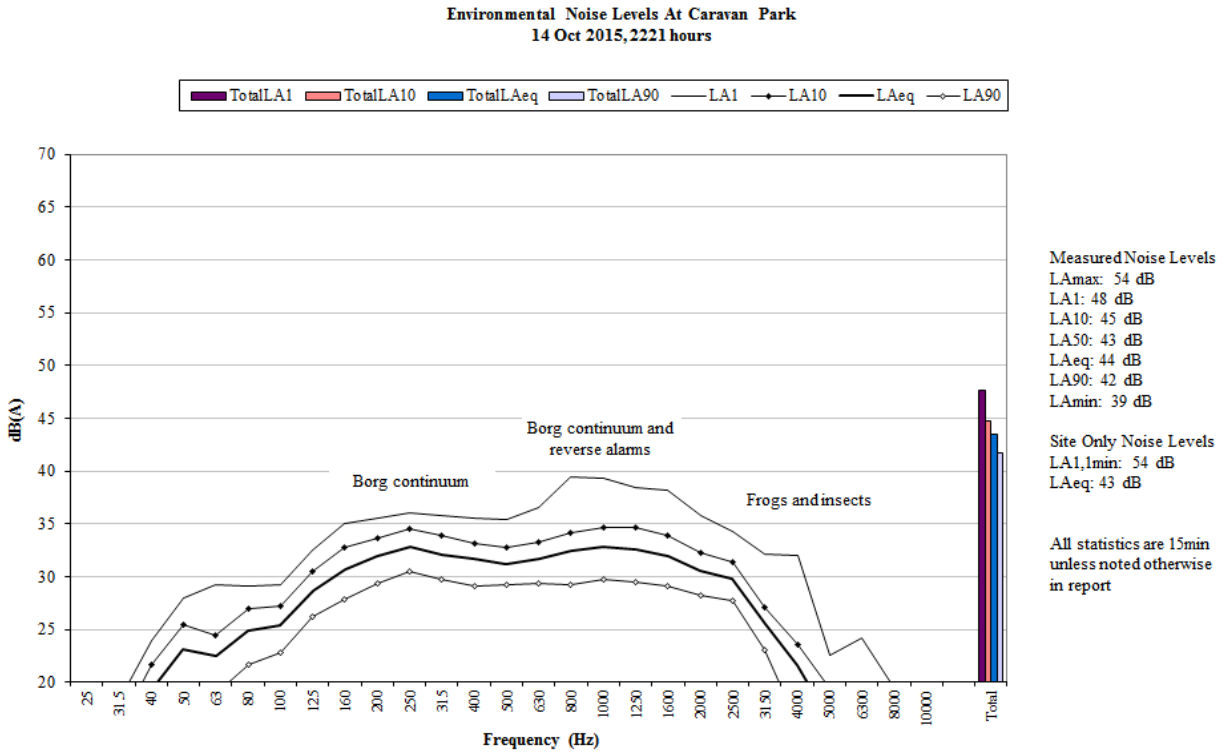


Figure 2: Environmental Noise Levels - NM1

A relatively continuous level continuum from Borg was audible throughout the measurement. Reverse alarms (quacker style) were audible at regular intervals. The resulting site only L_{Aeq} was 43 dB.

Wind direction was from the ENE, with a speed ranging from 1.0 to 1.9 metres/second at 1.8 metres above

ground level. This wind direction is consistent with the prevailing wind direction used for the modelling assessment, and wind speeds were in the noise enhancing range.

Other noise sources including frogs, insects, a flagpole and road traffic noise were noted, but did not contribute significantly to measured levels. No other industrial noise was audible at this location.

2.3.2 NM2 - O'Connell Road

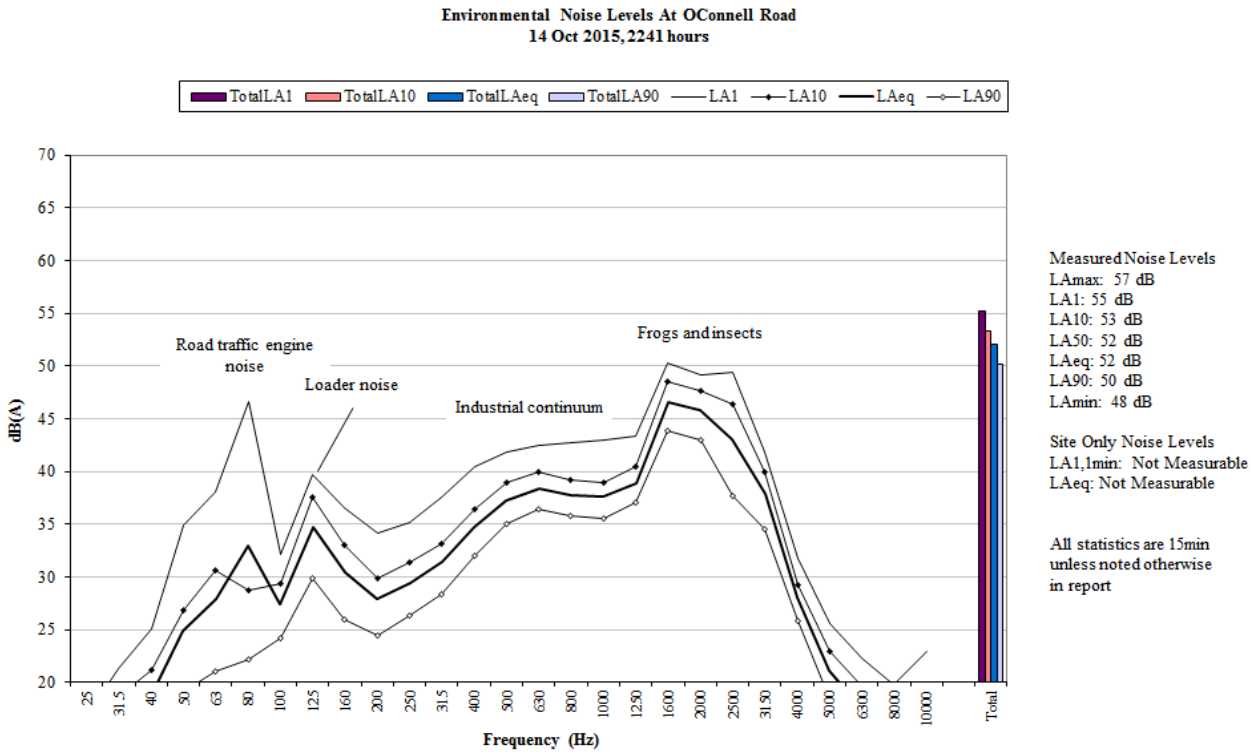


Figure 3: Environmental Noise Levels - NM2

Industrial noise from another site dominated the acoustic environment at frequencies less than 1.6 kHz at this location. Borg may have contributed to some degree, but was not discernible due to the continuum generated by the other site. Front end loader noise was regularly audible from the other site. The measured L_{Aeq} from this site was 47 dB.

Frogs and insects dominated the higher frequencies, with a measured L_{Aeq} exceeding 50 dB.

Other noise sources including bats, breeze in foliage, and road traffic noise were noted, but did not contribute significantly to measured levels.

2.3.3 NM3 - Hazelgrove Road

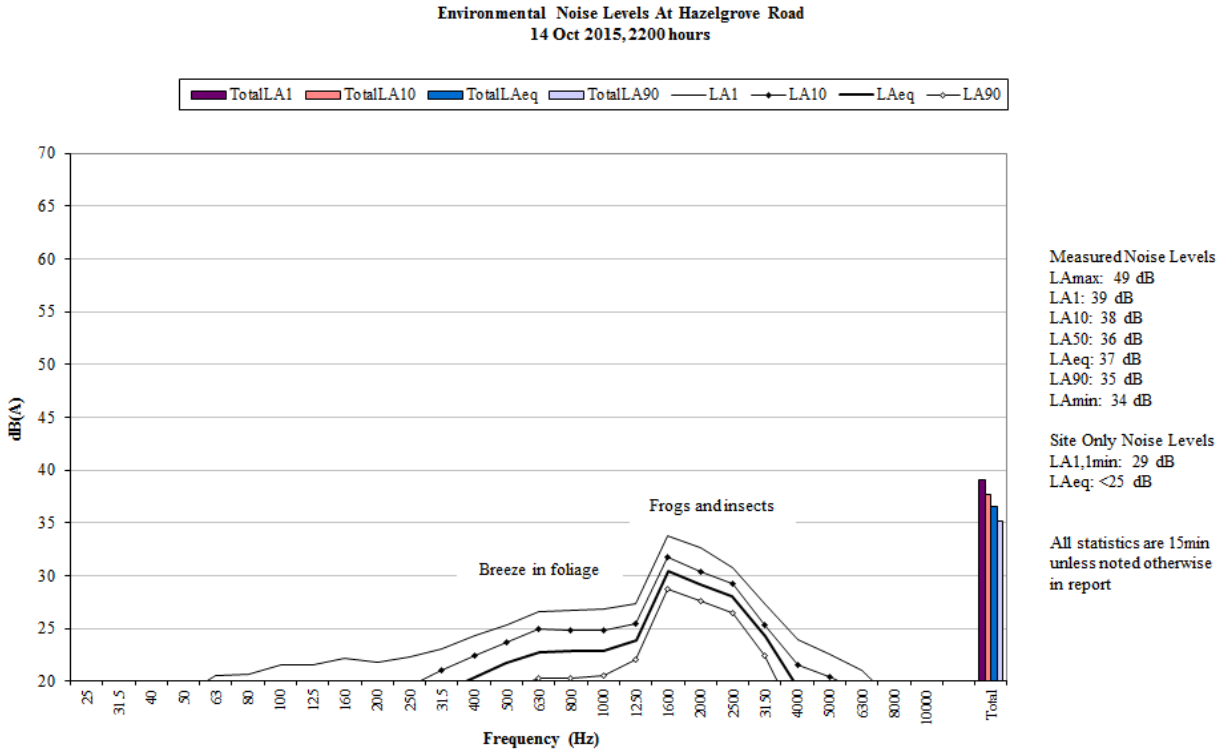


Figure 4: Environmental Noise Levels - NM3

A very low level continuum from Borg was audible at times during the measurement. However, the site was typically inaudible.

Frogs, insects and breeze in foliage primarily generated measured levels.

Birds, an aircraft and distant road traffic noise were also noted.

2.4 Operational Noise Criteria

The existing manufacturing facility, located on Lot 26 DP 1200697 operates under Environment Protection Licence (EPL) 3035. A variation to the EPL was issued by the NSW Environment Protection Authority (EPA) on 25 February 2015. Condition L4 of the EPL provides noise conditions, which are reproduced below:

L4 Noise limits

L4.1 Noise from the premises must not exceed:
a) 55 dB(A) $L_{Aeq(15\ minute)}$ during the day (7am to 6pm); and
b) 50 dB(A) $L_{Aeq(15\ minute)}$ during the evening (6pm to 10pm); and
c) at all other times 45 dB(A) $L_{Aeq\ (15\ minute)}$, except as expressly provided by this licence.

Where L_{Aeq} means the equivalent continuous noise level – the level of noise equivalent to the energy-average of noise levels occurring over a measurement period.

L4.2 To determine compliance with condition L4.1, noise must be measured or computed at for at Oberon High School or an other noise sensitve locations (such as a residence/school). A modifying factor correction must be applied for tonal, impulsive or intermittent noise in accordance with the "Environmental Noise Management - NSW Industrial Noise Policy (January 2000)".

L4.3 The noise emission limits identified in this licence apply under all meteorological conditions except:
a) during rain and wind speeds (at 10m height) greater than 3m/s; and
b) under "non-significant weather conditions".

Note Field meteorological indicators for non-significant weather conditions are described in the NSW Industrial Noise Policy, Chapter 5 and Appendix E in relation to wind and temperature inversions.

Borg propose to operate the Project with continuation of these existing noise limits.

2.5 Construction Noise Criteria

The NSW Interim Construction Noise Guideline (ICNG, July 2009), prepared by the NSW Environment Protection Authority (EPA), specifically relates to construction, maintenance and renewal activities. The guideline suggests that for short-term construction (not more than three weeks), a qualitative assessment will suffice and for longer-term construction, a quantitative assessment is required, with comparison to relevant criteria.

The anticipated duration of construction for the Project will exceed 18 months. As the proposed construction period exceeds three weeks, a quantitative assessment is required.

The ICNG recommended noise levels for the nearest residences in relation to work undertaken during standard construction hours are shown in Table 7.

Table 7: CONSTRUCTION NOISE AT RESIDENCES AND OTHER LAND USES, L_{Aeq} dB

Time of Day	$L_{Aeq,15minutes}$	Notes
Residential premises Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays and public holidays	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15minutes}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. time identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences). 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Commercial premises	70 dB(A)	External noise level at most affected point of the premises.

Construction of proposed infrastructure will occur concurrently with operation of the existing facility. All construction will generally be undertaken during standard construction hours, with the exception of 6pm – 7pm Monday to Friday. The operational noise criterion for the evening period would apply during these hours, as conditioned in EPL 3035. Only unforeseen circumstances would require work to continue outside of these hours. When construction work outside of these hours is required, the operational noise criterion for the relevant period would apply, as conditioned in EPL 3035.

Borg propose to generally restrict site noise emission from both construction and operational tasks combined to comply with the day period operational noise criterion of $L_{Aeq,15minute}$ 55 dB and the evening period operational noise criterion of $L_{Aeq,15minute}$ 50 dB, conditioned in EPL 3035. The exception will be for short duration high noise emitting tasks as such as rock/concrete breaking, for which the "highly noise affected" construction noise criterion of $L_{Aeq,15minute}$ 75 dB is deemed appropriate. Such construction tasks should be restricted to the least noise sensitive times of day. It is recommended all potentially affected receivers are notified in advance of any construction tasks where the operational day period criterion is likely to be

exceeded.

2.6 Traffic Noise Criteria

An assessment of additional traffic associated with operational activities has been considered. There will be additional vehicle movements resulting from the transport of logs and product material to and from site.

In 2011 the NSW state government department responsible for the environment (the Department of Environment, Climate Change and Water) released the NSW Road Noise Policy (RNP). The RNP outlines traffic noise criteria applicable to this project. The policy applies different noise limits dependent upon the road category and type of project/land use.

Table 8 presents noise criteria from the RNP for various road categories.

Table 8: ROAD TRAFFIC NOISE CRITERIA - dB

Road Category	Type of Project/Land use	Day	Night
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq,1hour}$ 55 (external)	$L_{Aeq,1hour}$ 50 (external)
Sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,15hour}$ 60	$L_{Aeq,9hour}$ 55

The RNP also includes relative increase criteria, which are primarily intended to protect existing quiet areas from excessive changes in amenity due to noise from a road project or from additional traffic generated by land use developments.. EPA application notes state:

- *...for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.*

In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. A relative increase in road traffic noise levels has been considered in this assessment.

2.7 Vibration Criteria

Vibration criteria in NSW are outlined in the guideline Assessing Vibration: A Technical Guideline (RNP), published by the NSW Department of Environment and Conservation (2006).

Vibration generated by short term works such as construction tasks, including vibrating roller compaction and rock/concrete breaking, are assessed as intermittent activities.

When assessing vibration for intermittent activities, the guideline recommends use of the vibration dose value (VDV). The VDV is given by the fourth root of the integral with respect to time of the fourth power of the acceleration after it has been weighted. This is the root-mean-quad approach.

VDV criteria are included in Table 2.4 of the guideline, and are reproduced below:

Table 2.4 Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas.
Source: BS 6472–1992

The manufacturing operations are not anticipated to produce any measurable vibration impact to surrounding residences due to the following factors:

- The equipment and processing of material does not involve blasting or generate any vibration of significance; and
- The separation distance from the plant to residences being significantly large enough for any vibrations to be damped out.

During construction of proposed infrastructure, vibrating equipment such as rollers and rock breakers may be utilised. Due to the distance to sensitive receivers from construction areas, no vibration impact is expected. Vibration is not discussed further in this report.

3 NOISE MODEL PARAMETERS

Noise levels were calculated using DataKustik CadnaA noise modelling software to determine the acoustic impact of operational and construction activities at noise sensitive receiver (NSR) locations.

3.1 Receivers

Ten NSR were included in the assessment, representing the nearest and potentially most affected residences to the site, and Oberon High School. Attended monitoring was undertaken adjacent Oberon Caravan Park (reception building) and Oberon High School. This point was included in the models as a receiver location. Modelled NSR are listed in Table 9, and shown in Figure 5.

Table 9: MODELLED RECEIVER LOCATIONS

Receiver ID	Receiver Location
V01	Attended Validation Monitoring Location
R01	32 O'Connell Road
R02	6 Herborn Street
R03	Oberon High School
R04	10 Tasman Street
R05	127 Hazelgrove Road
R06	26 Cunyngham Street
R07	131 Hazelgrove Road
R08	2 Herborn Street
R09	15-19 Albion Street
R10	Oberon Caravan Park

Figure 5: Modelled Receiver and Logging Locations

3.2 Topography

Borg provided topographical data for the site and surrounding area. These were input to the models, with modifications as required to account for changes in ground elevation through the proposed expansion area.

3.3 Atmospheric Conditions

Section 5 of the INP provides procedures for considering meteorological effects. The effects of gradient winds, drainage flow winds and temperature inversions need to be considered. Wind effects need to be assessed when wind is considered to be a feature of the area. Wind is considered a feature of the area when source-to-receiver wind speeds (at 10m height) of 3 m/s or less occur for more than 30 percent of the time in any time period, in any season.

The analysis of wind data included the following steps:

1. All wind speed data greater than 5 m/s was discarded, as higher wind speeds cause extraneous noise and, tend to drown out industrial noise;

2. All wind speed data less than 0.5 m/s was discarded, as these conditions are considered calm, or neutral;

3. Remaining data was sorted into data sets representing each time period (day, evening and night), and each season; and

4. For each time period, and for each season, the percentage occurrence of the vector component of each of the sixteen standard compass directions was determined for wind speed ranges of 0.5 to 3 m/s and 0.5 to 2.25 m/s. Vector components with a resulting direction component more than 45 degrees from each compass direction were excluded.

Borg provided meteorological data for the Oberon area for one full year (2014). Data provided did not include temperature inversion data. Stability class F, combined with calm winds was assessed for the night period to represent inversion conditions. The area around the site is relatively flat and drainage flow winds are not considered applicable.

Based on the analysis of meteorological data, the conditions listed in Table 10 are included in this assessment as prevailing meteorological conditions.

Table 10: PREVAILING METEOROLOGICAL CONDITIONS

Condition	Temperature ^{0}Celsius	Humidity %	Stability Class	Wind Speed m/s	Wind Direction Degrees
Neutral Atmosphere	10	70	D	0	-
Temperature Inversion	10	70	F	0	-

Condition	Temperature ^{0}Celsius	Humidity %	Stability Class	Wind Speed m/s	Wind Direction Degrees
Prevailing Wind	10	70	D	3	67.5

3.4 Equipment Sound Power

3.4.1 Existing Plant

Global Acoustics undertook a sound power survey of the existing site during October 2015. Acoustically significant noise sources were identified and, where possible, measured directly. The exception was existing enclosed electric debarker and chipping plant, which was measured in April 2016. Production hall and warehouse noise levels were found to be insignificant compared to external sources; therefore only external noise sources were modelled.

Modelled sound power data for existing plant are listed in Table 11.

Table 11: 15 MINUTE SOUND POWER DATA – EXISTING PLANT

Plant Item		Octave Band Sound Power Spectrum, L_{eq} dB									Total L_{eq} dB	
ID	Description	31.5	63	125	250	500	1k	2k	4k	8k	Lin	A wt
EF001	Conti 1 Drier fan	122	117	116	113	116	114	116	111	98	**126**	**121**
EF002	Fan 1	107	109	105	105	106	106	102	94	87	**115**	**110**
EF003	Fan 2	97	97	95	94	89	89	88	81	77	**103**	**94**
EF004	Bag Filter Fan Drive	104	106	104	104	100	99	94	87	83	**111**	**103**
EF005	Staged Fan Motor Drive	-	105	105	99	100	96	97	93	85	**110**	**103**
EF006	Extraction Fan	110	110	109	102	99	99	96	89	80	**115**	**104**
EF007	Filter Fan Drive	106	108	103	102	98	96	97	95	90	**112**	**103**
EF008	Fibre Transport 1 (230M1)	102	102	104	103	104	106	105	97	88	**113**	**110**
EF009	Fibre Transport 2 (Fibre Supply)	99	102	108	101	100	99	98	93	87	**111**	**104**
EF010	Fibre Transport 3 (Reject Fibre)	102	102	108	102	99	99	98	92	85	**111**	**104**
EF011	Fibre Transport 4 (Matt Trim Saw)	99	102	109	103	99	98	97	92	85	**112**	**104**
EF012	Fibre Transport 8 (Vacuum)	94	97	101	101	97	93	90	86	81	**106**	**99**
EF013	Fibre Transport 10 (Vacuum)	94	98	99	95	97	92	88	85	80	**104**	**98**
EF014	Fibre Transport 11 (Total Air)	94	98	99	95	103	93	90	90	88	**107**	**102**
EF015	Booster Fan Drive	112	113	111	114	112	111	109	104	99	**121**	**116**
EF016	Induct Draft Fan	106	105	103	100	98	97	94	91	83	**111**	**102**
EF017	Exhaust Stack 1	106	103	104	109	99	93	86	81	77	**112**	**103**
EF018	Blower Fan	99	104	103	101	105	103	101	96	84	**111**	**108**
EF019	Formaldehyde Plant	106	108	102	100	105	104	100	97	99	**113**	**108**
EF020	Exhaust Stack 2	106	103	105	104	97	92	86	80	76	**111**	**100**

Plant Item		Octave Band Sound Power Spectrum, L_{eq} dB									Total L_{eq} dB	
ID	**Description**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Lin**	**A wt**
EF021	Exhaust Stack 3	104	102	102	105	96	90	84	81	75	**110**	**99**
EF022	Exhaust Stack 4	101	101	104	99	92	87	80	77	71	**108**	**95**
EM023	Mobile chipper	118	127	123	119	122	121	118	115	121	**131**	**126**
EM024	Front end loader	95	98	108	103	94	95	91	86	80	**110**	**100**
ED025	Enclosed debarker/chipper	109	108	107	107	104	99	97	92	83	**114**	**106**

Modelling of the existing site indicated it currently operates close to EPL criteria during periods of enhancing meteorological conditions. To allow additional noise sources to be added to the site (the proposed expansion), a sound power reduction for primary noise emitters currently on site was required. Existing plant items Borg propose to attenuate include:

- The Conti 1 dryer fan. A sound power reduction from L_{Aeq} 121 dB to 114 dB or better is required;
- The booster fan drive. A sound power reduction from L_{Aeq} 116 dB to 109 dB or better is required and
- The main fibre transport fan. A sound power reduction from L_{Aeq} 110 dB to 104 dB or better is required.

Borg is committed to achieving these reductions to reduce noise emission from the existing operation. Modelled sound power data for these plant after attenuation are listed in Table 12.

Table 12: 15 MINUTE SOUND POWER DATA – EXISTING PLANT WITH NOISE CONTROL

Plant Item		Octave Band Sound Power Spectrum, L_{eq} dB									Total L_{eq} dB	
ID	Description	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Lin**	**A wt**
EF001	Conti 1 Drier Fan	112	107	106	103	106	104	106	111	98	**117**	**114**
EF008	Fibre Transport 1 (230M1)	96	96	98	97	98	100	99	89	88	**107**	**104**
EF015	Booster Fan Drive	102	103	101	104	102	101	99	104	99	**112**	**109**

3.4.2 Proposed Plant

Sound power data was not available for plant proposed for the expansion. Borg provided SPL data at 1 metre for significant plant items. However, insufficient information was available for most plant items to directly calculate sound power using provided SPL. Instead, a relationship was derived for each item between the SPL provided for proposed plant, SPL measured by Global Acoustics for similar plant items at 1 metre, and calculated sound power for similar plant items. Sound power spectra for similar plant items currently on site were adjusted as required to match derived sound power totals in order to obtain representative sound power spectra for proposed plant. Whilst this approach is not ideal, Global Acoustics

feel it is the best method available given the limited information.

Initial model iterations indicated noise control will be required for some plant. For critical plant, limiting sound powers were derived so that model predictions were within compliance levels. In some cases a significant degree of noise control may be required. Borg is aware that noise control is required, and is committed to achieving the limiting sound powers adopted in this assessment. Sound power limits (both linear and A-weighted) are included in tender documents for new plant. It is recommended compliance testing is undertaken upon commissioning, and any non-compliance identified should require an update of the site noise model to establish whether compliance with relevant noise criteria can be maintained. Actions required to maintain compliance, such as further noise control to the non-compliant item, or other plant items, should be suitably documented.

The noisiest plant associated with the proposal are the dry mills, flakers, screens, debarker and chipping plant. Borg propose to provide noise control for these plant as follows:

- Proposed debarker and chipping plant will be constructed to the south and east of the existing production hall in a similar fashion as existing enclosed electric plant. The chippers will be contained in concrete enclosures and acoustic panelling (see below for details) will be used for the building cladding. Sound power calculated for existing enclosed debarker and chipping plant was adopted for proposed plant, as the construction and performance are expected to be similar;

- A screening area will be constructed to the west of the proposed production hall. A limiting sound power for this area was derived, and is listed in Table 13;

- A mill building with dimensions 19 x 10 metres will be constructed to the west of the proposed production hall. The building is to be fully enclosed with acoustic panelling (see below for details). An opening for a conveyor of 1.2 x 0.6 metres has been allowed for on the southern side. A building acoustics model was developed to calculate the external sound power of each facade, which were in turn included in the environmental noise model for the site. Three mills were modelled within the building; sound power data used in the building acoustics model are listed in Table 13; and

- A flaker and mill building with dimensions 61 x 33 metres will be constructed to the west of the proposed production hall. The building is to be fully enclosed with acoustic panelling (see below for details). An opening for a conveyor of 1.4 x 0.6 metres has been allowed for on the southern side. A building acoustics model was developed to calculate the external sound power of each facade, which were in turn included in the environmental noise model for the site. Six flakers, twelve cyclones and two mills were modelled within the building; sound power data used in the building acoustics model are listed in Table 13.

Borg has advised the acoustic panelling to be used for the above buildings will consist of ISOFIRE acoustic panel with 150mm rockwool insulation. This material consists of a perforated metal internal lining, sheet metal external lining, and rockwool insulation filling.

Other proposed plant of significance includes the drier main fan, drier combustion air fan, and an associated exhaust stack known as the WESP.

- Limiting sound powers were derived for the drier main fans and drier combustion air fan. Modelled sound powers are listed in Table 13; and

- The WESP stack may require noise mitigation work to reduce noise emission from the stack outlet based on preliminary sound power data provided by a potential supplier. A limiting sound power was determined and is listed in Table 13. Directivity corrections were applied to account for the angle of view to sensitive receivers. Borg are aware of the limiting sound power required, and will investigate mitigation options should the limiting sound power not be achievable in the supplied state.

Table 13: 15 MINUTE SOUND POWER DATA – PROPOSED PLANT

Plant Item		Octave Band Sound Power Spectrum, L_{eq} dB									Total L_{eq} dB	
ID	**Description**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Lin**	**A wt**
PD1901	Chipper building 1	109	108	107	107	104	99	97	92	83	**114**	**106**
PD1902	Chipper building 2	109	108	107	107	104	99	97	92	83	**114**	**106**
PF1070	Fresh chips silo 1	89	88	86	83	81	80	77	74	66	**94**	**85**
PF1903	Cyclones	101	100	98	95	93	92	89	86	78	**106**	**97**
PF2125	Roller screen (same as row 1)	89	88	86	83	81	80	77	74	66	**94**	**85**
PF2135	Air grader	97	97	95	94	89	89	88	81	77	**103**	**94**
PF2205	Saw dust air grader	104	103	101	98	96	95	92	89	81	**109**	**100**
PF3005	Flaker dynascreen	89	88	86	83	81	80	77	74	66	**94**	**85**
PF3020	Flaker Wet chips silo	89	88	86	83	81	80	77	74	66	**94**	**85**
PF3135	Wet flakes silo	89	88	86	83	81	80	77	74	66	**94**	**85**
PF3240	Dry waste flakes silo	89	88	86	83	81	80	77	74	66	**94**	**85**
PF3505	Conidur Mills	104	103	101	98	96	95	92	89	81	**109**	**100**
PF3510	Flaker building wall 1 (external)	-	101	95	86	80	70	60	53	47	**103**	**84**
PF3511	Flaker building wall 2 (external)	-	101	95	84	77	67	57	51	45	**102**	**82**
PF3512	Flaker building wall 3 (external)	-	98	92	81	74	63	53	47	42	**99**	**80**
PF3513	Flaker building wall 4 (external)	-	99	93	83	77	66	56	50	44	**100**	**81**
PF3514	Flaker building opening (external)	-	99	95	89	92	91	90	89	84	**102**	**97**
PF3520	Flakers cyclones	104	103	101	98	96	95	92	89	81	**109**	**100**
PF3550	Pneumatic extraction	104	103	101	98	96	95	92	89	81	**109**	**100**
PF4050	Dust silo	89	88	86	83	81	80	77	74	66	**94**	**85**
PF4220	Drier combustion air fan	105	100	99	96	99	97	99	94	91	**109**	**104**
PF4600	Drier Drum Area	89	88	86	83	81	80	77	74	66	**94**	**85**
PF4800	Drier main fans	105	100	99	96	99	97	99	94	81	**109**	**104**
PF4950	WESP stack	124	123	117	106	86	73	72	79	88	**127**	**104**
PF5135	Surface layer air grader	99	98	96	93	91	90	87	84	76	**104**	**95**
PF5140	Surface layer air grader fan	104	103	101	98	96	95	92	89	81	**109**	**100**
PF5155	Cyclones - Filter	99	98	96	93	91	90	87	84	76	**104**	**95**
PF5165	SL silo - rotating screw	89	88	86	83	81	80	77	74	66	**94**	**85**
PF5230	Core layer air grader	99	98	96	93	91	90	87	84	76	**104**	**95**
PF5235	Core layer air grader fan	104	103	101	98	96	95	92	89	81	**109**	**100**
PF5260	CL silo - rotating screw	89	88	86	83	81	80	77	74	66	**94**	**85**
PF5330	Overs air Grader Cyclone	96	95	93	90	88	87	84	81	73	**101**	**92**
PF5340	Oversize silo - moving floor	89	88	86	83	81	80	77	74	66	**94**	**85**
PF5370	Pneumatic extraction	104	103	101	98	96	95	92	89	81	**109**	**100**
PF5385	Pneumatic extraction	104	103	101	98	96	95	92	89	81	**109**	**100**

Plant Item		Octave Band Sound Power Spectrum, L_{eq} dB									Total L_{eq} dB	
ID	**Description**	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Lin**	**A wt**
PF5400	Pneumatic extraction	104	103	101	98	96	95	92	89	81	**109**	**100**
PF5501	Mill building wall 1 (external)	-	98	92	81	74	64	54	48	42	**99**	**79**
PF5502	Mill building wall 2 (external)	-	102	95	85	77	66	57	51	45	**103**	**83**
PF5503	Mill building wall 3 (external)	-	98	92	82	75	65	55	48	43	**99**	**80**
PF5504	Mill building wall 4 (external)	-	102	96	86	79	69	59	53	47	**103**	**84**
PF5505	Mill building opening (external)	-	104	100	93	96	95	95	93	89	**107**	**101**
PF5509	Screen Area (all open side)	99	98	97	97	94	89	87	82	73	**104**	**96**
PF5510	Air graders baghouse filter	104	103	101	98	96	95	92	89	81	**109**	**100**
PF5520	Air grader Baghouse blower	101	100	98	95	93	92	89	86	78	**106**	**97**
PF7365	HP blower reject to fines building	106	105	103	100	98	97	94	91	83	**111**	**102**
PF7960	Reject mat cyclone	89	88	86	83	81	80	77	74	66	**94**	**85**
PF8910	Extraction forming line filter	104	103	101	98	96	95	92	89	81	**109**	**100**
PF8930	Extraction forming line filter	104	103	101	98	96	95	92	89	81	**109**	**100**
PF8940	Bag house filter extraction saw granulates	96	95	93	90	88	87	84	81	73	**101**	**92**
PF8941	Pneumatic extraction	104	103	101	98	96	95	92	89	81	**109**	**100**
PM1017	Front end loader	95	98	108	103	94	95	91	86	80	**110**	**100**
PM1018	Front end loader	95	98	108	103	94	95	91	86	80	**110**	**100**
PI5380	Dry mills (internal)	121	129	125	122	125	124	121	118	113	**134**	**128**
PI5365	Dry mills (internal)	121	129	125	122	125	124	121	118	113	**134**	**128**
PI5395	Dry mills (internal future)	121	129	125	122	125	124	121	118	113	**134**	**128**
PF3086	Flaker cyclone (Internal)	104	103	101	98	96	95	92	89	81	**109**	**100**
PF3106	Flaker cyclone (Internal)	104	103	101	98	96	95	92	89	81	**109**	**100**
PI3501	Flaker line 1 3065- 3105 (internal)	117	125	122	118	121	120	117	114	109	**130**	**124**
PI3502	Flaker building hammer mill (internal)	117	125	122	118	121	120	117	114	109	**130**	**124**

3.4.3 Construction Plant

Table 14 lists modelled sound power of plant included in the construction noise assessment. These were sourced from the Global Acoustics database of representative sound powers.

Table 14: 15 MINUTE SOUND POWER DATA – CONSTRUCTION PLANT

Plant Item		Octave Band Sound Power Spectrum, L_{eq} dB									Total L_{eq} dB	
ID	Description	**31.5**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**Lin**	**A wt**
CON01	Excavator	-	105	115	107	102	103	99	91	85	**117**	**107**
CON02	Loader	-	113	117	110	107	107	103	96	86	**120**	**111**
CON03	Road truck	-	102	99	96	93	95	94	88	86	**106**	**100**
CON04	Dozer	-	109	118	119	113	109	105	99	90	**123**	**116**
CON05	Grader	-	101	112	105	105	102	100	96	87	**114**	**108**
CON06	Roller	-	105	109	108	106	107	100	93	91	**114**	**110**
CON07	Mobile crane	-	112	108	100	98	93	91	92	82	**114**	**101**
CON09	Concrete truck	-	107	101	99	103	100	95	87	78	**110**	**104**
CON10	Bobcat	-	96	100	101	99	97	97	95	88	**107**	**103**
CON11	Articulated truck	-	103	113	107	101	99	98	93	86	**115**	**106**
CON12	Rock breaker	-	-	-	-	-	122	-	-	-	**122**	**122**

4 VALIDATION ASSESSMENT

A model validation assessment was undertaken to provide an estimate of model prediction reliability. Comparison was made between attended monitoring results, and model predictions for the existing site

4.1 Attended Measurement

Attended monitoring results from the night of 14 October 2015 was used for model validation. Details of attended monitoring are included in Section 2.3. Of the three measurement taken that night, only the measurement at Oberon Caravan Park was deemed suitable for model validation. At the O'Connell Road location, masking by another industrial site made determination of Borg only levels not measurable, and measured levels at Hazelgrove Road were too low to be utilised.

The resulting site only L_{Aeq} measured at the validation point adjacent the Oberon Caravan Park reception building was 43 dB.

4.2 Scenario Description

A model of the existing site was developed. Debarking and chipping plant was not operating on the night of attended measurement, therefore these sources were omitted from the model. All other significant existing fixed plant noise sources and two front end loaders were included in the scenario. Modelled sound power data for existing plant are listed in Table 11.

4.3 Meteorological Conditions

Weather conditions at a height of 1.8 metres above ground level, recorded by the operator at the time of monitoring, indicated wind speeds ranging from 1.0 to 1.9 m/s, with a direction of 60 to 70 degrees magnetic. The temperature was 14 degrees Celsius, and the cloud cover was six octas. Weather conditions recorded at the BOM Mount Boyce weather station indicated a wind speed of 3 m/s from the east-northeast.

Wind direction between the two locations was consistent, so a wind direction of 65 degrees was used for model input. Wind speed for model input is typically based on a 10 metre above ground level (agl) wind speed. As the Mount Boyce weather station is located in an exposed location, it is considered likely the wind speed measured there may overstate the wind speed at 10 metres agl in Oberon. Therefore, a wind speed of 2 metres per second was used for model input, which is mid way between the average wind speed measured at each location, and is consistent with the maximum wind speed measured at 1.8 metres agl at the monitoring location.

4.4 Results

The model prediction for the modelled scenario was L_{Aeq} 43 dB, which correlates exactly with the attended measured level. This correlation indicates the model of the existing site provides a good estimate of actual noise emission. Increasing the wind speed in the model to 3 m/s provides a prediction of L_{Aeq} 44 dB, indicating the model may slightly over predict should the 10 metre wind speed have been slightly higher than assumed.

5 OPERATIONAL NOISE ASSESSMENT

5.1 Existing Site

A model of the existing site was developed. Sound power of significant noise sources was measured by Global Acoustics during October 2015. The site has some equipment that operates with restricted operating hours; therefore a series of scenarios were developed representing different modes of operation according to time period.

Borg currently operate two mobile wood chipper plant, which are restricted to day period operation. An enclosed electric debarker and chipper unit was recently installed on site (approved under Modification 7). Mobile chipping plant are the highest noise emitters on site by a significant margin. Borg propose to install two additional enclosed electric debarker and chipper units to reduce reliance on mobile plant. Chipping will be restricted to the day and evening periods. Use of mobile chipping plant will not form part of normal operations, although they may be utilised during periods of maintenance or breakdown of electric chipping plant.

5.1.1 Scenarios

Plant included in each of the time period scenarios are outlined in Table 15.

Table 15: EXISITNG SITE SCENARIOS – PLANT INCLUSIONS

Plant Category	Day 1	Day 2	Evening	Night
Existing fixed plant	yes	yes	yes	yes
1st mobile chipper	yes	yes	no	no
2nd mobile chipper	no	yes	no	no
Existing front end loaders (2)	yes	yes	yes	yes
Existing enclosed chipper/debarker	yes	yes	yes	yes

Plant included in the existing fixed plant category are listed in Table 11 with "EF" as the first two letters in the plant ID. Sound power for plant was based on measured sound power of existing equipment.

Source locations figures are included in Appendix C.

5.1.2 Results

Table 16 and Table 17 present model predictions for the existing site (prior to noise control) for neutral atmospheric and worst case prevailing meteorological conditions respectively. Results that exceed the relevant time period criterion are shown in bold type (where applicable).

Table 16: EXISTING SITE RESULTS, NEUTRAL ATMOSPHERE - $L_{Aeq,15MINUTE}$ dB

Receptor	Criteria			Predictions			
	Day	Evening	Night	Day 1	Day 2	Evening	Night
R01	55	50	45	40	42	36	36
R02	55	50	45	45	47	38	38
R03	55	50	45	49	51	38	38
R04	55	50	45	46	49	36	36
R05	55	50	45	45	47	36	36
R06	55	50	45	46	48	37	37
R07	55	50	45	46	48	38	38
R08	55	50	45	45	48	39	39
R09	55	50	45	51	54	40	40
R10	55	50	45	49	51	40	40

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

Table 17: EXISTING SITE RESULTS, PREVAILING CONDITIONS - $L_{Aeq,15MINUTE}$ dB

Receptor	Criteria			Predictions			
	Day	Evening	Night	Day 1	Day 2	Evening	Night
R01	55	50	45	46	48	42	42
R02	55	50	45	50	53	44	44
R03	55	50	45	53	**56**	43	43
R04	55	50	45	48	51	38	41
R05	55	50	45	45	47	36	41
R06	55	50	45	51	54	42	42
R07	55	50	45	46	48	38	43
R08	55	50	45	51	53	44	44
R09	55	50	45	**56**	**59**	44	44
R10	55	50	45	53	**56**	44	44

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

5.1.3 Discussion

Model predictions for the existing site indicate:

- Compliance with existing EPL criteria is predicted for all receivers during non-enhancing meteorological conditions;
- Compliance with existing EPL criteria is predicted for all receivers for the evening and night periods during prevailing (enhancing) meteorological conditions;
- At R09, a minor 1 dB exceedance is predicted for the day period during enhancing meteorological conditions when one mobile chipper is operational; and
- A minor 1 dB exceedance is predicted for R03 and R10, and a moderate exceedance of 4 dB for R09 for the day period during enhancing meteorological conditions if two mobile chippers are operated concurrently.

The following management measures are recommended:

- Mobile chipping plant should be restricted to the day period;
- Two mobile chippers should not operate concurrently during enhancing meteorological conditions;
- During periods of strong meteorological enhancement to the south, neither mobile chipper should operate; and
- Plant listed in Table 12 should be provided with further noise control (attenuation).

5.2 Existing Site with Noise Controls

Modelling of the existing situation indicated the site currently operates close to EPL criteria during periods of enhancing meteorological conditions. A model of the existing site with key plant items attenuated was developed (refer Section 3.4.1). Modelled sound power spectra for these items, pre and post attenuation, are presented in Table 11 and Table 12.

5.2.1 Scenarios

The scenarios assessed were the same as for the existing site (per Table 15). Modelled sound power included the reduced sound power for the items listed above.

5.2.2 Results

Table 18 and Table 19 present model predictions for the existing site, with noise control implemented, for neutral atmospheric and worst case prevailing meteorological conditions respectively. Results that exceed the relevant time period criterion are shown in bold type (where applicable).

Table 18: EXISTING SITE WITH NOISE CONTROL RESULTS, NEUTRAL ATMOSPHERE - $L_{Aeq,15MINUTE}$ dB

Receptor	Criteria			Predictions			
	Day	Evening	Night	Day 1	Day 2	Evening	Night
R01	55	50	45	39	42	30	30
R02	55	50	45	44	47	34	34
R03	55	50	45	49	51	37	37
R04	55	50	45	46	49	35	35
R05	55	50	45	44	47	34	34
R06	55	50	45	45	48	34	34
R07	55	50	45	45	48	35	35
R08	55	50	45	44	47	34	34
R09	55	50	45	51	53	37	37
R10	55	50	45	48	51	37	37

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

Table 19: EXISTING SITE WITH NOISE CONTROL RESULTS, PREVAILING CONDITIONS - $L_{Aeq,15MINUTE}$ dB

Receptor	Criteria			Predictions			
	Day	Evening	Night	Day 1	Day 2	Evening	Night
R01	55	50	45	45	47	36	36
R02	55	50	45	50	52	39	39
R03	55	50	45	53	**56**	41	42
R04	55	50	45	48	51	36	40
R05	55	50	45	44	47	34	39
R06	55	50	45	51	54	39	39
R07	55	50	45	45	48	35	40
R08	55	50	45	50	53	39	39
R09	55	50	45	**56**	**58**	42	42
R10	55	50	45	53	**56**	42	42

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

5.2.3 Discussion

Model predictions indicate reductions of up to 5 dB at receiver locations may result from implementation of noise control. Compliance is indicated for all receivers for the evening and night periods. Exceedances predicted for the day period remain unchanged, as these are caused by mobile chipping plant. Operation of mobile chippers will need to be managed during periods of meteorological enhancement as discussed previously.

5.3 Proposed Expansion

A description of the proposed expansion in included in Section 1.1. A description of acoustically significant plant associated with the proposed particle board manufacturing line is provided in Section 3.4.2.

A model of the proposed expansion was developed, which included all existing plant (with noise control recommended above) and proposed infrastructure. Mobile chipping plant will only be used during he day period, when required, due to breakdown or scheduled maintenance of electric chipping plant. Mobile chippers will generally be replaced with three enclosed electric chippers (one currently exists). Two day scenarios were assessed, one of which includes one mobile chipper (not considered normal operations), and another which included electric chipping plant only (normal operations).

5.3.1 Scenarios

Plant included in each of the time period scenarios are outlined in Table 20.

Table 20: EXISTING SITE SCENARIOS – PLANT INCLUSIONS

Plant Category	Day 1	Day 2	Evening	Night
Existing fixed plant	yes	yes	yes	yes
Existing front end loaders (2)	yes	yes	yes	yes
Mobile chipping plant	yes	no	no	no
Existing enclosed electric chipper/debarker	yes	yes	yes	no
Proposed fixed plant	yes	yes	yes	yes
Proposed enclosed electric chipper/debarker (2)	yes	yes	yes	no
Proposed front end loaders (2)	yes	yes	yes	yes

Plant included in the existing fixed plant category are listed in Table 12 with "PF" as the first two letters in the plant ID.

Sound power for proposed plant was based on assumed limiting sound powers as described in Section 3.4. Sound power for existing plant was based on measured sound power of existing equipment, but with attenuated sound power for the items listed in Section 5.2.

Source locations figures are included in Appendix C.

5.3.2 Results

Table 21 and Table 22 present model predictions for the existing site combined with the proposed expansion, with noise control implemented, for neutral atmospheric and worst case prevailing meteorological conditions respectively. Results that exceed the relevant time period criterion are shown in bold type (where applicable).

Table 21: PROPOSED EXPANSION RESULTS, NEUTRAL ATMOSPHERE - $L_{Aeq,15MINUTE}$ dB

Receptor	Criteria			Predictions			
	Day	Evening	Night	Day 1	Day 2	Evening	Night
R01	55	50	45	39	34	34	33
R02	55	50	45	44	37	37	36
R03	55	50	45	49	41	41	39
R04	55	50	45	46	37	37	35
R05	55	50	45	45	35	35	34
R06	55	50	45	46	38	38	37
R07	55	50	45	45	36	36	35
R08	55	50	45	45	37	37	36
R09	55	50	45	51	43	43	41
R10	55	50	45	49	41	41	39

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

Table 22: PROPOSED EXPANSION RESULTS, PREVAILING CONDITIONS - $L_{Aeq,15MINUTE}$ dB

Receptor	Criteria			Predictions			
	Day	Evening	Night	Day 1	Day 2	Evening	Night
R01	55	50	45	45	39	39	38
R02	55	50	45	50	42	42	41
R03	55	50	45	53	44	44	43
R04	55	50	45	48	38	38	40
R05	55	50	45	45	35	35	39
R06	55	50	45	51	43	43	42

Receptor	Criteria			Predictions			
	Day	Evening	Night	Day 1	Day 2	Evening	Night
R07	55	50	45	45	36	36	40
R08	55	50	45	50	43	43	41
R09	55	50	45	**56**	47	47	45
R10	55	50	45	53	45	45	44

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

5.3.3 Discussion

Model predictions for the proposed site indicate:

- Compliance with existing EPL criteria is predicted for all receivers during non-enhancing meteorological conditions; and
- Compliance with existing EPL criteria is predicted for all receivers except R09, for which a minor 1 dB exceedance is predicted for the day period when a mobile chipper is operational.

The following management measures are recommended:

- Mobile chipping plant should be restricted to the day period, and should not be operated during periods of meteorological enhancement towards R09;
- No chipping plant should operate during the night period; and
- Plant listed in Table 12 should be provided with further noise control (attenuation).

Model predictions are dependent on limiting sound powers provided in Table 13 being achieved. Recommendations are provided in Section 3.4.2 regarding sound power specifications.

5.4 Low Frequency Noise

A low frequency noise assessment was undertaken in accordance with INP guidelines. Where the total C-weighted prediction exceeds the total A-weighted prediction by 15 dB or more, a 5 dB modifying factor penalty is applied to predicted L_{Aeq}.

5.4.1 Existing Site with Noise Controls

Table 23, Table 24 and Table 25 present low frequency noise assessment results for the existing site with noise controls implemented, for the day, evening and night periods respectively. Results are provided for meteorological conditions relevant for each time period.

Whilst low frequency modifying factor penalties are applicable in some instances, none cause an exceedance

of operational noise criteria not previously indicated in Section 5.2.

Table 23: EXISTING SITE LOW FREQUENCY NOISE RESULTS, DAY PERIOD - $L_{eq,15MINUTE}$ dB

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R01	Neutral	55	49	39	10	0	39	Nil
	ENE wind	55	53	45	8	0	45	Nil
R02	Neutral	55	53	44	9	0	44	Nil
	ENE wind	55	56	49	7	0	49	Nil
R03	Neutral	55	56	48	8	0	48	Nil
	ENE wind	55	59	53	6	0	53	Nil
R04	Neutral	55	54	46	8	0	46	Nil
	ENE wind	55	55	48	7	0	48	Nil
R05	Neutral	55	59	44	15	5	49	Nil
	ENE wind	55	56	36	20	5	41	Nil
R06	Neutral	55	54	45	9	0	45	Nil
	ENE wind	55	57	51	6	0	51	Nil
R07	Neutral	55	60	45	15	5	50	Nil
	ENE wind	55	56	37	19	5	42	Nil
R08	Neutral	55	53	44	9	0	44	Nil
	ENE wind	55	56	50	6	0	50	Nil
R09	Neutral	55	58	50	8	0	50	Nil
	ENE wind	55	61	56	5	0	**56**	**1**
R10	Neutral	55	56	48	8	0	48	Nil
	ENE wind	55	59	53	6	0	53	Nil

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

Table 24: EXISTING SITE LOW FREQUENCY NOISE RESULTS, EVENING PERIOD - $L_{eq,15MINUTE}$ dB

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R01	Neutral	50	45	30	15	5	35	Nil
	ENE wind	50	48	36	12	0	36	Nil

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R02	Neutral	50	46	34	12	0	34	Nil
	ENE wind	50	49	39	10	0	39	Nil
R03	Neutral	50	48	37	11	0	37	Nil
	ENE wind	50	50	41	9	0	41	Nil
R04	Neutral	50	46	35	11	0	35	Nil
	ENE wind	50	46	36	10	0	36	Nil
R05	Neutral	50	50	34	16	5	39	Nil
	ENE wind	50	46	26	20	5	31	Nil
R06	Neutral	50	46	34	12	0	34	Nil
	ENE wind	50	49	39	10	0	39	Nil
R07	Neutral	50	51	35	16	5	40	Nil
	ENE wind	50	47	27	20	5	32	Nil
R08	Neutral	50	46	34	12	0	34	Nil
	ENE wind	50	49	39	10	0	39	Nil
R09	Neutral	50	49	37	12	0	37	Nil
	ENE wind	50	52	42	10	0	42	Nil
R10	Neutral	50	50	37	13	0	37	Nil
	ENE wind	50	52	42	10	0	42	Nil

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

Table 25: EXISTING SITE LOW FREQUENCY NOISE RESULTS, NIGHT PERIOD - $L_{eq,15MINUTE}$ dB

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R01	Neutral	45	45	30	15	5	35	Nil
	Inversion	45	47	35	12	0	35	Nil
	ENE wind	45	48	36	12	0	36	Nil
R02	Neutral	45	46	34	12	0	34	Nil
	Inversion	45	48	38	10	0	38	Nil
	ENE wind	45	49	39	10	0	39	Nil

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R03	Neutral	45	48	37	11	0	37	Nil
	Inversion	45	51	41	10	0	41	Nil
	ENE wind	45	50	41	9	0	41	Nil
R04	Neutral	45	46	35	11	0	35	Nil
	Inversion	45	48	40	8	0	40	Nil
	ENE wind	45	46	36	10	0	36	Nil
R05	Neutral	45	50	34	16	5	39	Nil
	Inversion	45	52	39	13	0	39	Nil
	ENE wind	45	46	26	20	5	31	Nil
R06	Neutral	45	46	34	12	0	34	Nil
	Inversion	45	48	39	9	0	39	Nil
	ENE wind	45	49	39	10	0	39	Nil
R07	Neutral	45	51	35	16	5	40	Nil
	Inversion	45	52	40	12	0	40	Nil
	ENE wind	45	47	27	20	5	32	Nil
R08	Neutral	45	46	34	12	0	34	Nil
	Inversion	45	48	39	9	0	39	Nil
	ENE wind	45	49	39	10	0	39	Nil
R09	Neutral	45	49	37	12	0	37	Nil
	Inversion	45	51	41	10	0	41	Nil
	ENE wind	45	52	42	10	0	42	Nil
R10	Neutral	45	50	37	13	0	37	Nil
	Inversion	45	52	42	10	0	42	Nil
	ENE wind	45	52	42	10	0	42	Nil

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

5.4.2 Proposed Expansion

Table 27, Table 28 and Table 29 present low frequency noise assessment results for the existing site combined with the proposed expansion, for the day, evening and night periods respectively. Results are provided for meteorological conditions relevant for each time period.

Modifying factor penalties are applicable in some instances; however, none cause exceedance of relevant criteria.

Another method commonly adopted in contemporary noise impact assessments is the Broner method, which evaluates low frequency noise through comparison of total predicted C-weighted levels at receptor locations with an upper limit criterion. This method is in accordance with recommendations published in A Simple Method for Low Frequency Noise Emission Assessment (Broner, 2010), published in the Journal of Low Frequency Noise, Vibration and Active Control, Volume 29 Number 1 2010. The author of the document recommends outdoor criteria for LFN assessment; Table 26 presents criteria recommended in the document. If the total predicted C-weighted noise level at a receptor exceeds the relevant criterion a 5 dB penalty (modifying factor) is added to predicted levels.

Table 26: LOW FREQUENCY NOISE CRITERIA - BRONER METHOD

Land Use	Sensitive Receiver	Range	Criteria L_{Ceq} (dB)
Residential	Night time of plant operation 24/7	Desirable	60
		Maximum	65
	Daytime or Intermittent (1-2 hours)	Desirable	65
		Maximum	70
Commercial/Office	Night time or plant operation 24/7	Desirable	70
		Maximum	75
Industrial	Daytime or Intermittent (1-2 hours)	Desirable	75
		Maximum	80

Source: A Simple Method for Low Frequency Noise Emission Assessment by N. Broner.

Total C-weighted predictions meet the desirable limit for residential receptors of L_{Ceq} 60 dB for the night period, and L_{Ceq} 65 dB for the day and evening periods, and are 5 dB or more below suggested maximum limits.

Table 27: PROPOSED EXPANSION LOW FREQUENCY NOISE RESULTS, DAY PERIOD - $L_{eq,15MINUTE}$ dB

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R01	Neutral	55	50	34	16	5	39	Nil
	ENE wind	55	53	39	14	0	39	Nil
R02	Neutral	55	53	37	16	5	42	Nil
	ENE wind	55	56	42	14	0	42	Nil

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R03	Neutral	55	55	41	14	0	41	Nil
	ENE wind	55	56	44	12	0	44	Nil
R04	Neutral	55	50	37	13	0	37	Nil
	ENE wind	55	50	38	12	0	38	Nil
R05	Neutral	55	51	35	16	5	40	Nil
	ENE wind	55	48	27	21	5	32	Nil
R06	Neutral	55	53	38	15	5	43	Nil
	ENE wind	55	56	43	13	0	43	Nil
R07	Neutral	55	52	36	16	5	41	Nil
	ENE wind	55	49	28	21	5	33	Nil
R08	Neutral	55	53	37	16	5	42	Nil
	ENE wind	55	56	42	14	0	42	Nil
R09	Neutral	55	57	43	14	0	43	Nil
	ENE wind	55	59	47	12	0	47	Nil
R10	Neutral	55	56	41	15	5	46	Nil
	ENE wind	55	57	45	12	0	45	Nil

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

Table 28: PROPOSED EXPANSION LOW FREQUENCY NOISE RESULTS, EVENING PERIOD - $L_{eq,15MINUTE}$ dB

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R01	Neutral	50	50	34	16	5	39	Nil
	ENE wind	50	53	39	14	0	39	Nil
R02	Neutral	50	53	37	16	5	42	Nil
	ENE wind	50	56	42	14	0	42	Nil
R03	Neutral	50	55	41	14	0	41	Nil
	ENE wind	50	56	44	12	0	44	Nil
R04	Neutral	50	50	37	13	0	37	Nil
	ENE wind	50	50	38	12	0	38	Nil

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R05	Neutral	50	51	35	16	5	40	Nil
	ENE wind	50	48	27	21	5	32	Nil
R06	Neutral	50	53	38	15	5	43	Nil
	ENE wind	50	56	43	13	0	43	Nil
R07	Neutral	50	52	36	16	5	41	Nil
	ENE wind	50	49	28	21	5	33	Nil
R08	Neutral	50	53	37	16	5	42	Nil
	ENE wind	50	56	42	14	0	42	Nil
R09	Neutral	50	57	43	14	0	43	Nil
	ENE wind	50	59	47	12	0	47	Nil
R10	Neutral	50	56	41	15	5	46	Nil
	ENE wind	50	57	45	12	0	45	Nil

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

Table 29: PROPOSED EXPANSION LOW FREQUENCY NOISE RESULTS, NIGHT PERIOD - $L_{eq,15MINUTE}$ dB

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R01	Neutral	45	49	33	16	5	38	Nil
	Inversion	45	51	38	13	0	38	Nil
	ENE wind	45	52	38	14	0	38	Nil
R02	Neutral	45	53	36	17	5	41	Nil
	Inversion	45	54	40	14	0	40	Nil
	ENE wind	45	55	41	14	0	41	Nil
R03	Neutral	45	54	39	15	5	44	Nil
	Inversion	45	56	43	13	0	43	Nil
	ENE wind	45	55	42	13	0	42	Nil
R04	Neutral	45	49	35	14	0	35	Nil
	Inversion	45	51	40	11	0	40	Nil
	ENE wind	45	49	36	13	0	36	Nil

Receptor	Met	Criterion	L_{Ceq}	L_{Aeq}	C-A	LFN penalty	Revised L_{Aeq}	Exceedance
R05	Neutral	45	50	34	16	5	39	Nil
	Inversion	45	52	39	13	0	39	Nil
	ENE wind	45	47	26	21	5	31	Nil
R06	Neutral	45	53	37	16	5	42	Nil
	Inversion	45	55	41	14	0	41	Nil
	ENE wind	45	55	42	13	0	42	Nil
R07	Neutral	45	51	35	16	5	40	Nil
	Inversion	45	53	40	13	0	40	Nil
	ENE wind	45	48	27	21	5	32	Nil
R08	Neutral	45	53	36	17	5	41	Nil
	Inversion	45	55	40	15	5	45	Nil
	ENE wind	45	55	41	14	0	41	Nil
R09	Neutral	45	56	40	16	5	45	Nil
	Inversion	45	58	44	14	0	44	Nil
	ENE wind	45	58	44	14	0	44	Nil
R10	Neutral	45	55	39	16	5	44	Nil
	Inversion	45	56	43	13	0	43	Nil
	ENE wind	45	56	43	13	0	43	Nil

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

5.5 Sleep Disturbance

A sleep disturbance assessment was undertaken for the proposed expansion. The current license does not include sleep disturbance criteria. Most sources on site operate with relatively constant noise output during the night period. However, front loaders and other mobile plant may operate at night. Impact noise from objects being dropped, or inadvertent impact of loader buckets are considered the most likely noise sources to generate short duration high level noise emission. A noise source with L_{Amax} sound power of 120 dB was added to the night period scenario. The source was located in a worst case location, near the southern site boundary (in the log yard).

Table 30 presents $L_{A1,1minute}$ predictions, and provides an indication of potential increase relative to the operational $L_{Aeq,15minute}$ prediction. Results are the worst case of modelled prevailing meteorological conditions. For many industries, where short duration maximum noise events are relatively frequent, sleep

disturbance $L_{A1,1minute}$ criteria are typically 10 dB higher than operational L_{Aeq} noise criteria. The maximum increase above the relatively steady state output of the site is 10 dB. Such increases are considered acceptable, and not likely to cause sleep disturbance. Further, with the exception of R09, all predictions are less than the EPA draft Industrial Noise Guideline (dING) maximum noise level screening criterion of L_{Amax} 52 dB, which, whilst not current policy, is the likely future method for assessing maximum noise events.

Table 30: SLEEP DISTURBANCE RESULTS - dB

Receptor	Operational $L_{Aeq,15minute}$	$L_{A1,1minute}$	Emergence
R01	38	45	7
R02	41	48	7
R03	43	48	5
R04	40	49	9
R05	39	49	10
R06	42	50	8
R07	40	50	10
R08	41	51	10
R09	45	54	9
R10	44	52	8

Notes 1: Bolded results exceed relevant operational noise criterion (if applicable).

5.6 Cumulative Noise

Predictions for the proposed expansion are typically the same as, or slightly lower than, predictions for the existing site. As no significant change is predicted relative to the existing situation, no significant change to cumulative noise levels should result.

6 CONSTRUCTION NOISE ASSESSMENT

A construction period of approximately 24 months is proposed, during which time modifications to the existing site and construction of proposed infrastructure will be undertaken. As described in Section 2.5, construction tasks will be generally undertaken within the following hours:

- Monday to Friday 7 am to 7 pm;
- Saturday 8 am to 1 pm; and
- No work on Sundays and public holidays.

Construction activities will be undertaken in conjunction with regular operation of the existing site. Borg propose to generally restrict site noise emission from both construction and operational tasks combined to comply with operational noise criteria conditioned in EPL 3035.

6.1 Construction Scenarios

Borg advised the noisiest construction activity is likely to be rock or concrete breaking. This activity was assessed, along with two additional construction scenarios considering earthworks, and, infrastructure installation.

Scenarios inclusions are outlined in Table 31. Plant quantities included in each scenario are listed in Table 32. Sound power of equipment is provided in Table 13. Conservatively, it was assumed all construction plant within each scenario would operate concurrently, at full power, for the entire 15 minute duration. In reality, such a scenario is unlikely to occur. Equipment was modelled in exposed locations, typically in the southern portion of the site.

All sources associated with the existing site were included in the construction models; it is assumed noise control proposed for existing plant will be implemented prior to commencement of construction activities. Each of the three construction scenarios was modelled with and without one mobile chipper operating.

Table 31: CONSTRUCTION SCENARIO INCLUSIONS

Scenario ID	Existing site	Mobile Chipper	Earthworks	Installation	Rock Breaking
V01	yes	no	yes	no	no
V02	yes	yes	yes	no	no
V03	yes	no	no	yes	no
V04	yes	yes	no	yes	no
V05	yes	no	no	no	yes
V06	yes	yes	no	no	yes

Table 32: CONSTRUCTION SCENARIOS – CONSTRUCTION EQUIPMENT INCLUSIONS

Equipment Type	Earthworks (V01/V02)	Installation (V03/V04)	Rock breaking (V05/V06)
Excavator	1	0	0
Loader	1	0	0
Dozer	1	0	0
Dump truck	2	0	0
Grader	1	0	0
Roller	1	0	0
Articulated Truck	2	0	0
Mobile Crane	0	2	0
Concrete Truck	0	1	0
Delivery Truck	0	2	0
Bobcat	0	1	0
Rock Breaker	0	0	1

6.2 Construction Results

Table 33 presents model results for six construction scenarios. Results are presented as a range showing the predicted variation from neutral atmospheric conditions (first value) to prevailing east-north-east winds (second value). Prevailing wind results are lower than for neutral atmospheric conditions for some receivers, as these conditions will tend to mitigate noise propagation towards those receivers. Construction was not assessed under temperature inversion conditions as these are unlikely to occur before 7pm. Results in bold type exceed the day period operational noise criterion.

Model predictions for the earthworks and installation scenarios (V01 to V04) indicate general compliance with the day period operational noise criterion at all receivers, with the exception of R09. At R09, exceedances up to 3 dB are predicted during prevailing wind conditions when a mobile chipper is operated concurrently with construction plant. Exceedance of the evening period operational noise criterion is predicted at R02, R03, R06, R08, R09 and R10. These exceedances are predicted during calm and prevailing wind conditions when a mobile chipper is operated concurrently with construction plant. Construction noise can be managed through monitoring weather conditions, restricting use of the mobile chipper during enhancing conditions if a large amount of construction plant is operating, and restricting construction activities to the standard ICNG construction hours where possible

Predictions for the rock breaking scenarios (V05 and V06) include a plus 5 dB modifying factor penalty to account for the intermittent nature of rock breaking works. It is recommended mobile chipping plant is not operated during rock breaking works; in that case V06 would not eventuate. As discussed in Section 2.5, it is considered reasonable to assess rock breaking against the "highly affected" construction noise criterion of $L_{Aeq,15minute}$ 75 dB, as the duration would be relatively short compared with other construction tasks, and few options are available to mitigate noise from this activity. Predictions for V05 are well below this criterion.

Table 33: CONSTRUCTION RESULTS - $L_{Aeq,15MINUTE}$ dB

Receptor	Criterion (day/evening)	V01	V02	V03	V04	V05	V06
R01	55/50	37-42	41-46	34-39	40-45	45-50	47-**53**
R02	55/50	44-49	47-**52**	39-44	45-50	**51-56**	**53-58**
R03	55/50	47-49	**51-55**	42-46	50-**54**	**55-58**	**57-61**
R04	55/50	41-41	47-49	38-40	46-48	50-49	**53-54**
R05	55/50	37-30	45-37	36-29	45-37	42-34	50-42
R06	55/50	43-48	47-**52**	39-44	46-**51**	**52-57**	**54-59**
R07	55/50	38-31	46-38	37-30	46-37	43-35	**51**-43
R08	55/50	42-47	46-**52**	38-44	45-**51**	**51-56**	**53-59**
R09	55/50	50-**54**	**54-58**	45-49	**52-57**	**59-63**	**60-65**
R10	55/50	46-49	50-**55**	42-46	49-**54**	**55-59**	**57-61**

Notes 1: Bolded results exceed the evening period operational noise criterion; and

2. Results for V05 and V06 include a plus 5 dB modifying factor penalty to account for the intermittent nature of rock breaking works.

6.3 Construction Recommendations

The ICNG provides options for work practices and community consultation to minimise and manage noise impact from construction activities. It is recommended construction managers review and implement noise reduction and management strategies outlined in Section 6 of the ICNG.

7 ROAD TRAFFIC ASSESSMENT

SMEC Australia Pty Ltd (SMEC) has undertaken a traffic impact assessment (TIA) for the Project. Road traffic flow volumes and distribution of traffic on the road network used for assessment of noise impact is based on data provided in the TIA.

7.1 Operational Road Traffic Noise

The TIA indicates the majority of operational road traffic generated by the development will travel on North Street (light vehicles) and Albion Street (heavy vehicles), to access/depart the site via Lowes Mount Road. The speed limit on both roads within the town of Oberon is 60 km/h. In accordance with RNP definitions, North Street is classified a local road, and Albion Street is classified a sub-arterial road due to the high proportion of heavy vehicles utilising the route, both to serve industry within Oberon, and through traffic between Bathurst and Sydney. The definition of a sub-arterial road in the RNP is:

- Provide connection between arterial roads and local roads;
- May support arterial roads during peak periods; and
- May have been designed as local streets but can serve major traffic-generating developments or support non-local traffic.

Road traffic noise models were developed for North Street and Albion Street using the FHWA methodology. Lowes Mount Road north of Albion Street was not assessed, as there are no residences between Albion Street and the site access, the section upon which the majority of traffic would travel. Only 5 percent of project generated light vehicle traffic would utilise Lowes Mount Road north of the site, which is considered significantly minor that any increase in noise levels would be insignificant.

Figure 6 to Figure 8 show existing and projected operational road traffic volumes at the Lowes Mount Road/North Street/Albion Street intersection for Years 2015, 2017 and 2027 respectively.

Site personnel undertake works as per the following shift times:

- Morning shift, 6:30am to 2:30pm;
- Day shift, 2:30pm to 10:30pm; and
- Night shift, 10:30pm to 6:30am.

Table 4.2 of the TIA provides existing and projected operational light vehicle volumes. This table is reproduced below.

Table 4-2: Operational traffic generation

Operational year	Number of personnel	Vehicle movements per day	
		One-way trip	Two-way trip
Existing (2015)	231	146	292
2017	291	184	368
2027	306	194	388

7.1.1 North Street

Data presented in the TIA indicates morning and afternoon traffic peaks on North Street occur between 8am and 9am, and, 3:15pm and 4:15pm respectively.

Table 34 presents peak hour model predictions for North Street at a distance of 20 metres from the road. Results indicate the day period criterion of $L_{Aeq,1hour}$ 55 dB would be exceeded during both morning and afternoon peak periods at this distance. However, the TIA indicates no change in peak hour traffic volumes will occur on North Street relative to the existing situation. As site shift changes occur outside of peak hours, no change to peak hour road traffic noise impact on North Street is predicted relative to the existing situation.

Table 34: NORTH STREET ROAD TRAFFIC ASSESSMENT RESULTS – $L_{Aeq,1hour}$ dB

Period	Speed	Light Vehicles	Heavy Vehicles	Prediction	Change relative to 2015
AM PEAK					
2015	60	172	20	61.8	-
2017	60	172	20	61.8	0
2027	60	172	20	61.8	0
PM PEAK					
2015	60	264	19	62.1	-
2017	60	264	19	62.1	0
2027	60	264	19	62.1	0

7.1.2 Albion Street

Data presented in the TIA indicates morning and afternoon traffic peaks on Albion Street occur between 8am and 9am, and, 3:15pm and 4:15pm respectively. The nearest residence on Albion Street, located off Tarana Crescent, is 23 metres from Albion Street at the nearest facade.

Albion Street is categorised as a sub-arterial road; therefore, road traffic noise criteria in the RNP are expressed in terms of $L_{Aeq,period}$. Road traffic volumes over the entire day and night periods was not available, however, Borg has advised the following in terms of heavy vehicles volumes generated by the site:

- Heavy vehicle movements will be relatively uniformly distributed between the hours of 6am and 6pm;
- Heavy vehicle movements for the base case (2015) are 6 per hour;
- Heavy vehicle movements projected for 2017 are 10 per hour; and
- Heavy vehicle movements projected for 2027 are 14 per hour.

Figures 4.3 and 4.4 of the TIA (reproduced in Figure 11) show all heavy vehicle traffic will use Albion Street; 72 percent will travel east of Lowes Mount Road, and 28 percent will travel west of Lowes Mount Road. The distribution remains unchanged over time.

Borg provided traffic count data for Duckmaloi Road, just south of the Albion Street/Duckmaloi Road intersection, and, traffic count data for the periods 6am to 9am and 3pm to 6pm on Albion Street. It is assumed traffic flows on Albion Street between the hours of 9am and 3pm, and after 6pm are proportionally similar to the distribution on Duckmaloi Road for the same periods. Hourly traffic flows for Albion Street were estimated by applying the percentage distribution of traffic from Duckmaloi Road to the total traffic counts of light and heavy vehicles for Albion Street. Data in the TIA indicates light vehicle traffic on Albion Street is projected to increase by 7 percent by 2027. To gain projected traffic flow data on Albion Street for 2027:

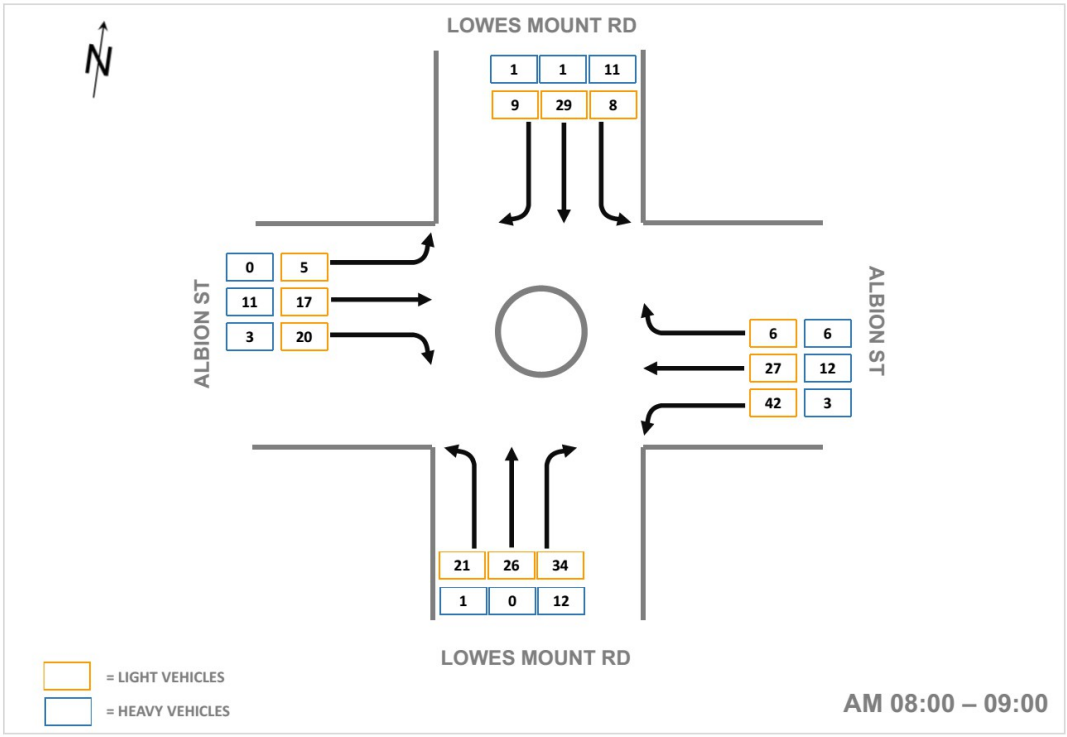
- Light vehicle counts calculated for 2015 were increase by 7 percent; and
- Heavy vehicle movements on Albion Street east of Lowes Mount Road were taken as 72 percent of the hourly average (0.72 x 14 = 10 per hour).

Table 35 presents the hourly distribution of traffic flows, corresponding $L_{Aeq,1hour}$ predictions, and the calculated $L_{Aeq,15hour}$ for both 2015 and 2027. Results indicate the day period criterion of $L_{Aeq,15hour}$ 60 dB would be exceeded at a distance of 23 metres from the road. However, the predicted increase is 0.8 dB, which is less than the relative increase criterion outlined in the RNP of 2 dB. An increase of 0.8 dB would be neither measurable, nor perceptible to the human ear.

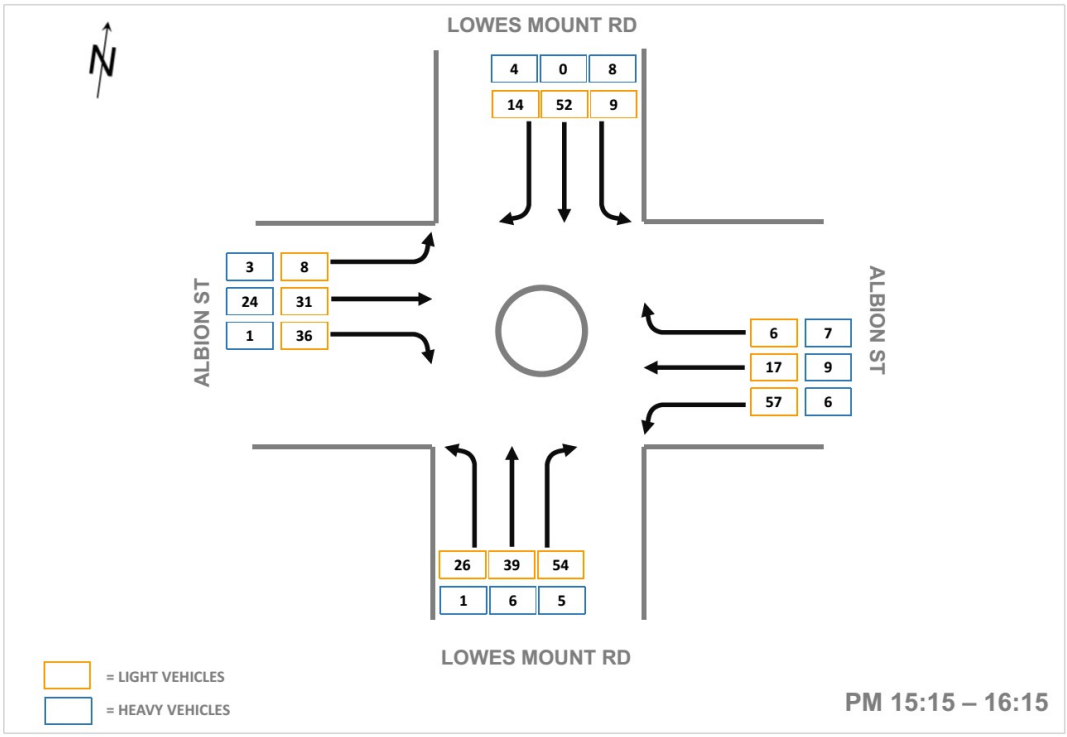
Table 35: ALBION STREET EAST ROAD TRAFFIC ASSESSMENT RESULTS – dB

Period end	Speed	Light Vehicles	Heavy Vehicles	$L_{Aeq,1hour}$ dB
		2015		
8:00	60	96	58	64.6
9:00	60	134	55	64.5
10:00	60	154	63	65.1
11:00	60	161	66	65.3
12:00	60	157	64	65.2
13:00	60	167	68	65.5
14:00	60	152	62	65.0
15:00	60	160	65	65.3
16:00	60	166	68	65.4
17:00	60	156	48	64.0
18:00	60	137	22	61.0
19:00	60	47	19	59.9
20:00	60	31	13	58.2
21:00	60	24	10	57.1
22:00	60	22	9	56.7
			$L_{Aeq,15hour}$	**63.8**
		2027		
8:00	60	103	68	65.3
9:00	60	143	65	65.2
10:00	60	164	73	65.7
11:00	60	172	76	65.9
12:00	60	168	74	65.8
13:00	60	179	78	66.0
14:00	60	162	72	65.7
15:00	60	171	75	65.9
16:00	60	178	78	66.0

Period end	Speed	Light Vehicles	Heavy Vehicles	$L_{Aeq,1hour}$ dB
17:00	60	167	58	64.8
18:00	60	147	32	62.4
19:00	60	50	29	61.7
20:00	60	33	23	60.6
21:00	60	26	20	60.0
22:00	60	24	19	59.8
			$L_{Aeq,15hour}$	**64.6**

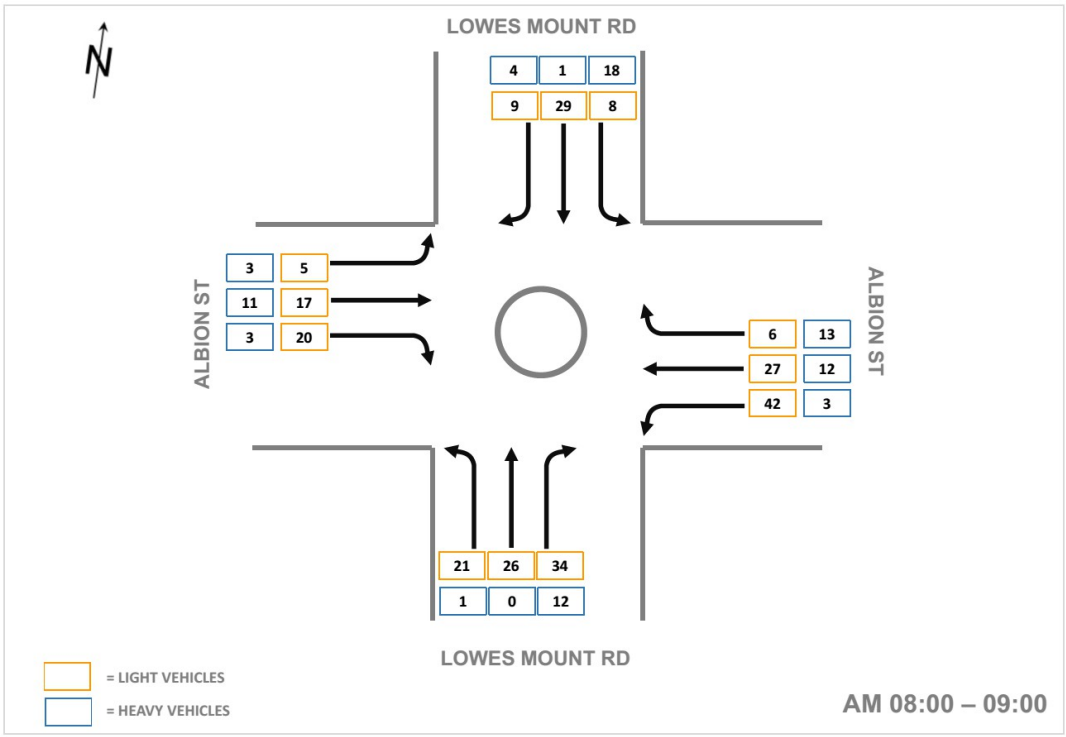


Site 3 – Lowes Mount Road and Albion Street, AM peak hour

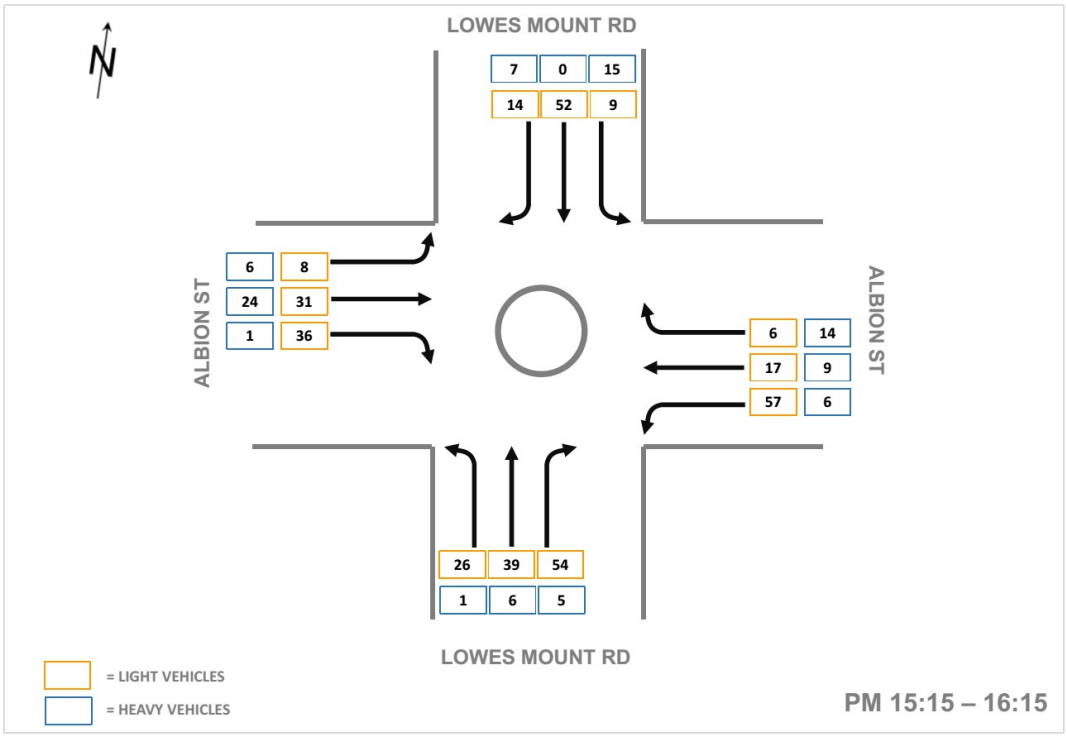


Site 3 – Lowes Mount Road and Albion Street, PM peak hour

Figure 6: Traffic Volumes, Lowes Mount Road and Albion Street - 2015

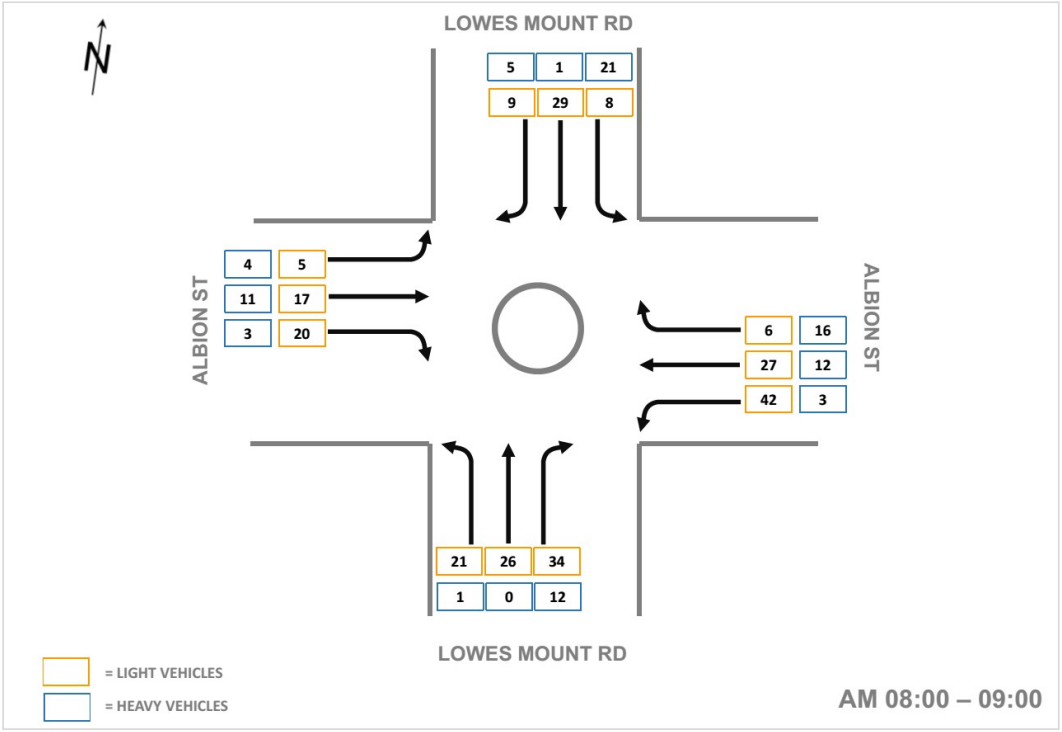


Site 3 – Lowes Mount Road and Albion Street, AM peak hour (Operational, 2017)

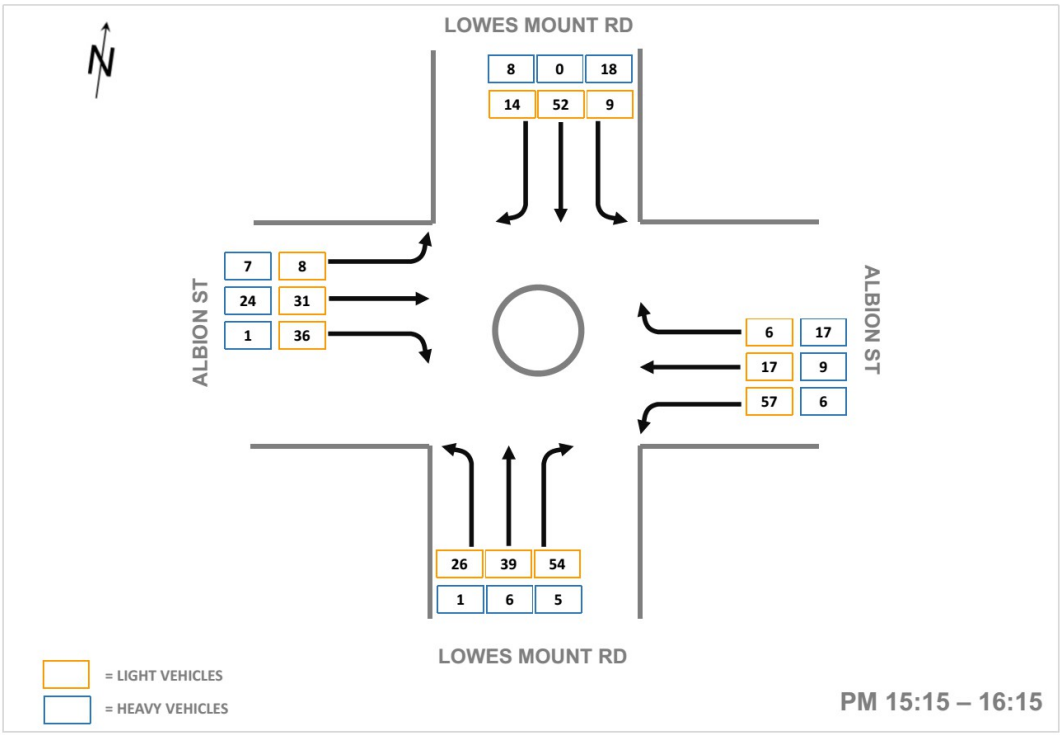


Site 3 – Lowes Mount Road and Albion Street, PM peak hour (Operational, 2017)

Figure 7: Traffic Volumes, Lowes Mount Road and Albion Street - 2017



Site 3 – Lowes Mount Road and Albion Street, AM peak hour (Operational, 2027)



Site 3 – Lowes Mount Road and Albion Street, PM peak hour (Operational, 2027)

Figure 8: Traffic Volumes, Lowes Mount Road and Albion Street - 2027

Figure 4-1: Light vehicle traffic distribution - AM peak period

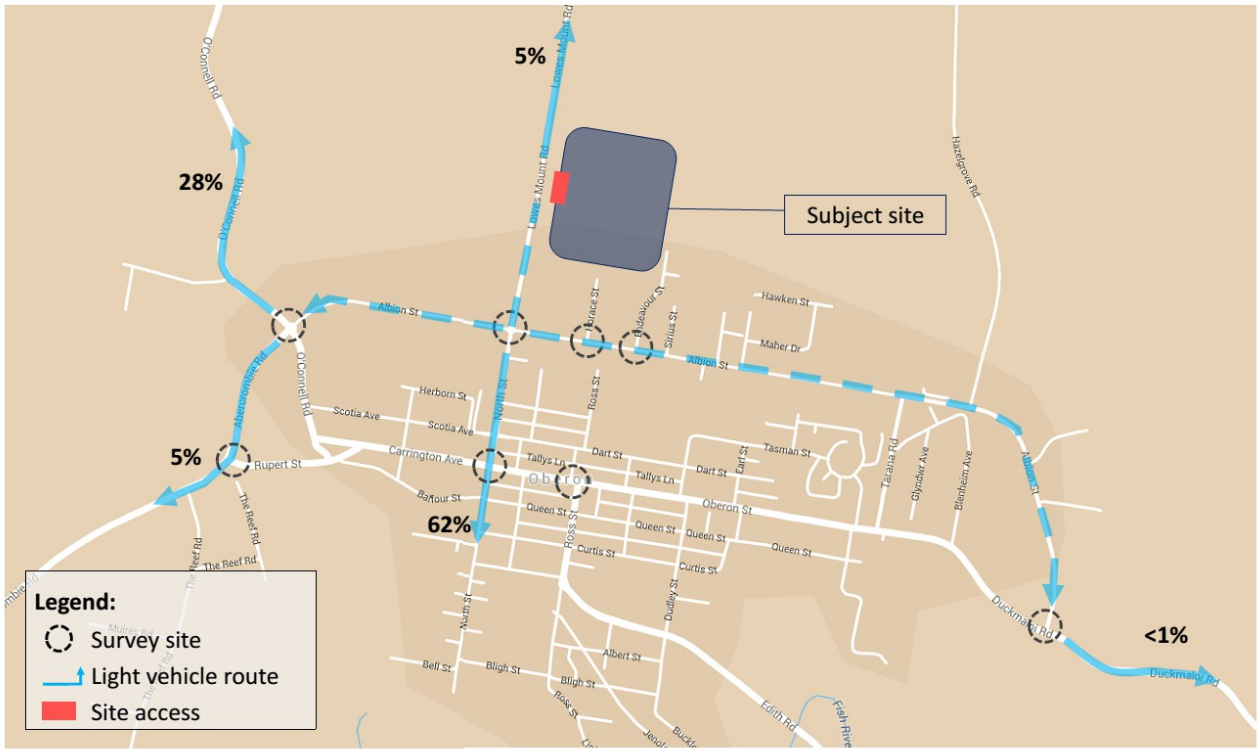


Figure 4-2: Light vehicle traffic distribution - PM peak period

Figure 9: Light Vehicle Traffic Distribution (draft TIA)

Figure 4-3: Heavy vehicle traffic distribution - AM peak period

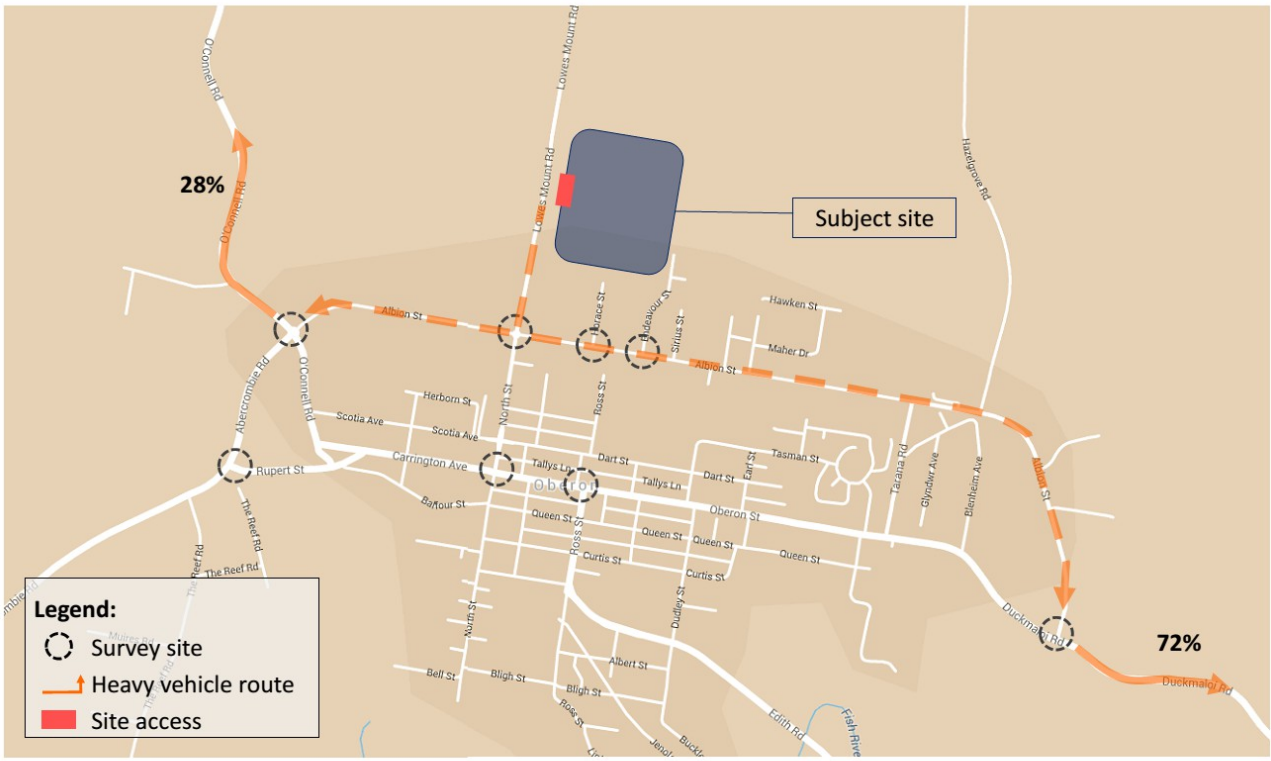


Figure 4-4: Heavy vehicle traffic distribution - PM peak period

Figure 10: Heavy Vehicle Traffic Distribution (draft TIA)

7.2 Construction Road Traffic Noise

Table 4.1 of the TIA (reproduced below) provides estimated vehicle movements associated with the construction phase of the project.

Phase	Duration of peak	Vehicle movements per day (two-way trip)	Number of personnel
Site establishment and construction	24 months	240 trips per day (light vehicles) 60 trips per day (heavy vehicles)	Maximum 120 per day

A key finding of the construction impact assessment in the TIA was:

The construction phase is likely to have minimal impact on the existing transport network, with the majority of the vehicle movements occurring outside of the general peak periods.

As the majority of construction vehicle movements are expected to occur outside of general peak periods, no change to peak period noise impact should result. A minor increase to $L_{Aeq,period}$ levels may result; however, when the projected construction traffic movements are averaged out over the day period, the resulting increase is considered insignificant relative to total existing road volumes. Any resulting increase is considered unlikely to be either measurable, or perceptible to the human ear.

8 MONITORING AND MEASUREMENT MEASURES

8.1 Noise Control

Noise control is proposed for some existing plant, as described in Section 3.4.1.

For critical plant, associated with the proposal, limiting sound powers were derived to reduce model predictions to within compliance levels. In some cases, a significant degree of noise control may be required. Sound power limits (both linear and A-weighted) are included in tender documents for new plant. It is recommended compliance testing is undertaken upon commissioning, and any non-compliance identified should require an update of the site noise model to establish whether compliance with relevant noise criteria can be maintained. Actions required to maintain compliance, such as further noise control to the non-compliant item, or other plant items, should be suitably documented.

8.2 Management Measures

The following management measures are recommended for the existing site:

- Mobile chipping plant should be restricted to the day period;
- Two mobile chippers should not operate concurrently during enhancing meteorological conditions;
- During periods of strong meteorological enhancement to the south, neither mobile chipper should operate; and
- Plant listed in Table 12 should be provided with further noise control (attenuation).

The following management measures are recommended for the proposed expansion:

- Mobile chipping plant should be phased out from permanent use. When required, mobile chipping plant should be restricted to the day period, and should not be operated during periods of meteorological enhancement towards R09;
- No chipping plant should operate during the night period; and
- Plant listed in Table 12 should be provided with further noise control (attenuation).

The ICNG provides options for work practices and community consultation to minimise and manage noise impact from construction activities. It is recommended construction managers review and implement noise reduction and management strategies outlined in Section 6 of the ICNG.

Additionally, the following management measures are recommended for construction activities:

- The proponent should inform potentially noise affected residents of the nature of works to be carried out, the expected noise levels and duration, as well as relevant contact details;

- All feasible and reasonable work practices should be implemented where possible to meet EPL operational noise criteria; and

- Construction personnel should be aware of the requirement to minimise noise impact, and to implement best practice operating techniques to minimise noise. Consideration should be given to operating low noise emission plant where possible.

8.3 Monitoring

The following compliance monitoring, to be undertaken by a suitably qualified acoustic consultant, is recommended for the project:

- Periodic attended noise monitoring at the potentially most affected residences during the day period, with a frequency of once per quarter, during the construction phase of the Project;

- Periodic attended noise monitoring at the potentially most affected residences during the noise sensitive night period, with a frequency of one night per quarter; and

- If non-compliance is demonstrated, additional monitoring should be undertaken within one week following implementation of additional mitigation controls.

Attended compliance noise monitoring results and a description of actions taken to reduce noise levels in response to non-compliances should be reported internally quarterly, and externally annually in an annual report.

Off site noise monitoring by suitably trained site personnel should be undertaken regularly, particularly during periods of meteorological enhancement, to ensure relevant noise criteria are adhered to. Operations should be modified accordingly as required when exceedance, or potential exceedances are measured.

Development of a noise management plan, covering both construction and operational phases of the project is recommended. The noise management plan should formalise monitoring locations, relevant criteria, monitoring programs, roles and responsibilities, complaint response protocols and reporting requirements.

9 SUMMARY

Global Acoustics was engaged by Borg Manufacturing Pty Ltd (Borg) to carry out a noise and vibration impact assessment for a proposed expansion of their panel manufacturing facility, located approximately 1.5 kilometres from the centre of Oberon at 124 Lowes Mount Road. This assessment considered impacts associated with noise emission from the existing site, and, the proposed expansion. Potential impact from operational noise, low frequency noise, sleep disturbance, cumulative noise, construction noise and road traffic noise were assessed. A model validation assessment was undertaken to provide an estimate of model prediction reliability.

9.1 Validation Assessment

A model of the existing site was developed, and refined to represent a scenario of operations in progress on the night of 14 October 2015. Results of attended monitoring at Oberon Caravan Park were compared with model predictions for the same location under meteorological conditions in effect at the time of monitoring. The model prediction for the modelled scenario was L_{Aeq} 43 dB, which correlated exactly with the attended measured level. This correlation indicates the model of the existing site provides a good estimate of actual noise emission. Compliance with the current EPL night period operational noise criterion was demonstrated.

9.2 Operational Noise

A model of the existing site was developed. Sound power of significant noise sources was measured by Global Acoustics during October 2015 and April 2016. The site has some equipment that operates with restricted operating hours; therefore a series of scenarios were developed representing different modes of operation according to time period.

Model predictions for the existing site indicate:

- Compliance with existing EPL criteria is predicted for all receivers during non-enhancing meteorological conditions;
- Compliance with existing EPL criteria is predicted for all receivers for the evening and night periods during prevailing (enhancing) meteorological conditions;
- At R09, a minor 1 dB exceedance is predicted for the day period during enhancing meteorological conditions when one mobile chipper is operational; and
- A minor 1 dB exceedance is predicted for R03 and R10, and a moderate exceedance of 4 dB for R09 for the day period during enhancing meteorological conditions if two mobile chippers are operated concurrently.

Modelling of the existing situation indicated the site currently operates close to EPL criteria during periods of enhancing meteorological conditions. Management measures and noise control for some plant were

recommended to both manage and reduce noise emission from the existing site.

A model of the proposed expansion was developed, which included all existing plant (with noise control as required) and proposed infrastructure. Mobile chipping plant will only be used during breakdown or scheduled maintenance of electric chipping plant, and will generally be replaced with three enclosed electric chippers (one of which currently exists). Sound power data was not available for plant proposed for the expansion; Borg provided sound pressure level (SPL) data at 1 metre. Sound power for proposed infrastructure was estimated using a relationship derived for each item between the SPL provided by Borg, SPL measured by Global Acoustics for similar plant items at 1 metre, and calculated sound power for similar plant items. Initial model iterations indicated noise control will be required for some plant. For critical plant, limiting sound powers were derived to reduce model predictions to within compliance levels. In some cases, a significant degree of noise control may be required. Full details regarding sound power derivation and recommendations are included in Section 3.4 of this report.

Model predictions for the proposed site indicate:

- Compliance with existing EPL criteria is predicted for all receivers during non-enhancing meteorological conditions; and
- Compliance with existing EPL criteria is predicted for all receivers except R09, for which a minor 1 dB exceedance is predicted for the day period when a mobile chipper is operational. Compliance was predicted for all receivers for 'normal' operations when no mobile chipping plant is operated.

Model predictions are dependent on limiting sound powers provided being attained, and may be lower than currently predicted if higher levels of acoustic performance are achieved.

A low frequency noise assessment was undertaken in accordance with INP guidelines. Low frequency modifying factor penalties were applicable in some instances; however, none caused an exceedance of operational noise criteria not previously indicated in the operational noise assessment.

Total C-weighted noise predictions remained within desirable limits suggested in *A Simple Method for Low Frequency Noise Emission Assessmen*t (Broner, 2010).

A sleep disturbance assessment was undertaken for the proposed expansion. The current license does not include sleep disturbance criteria. Maximum noise level increases above predicted steady state noise emissions were considered acceptable, and not likely to cause sleep disturbance.

Predictions for the proposed expansion are typically the same as, or slightly lower than, predictions for the existing site. As no significant change is predicted relative to the existing situation, no significant change to cumulative noise levels should result.

9.3 Construction Noise

A construction period of approximately 24 months is proposed, during which time modifications to the

existing site and construction of proposed infrastructure will be undertaken. Construction activities will be undertaken in conjunction with regular operation of the existing site. Borg propose to generally restrict site noise emission from both construction and operational tasks combined to comply with operational noise criteria conditioned in EPL 3035.

Borg advised the noisiest construction activity is likely to be rock or concrete breaking. This activity was assessed, along with two additional construction scenarios considering earthworks, and, infrastructure installation.

Model predictions for the earthworks and installation scenarios indicate general compliance with the day period operational noise criterion at all receivers, with the exception of R09. At R09, exceedances up to 3 dB were predicted during prevailing wind conditions if a mobile chipper is operated concurrently with construction plant. Exceedance of the evening period operational noise criterion is predicted at R02, R03, R06, R08, R09 and R10. These exceedances are predicted during calm and prevailing wind conditions when a mobile chipper is operated concurrently with construction plant. Construction noise can be managed through monitoring weather conditions, restricting use of the mobile chipper during enhancing conditions if a large amount of construction plant is operating, and restricting construction activities to the standard ICNG construction hours where possible.

Rock breaking predictions included a 5 dB modifying factor penalty for intermittency. This activity was assessed against the "highly affected" construction noise criterion of $L_{Aeq,15minute}$ 75 dB, as the duration would be relatively short compared with other construction tasks, and few options are available to mitigate noise from this activity. Predictions were well below this criterion.

It is recommended construction managers review and implement noise reduction and management strategies outlined in Section 6 of the Interim Construction Noise Guideline.

9.4 Vibration

The manufacturing operations are not anticipated to produce any measurable vibration impact to surrounding residences due to the following factors:

- The equipment and processing of material does not involve blasting or generate any vibration of significance; and
- The separation distance from the plant to residences being significantly large enough for any vibrations to be damped out.

During construction of proposed infrastructure, vibrating equipment such as rollers and rock breakers may be utilised. Due to the distance to sensitive receivers from construction areas, no vibration impact is expected.

9.5 Road Traffic Noise

Construction and operational road traffic noise impacts were assessed for North Street and Albion Street, the roads indicated in the Traffic Impact Assessment report to receive the greatest traffic flows. The majority of both construction and operational project generated traffic will occur outside of general peak hour traffic flows. Increases to road traffic noise relative to the existing situation were found to be insignificant, and less than 1 dB. Such an increase is unlikely to be either measurable, or perceptible to the human ear.

9.6 Closure

In general, operation of both the existing site and the proposed expansion are predicted to comply with current EPL operational noise criteria when recommended management strategies are implemented. A minor 1 dB exceedance is predicted at R09 when a mobile chipper is operated during enhancing meteorological conditions. Operation of mobile chippers does not form part of 'normal' operations, as they will typically be only used during breakdown of electric plant. Exceedances can be avoided through monitoring weather and restricting use of mobile chipping plant during periods of meteorological enhancement.

Results of this assessment are dependent upon limiting sound powers for proposed infrastructure, and recommended noise controls for existing plant, being achieved. Borg has committed to including sound power limits in tender documents to ensure required targets are achieved.

Global Acoustics Pty Ltd

APPENDIX

A CALIBRATION CERTIFICATES

Acoustic Research Labs Pty Ltd
Level 7 Building 2 423 Pennant Hills Rd
Pennant Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
www.acousticresearch.com.au

Sound Level Meter
AS 1259.1:1990 - AS 1259.2:1990

Calibration Certificate

Calibration Number C14643

Client Details Global Acoustics Pty Ltd
12/16 Huntingdale Drive
THORNTON NSW 2322

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 878017
Microphone Serial Number : 316087
Pre-amplifier Serial Number : 27806

Atmospheric Conditions
Ambient Temperature : 22.8°C
Relative Humidity : 50.2%
Barometric Pressure : 100.22kPa

Calibration Technician : Corey Stewart
Calibration Date : 28/11/2014
Secondary Check: Sandra Minto
Report Issue Date : 01/12/2014
Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	*Pass*	10.3.4: Inherent system noise level	*Pass*
10.2.3: Frequency weighting	*Pass*	10.4.2: Time weighting characteristic F and S	*Pass*
10.3.2: Overload indications	*Pass*	10.4.3: Time weighting characteristic I	*Pass*
10.3.3: Accuracy of level range control	*Pass*	10.4.5: R.M.S performance	*Pass*
8.9: Detector-indicator linearity	*Pass*	9.3.2: Time averaging	*Pass*
8.10: Differential level linearity	*Pass*	9.3.5: Overload indication	*Pass*

Least Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.120dB*	*Temperature*	*±0.3°C*
12.5kHz	*±0.165dB*	*Relative Humidity*	*±4.1%*
16kHz	*±0.245dB*	*Barometric Pressure*	*±0.1kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.098dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

NATA
WORLD RECOGNISED ACCREDITATION

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

PAGE 1 OF 1

Acoustic Research Labs Pty Ltd
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Ph: +61 2 9484 0800 A.B.N. 65 160 399 119
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Calibration Certificate

Number : C13713

Client Details :	Global Acoustics Pty Ltd 12/16 Huntingdale Drive Thornton NSW 2322
Equipment Tested/ Model Number :	**ARL Ngara**
Instrument Serial Number :	878041
Microphone Serial Number :	320464
Preamplifier Serial Number :	28168
Ambient Temperature :	22°C
Relative Humidity :	53%
Barometric Pressure :	100.7 kPa
Calibration Technician :	Adrian Walker
Calibration Date :	20-January-2014
Secondary Check by :	Tim Williams
Report Issue Date :	20-January-2014
Approved Signatory :	
Tested To :	AS1259.1:1990 AS1259.2:1990
Comments :	All tests passed for type 1

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	Pass	10.4.5: R.M.S performance	Pass
10.2.3: Frequency weighting	Pass	9.3.2: Time averaging	Pass
10.3.2: Overload indications	Pass	9.3.5: Overload indication	Pass
8.9: Detector-indicator linearity	Pass		
8.10: Differential level linearity	Pass		
10.3.4: Inherent weighted system noise level	Pass		
10.4.2: Time weighting characteristics F and S	Pass		

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Calibration Certificate

Number : C13689

Client Details : Global Acoustics Pty Ltd
12/16 Huntingdale Drive
Thornton NSW 2322

Equipment Tested/ Model Number : **ARL Ngara**
Instrument Serial Number : 87801F
Microphone Serial Number : 316671
Preamplifier Serial Number : 27809

Ambient Temperature : 24°C
Relative Humidity : 51%
Barometric Pressure : 100.8 kPa

Calibration Technician : Adrian Walker
Calibration Date : 13-December-2013
Secondary Check by : Tim Williams
Report Issue Date : 16-December-2013
Approved Signatory :

Tested To : AS1259.1:1990
AS1259.2:1990

Comments : All tests passed for type 1

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
10.2.2: Absolute sensitivity	Pass	10.4.5: R.M.S performance	Pass
10.2.3: Frequency weighting	Pass	9.3.2: Time averaging	Pass
10.3.2: Overload indications	Pass	9.3.5: Overload indication	Pass
8.9: Detector-indicator linearity	Pass		
8.10: Differential level linearity	Pass		
10.3.4: Inherent weighted system noise level	Pass		
10.4.2: Time weighting characteristics F and S	Pass		

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Sound Calibrator
IEC 60942-2004

Calibration Certificate

Calibration Number C15325

Client Details Global Acoustics Pty Ltd
12/16 Huntingdale Drive
THORNTON NSW 2322

Equipment Tested/ Model Number : Pulsar Model 106
Instrument Serial Number : 74813

Atmospheric Conditions
Ambient Temperature : 21.9°C
Relative Humidity : 44%
Barometric Pressure : 100.6kPa

Calibration Technician : Dennis Kim
Calibration Date : 08/07/2015
Secondary Check: Sandra Minto
Report Issue Date : 13/07/2015
Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
5.2.2: Generated Sound Pressre Level	*Pass*	5.3.2: Frequency Generated	*Pass*
5.2.3: Short Term Fluctuation	*Pass*	5.5: Total Distortion	*Pass*

The sound calibrator has been shown to conform to the class 2 requirements for periodic testing, described in Annex B of IEC 60942:2004 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed..

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.09dB*	*Temperature*	*±0.3°C*
Short Term Fluct.	*±0.02dB*	*Relative Humidity*	*±4.1%*
Frequency	*±0.01%*	*Barometric Pressure*	*±0.1kPa*
Distortion	*±0.26%*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

NATA
WORLD RECOGNISED ACCREDITATION

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

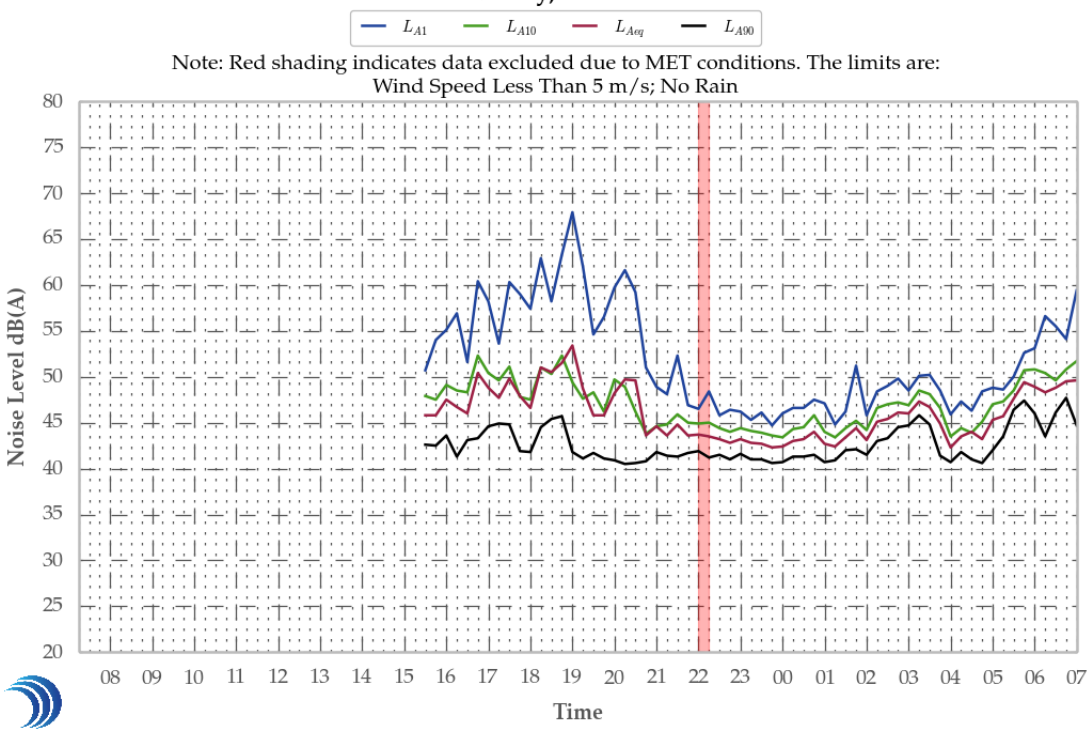
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards.

PAGE 1 OF 1

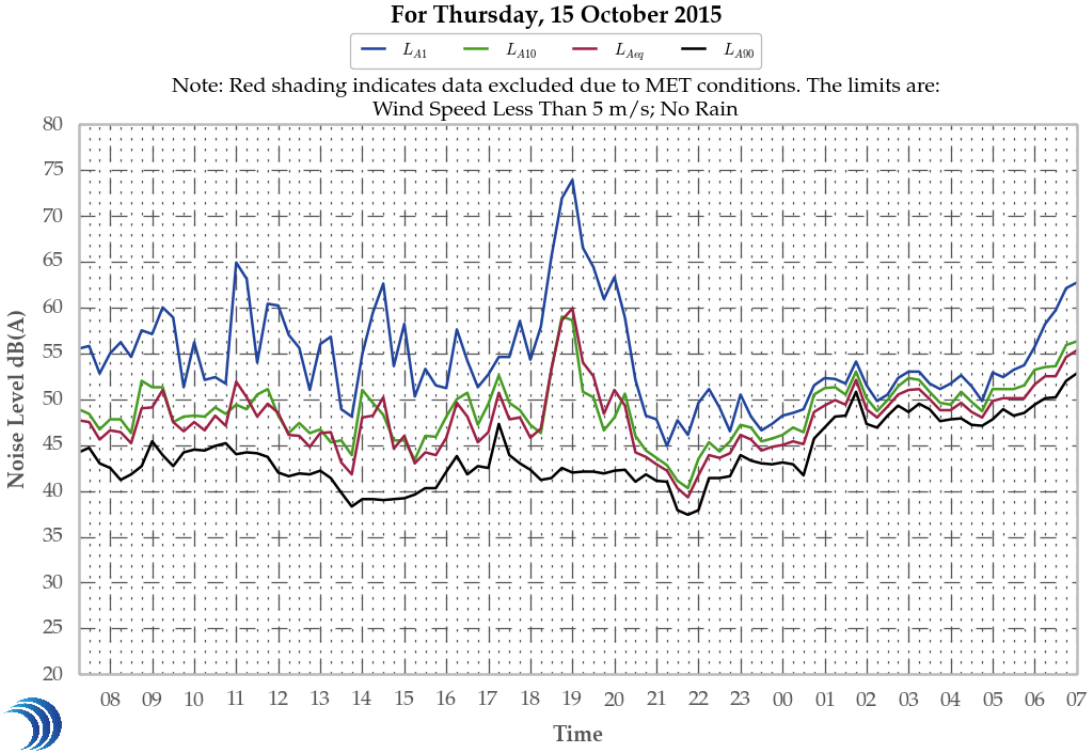
APPENDIX

B LOGGER GRAPHS

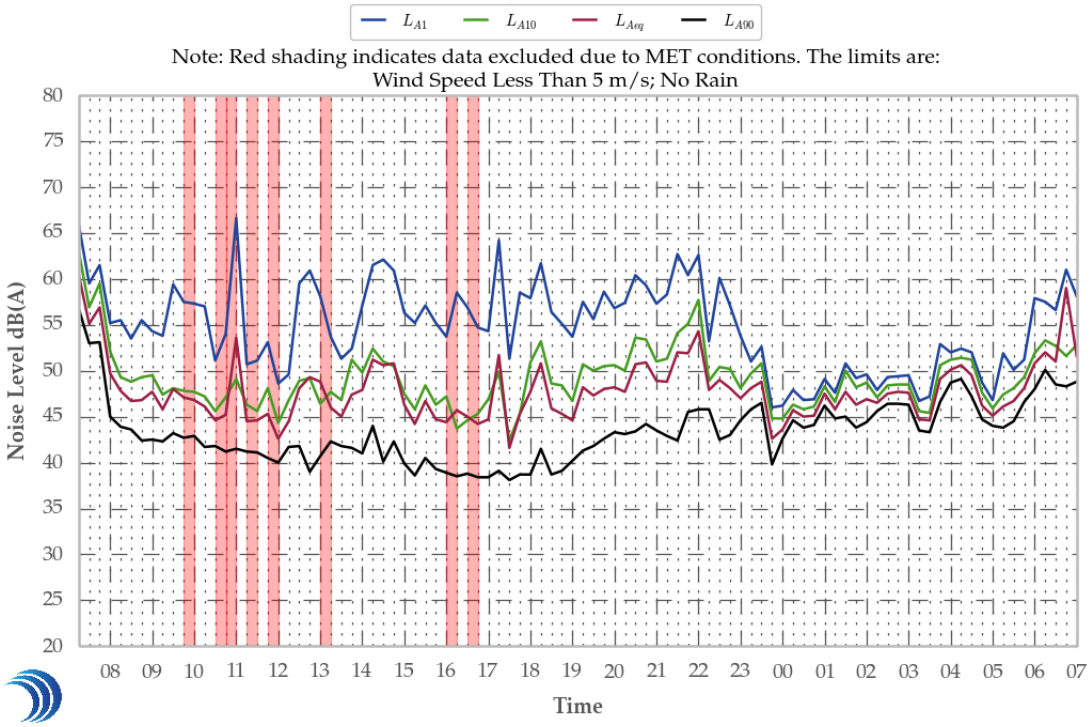
Environmental Noise Levels at Oberon Caravan Park
For Wednesday, 14 October 2015



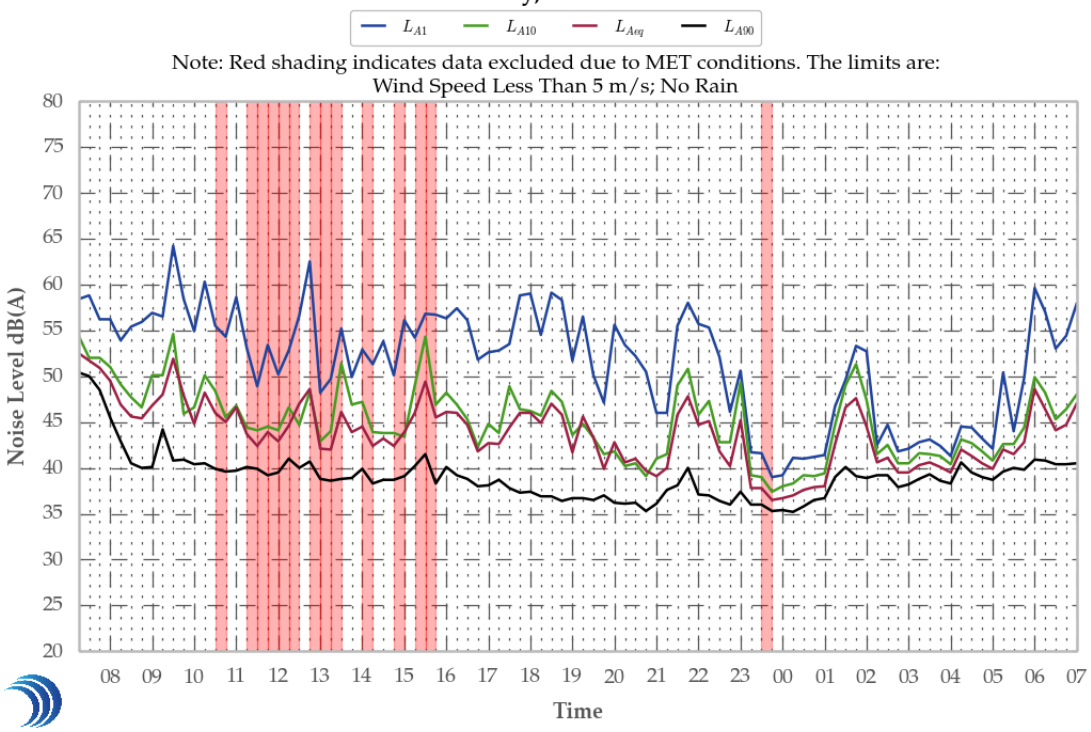
Environmental Noise Levels at Caravan Park
For Thursday, 15 October 2015



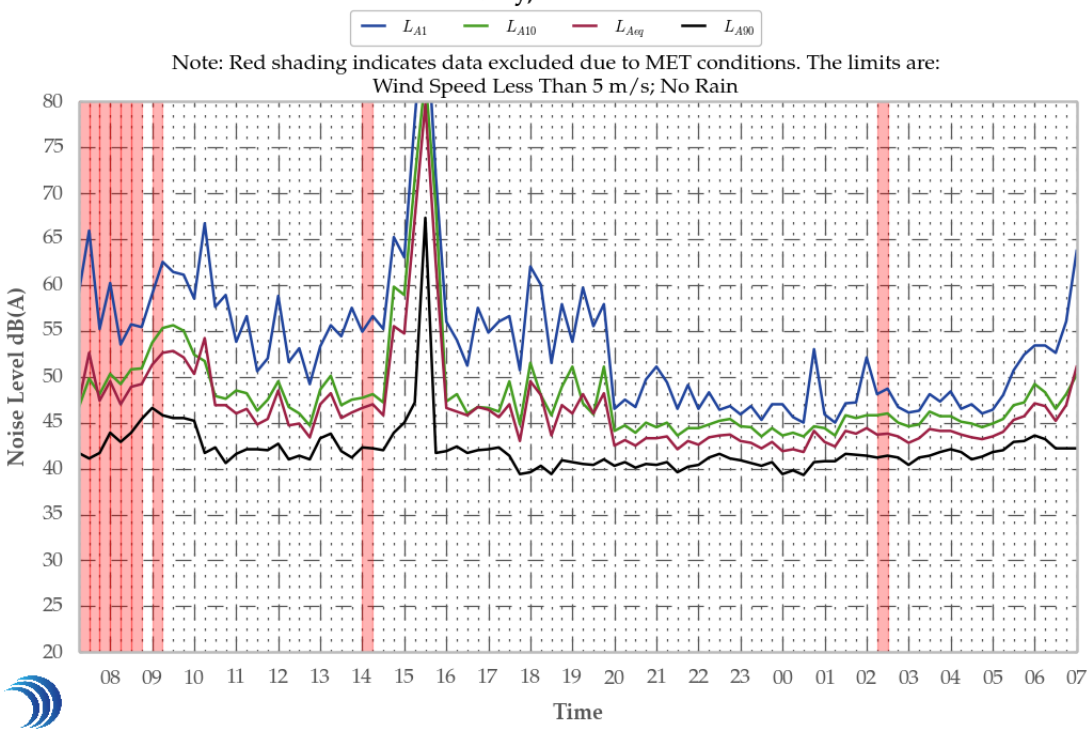
Environmental Noise Levels at Caravan Park
For Friday, 16 October 2015



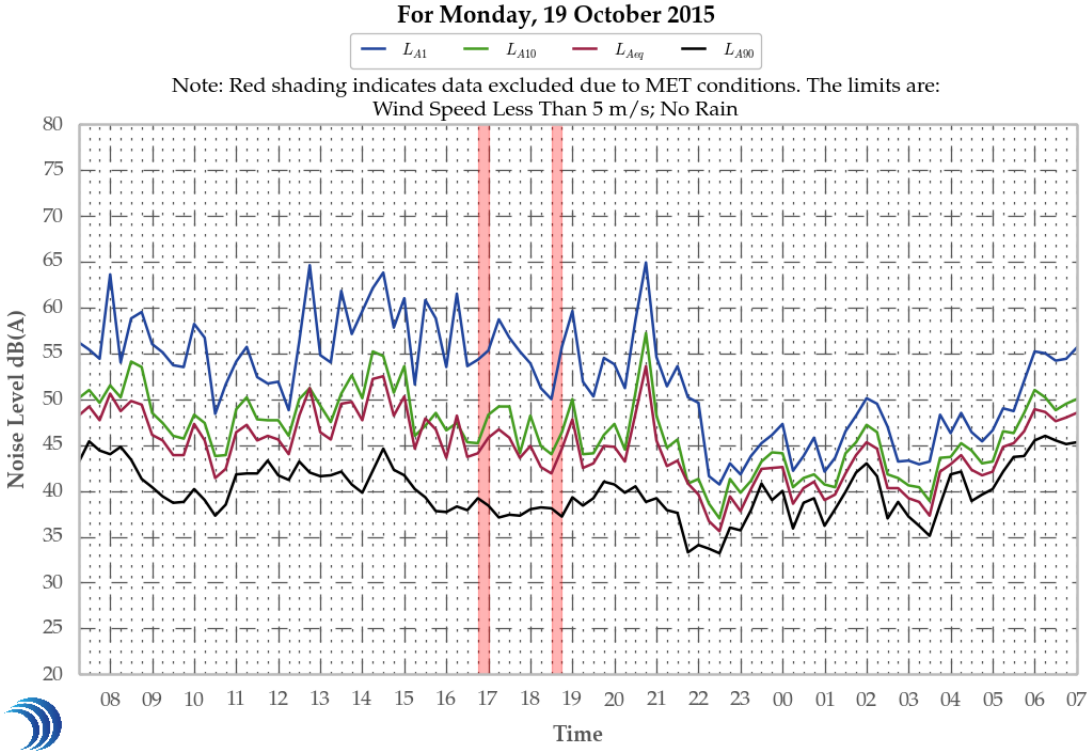
Environmental Noise Levels at Caravan Park
For Saturday, 17 October 2015



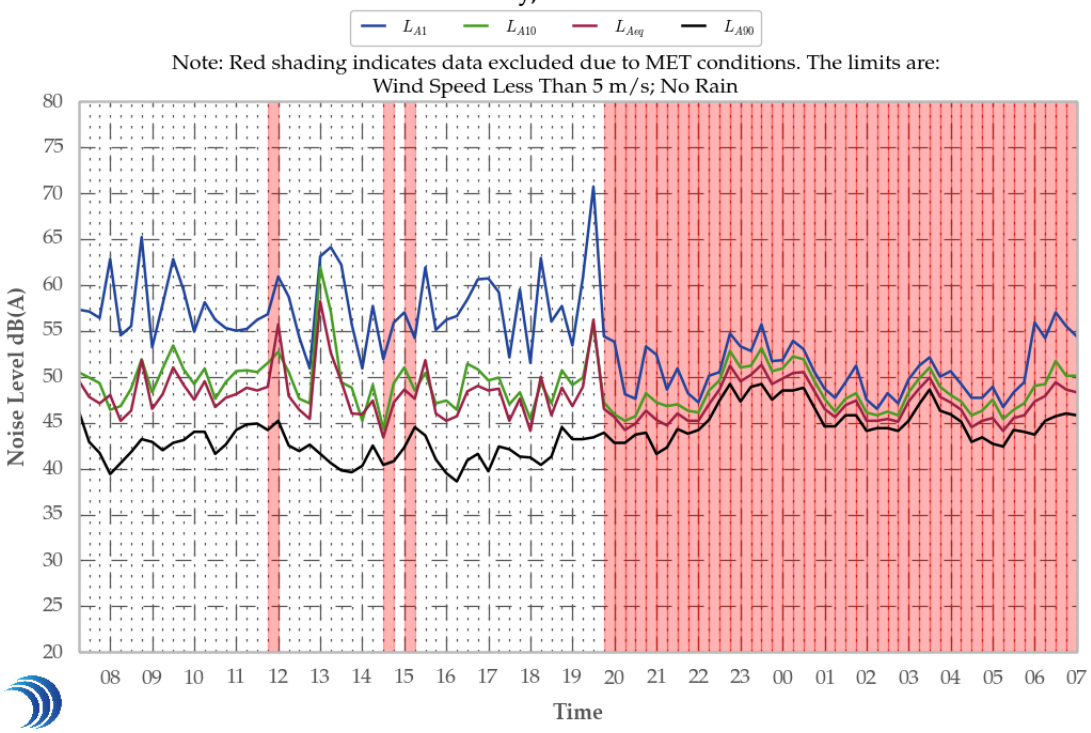
Environmental Noise Levels at Caravan Park
For Sunday, 18 October 2015



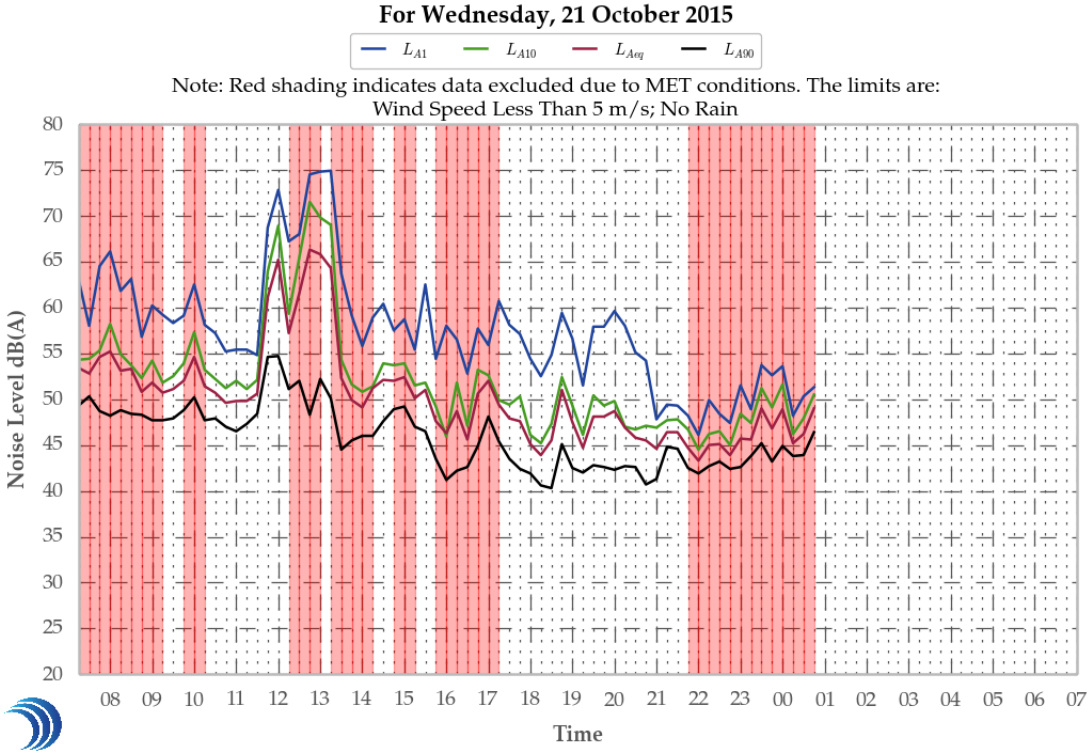
Environmental Noise Levels at Caravan Park
For Monday, 19 October 2015

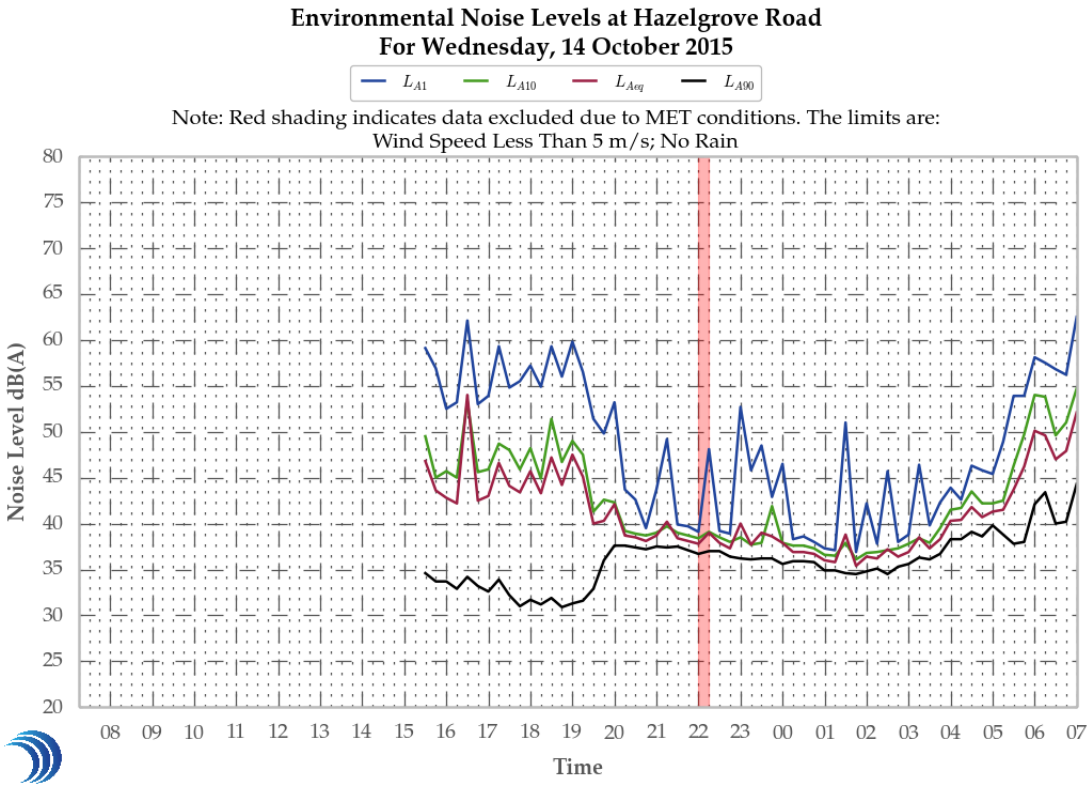


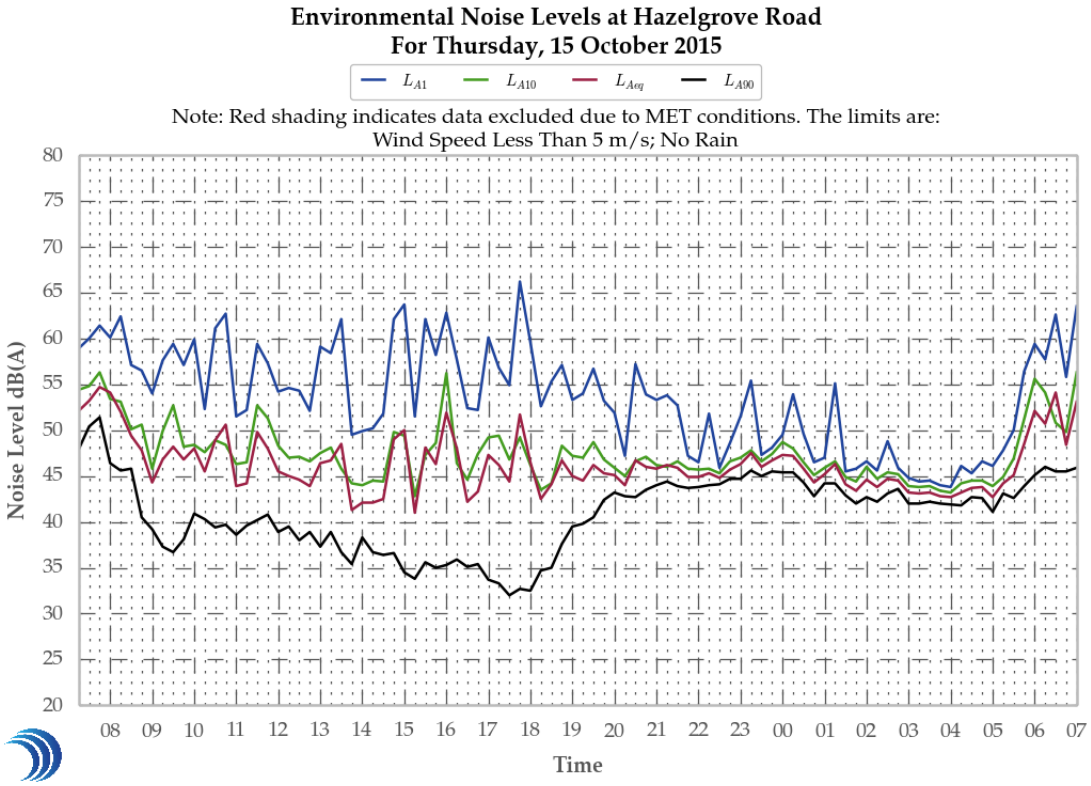
Environmental Noise Levels at Caravan Park
For Tuesday, 20 October 2015



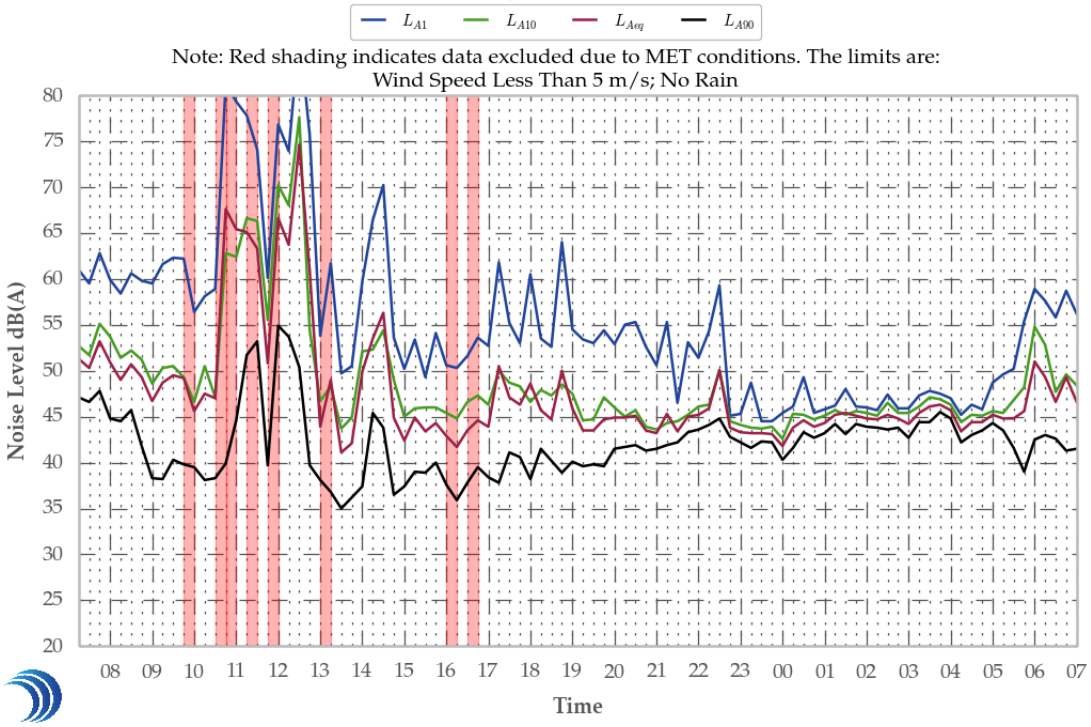
Environmental Noise Levels at Caravan Park
For Wednesday, 21 October 2015



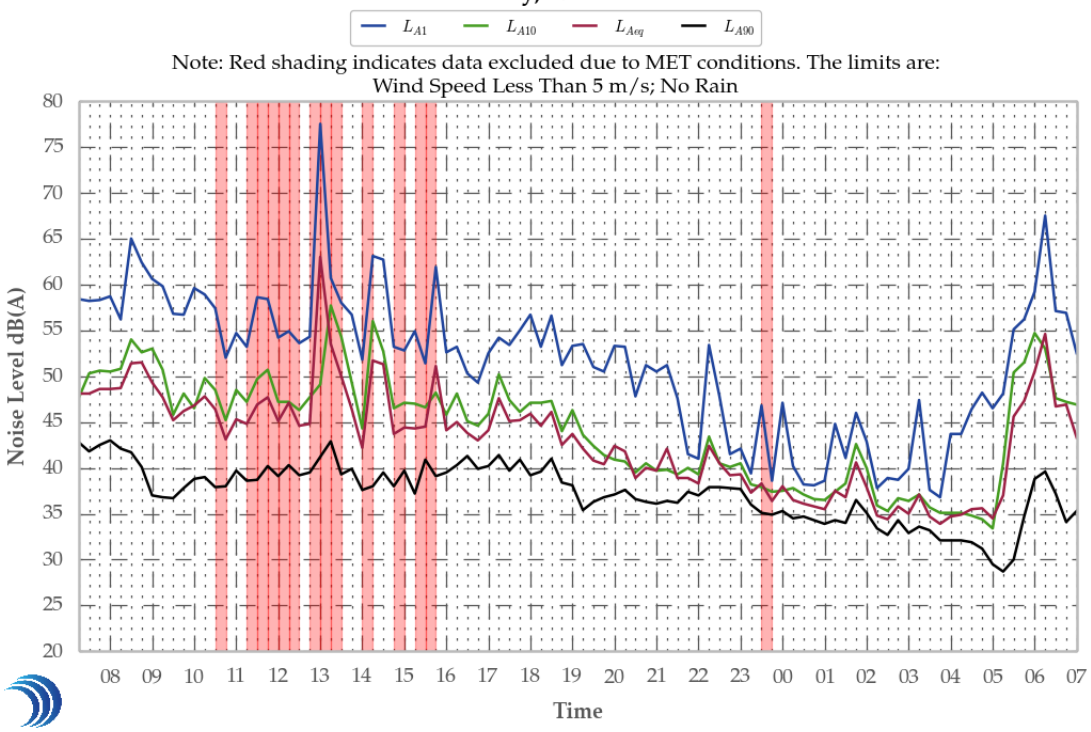

Environmental Noise Levels at Hazelgrove Road
For Wednesday, 14 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time


Environmental Noise Levels at Hazelgrove Road
For Thursday, 15 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time

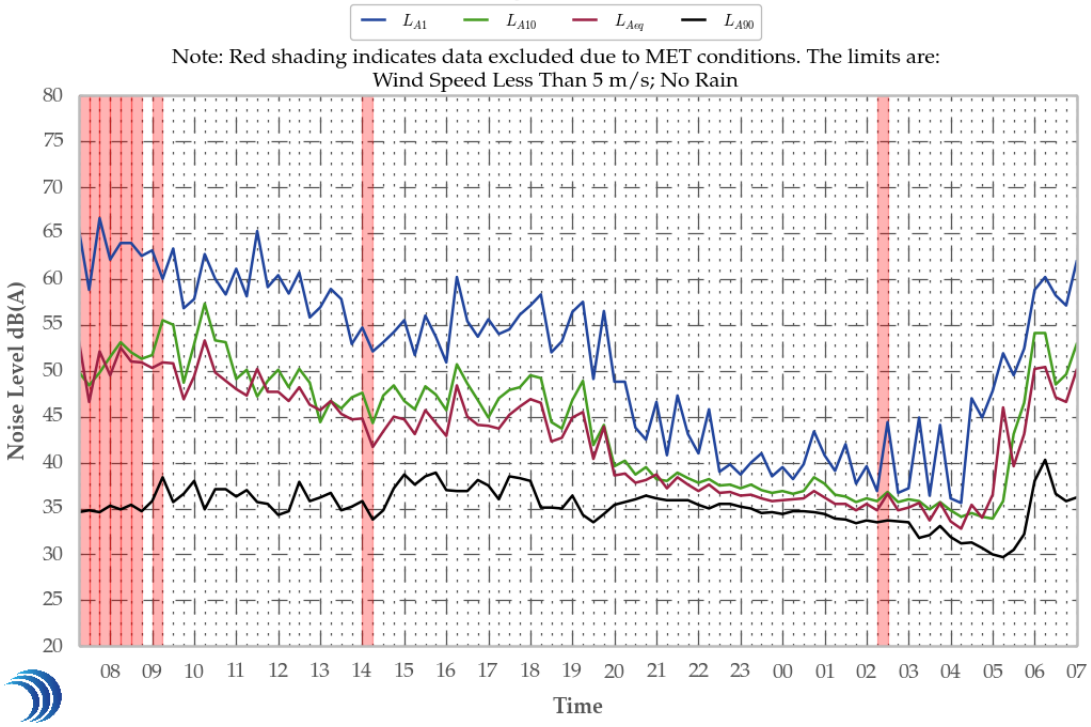
Environmental Noise Levels at Hazelgrove Road
For Friday, 16 October 2015



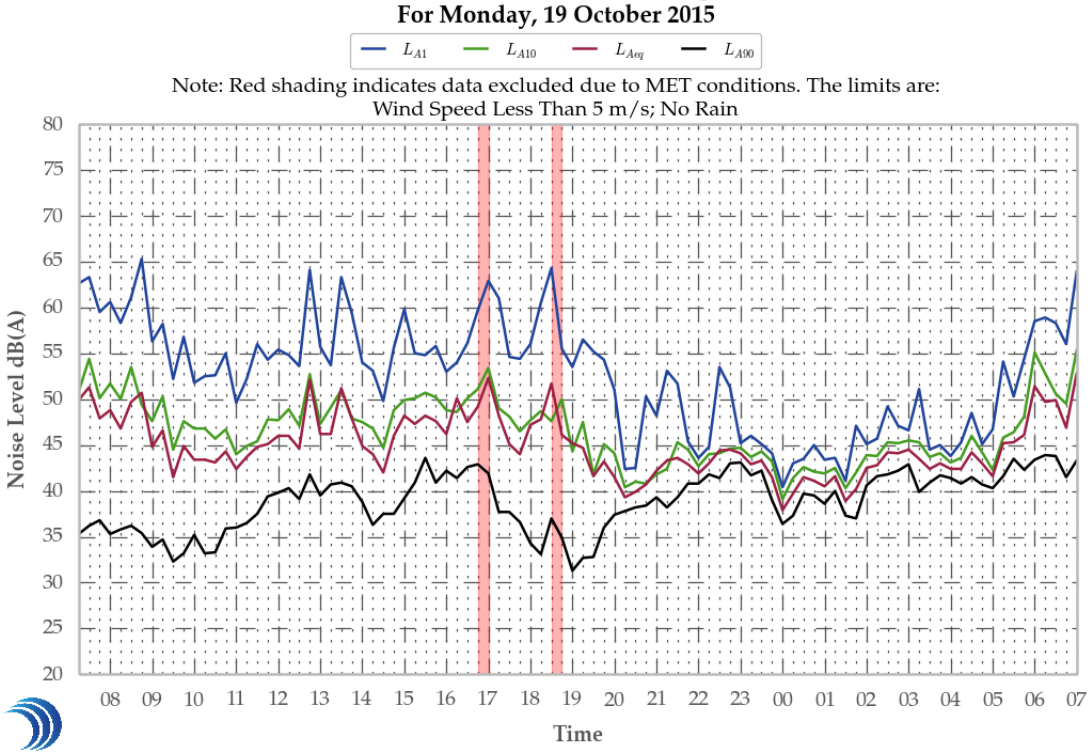
Environmental Noise Levels at Hazelgrove Road
For Saturday, 17 October 2015

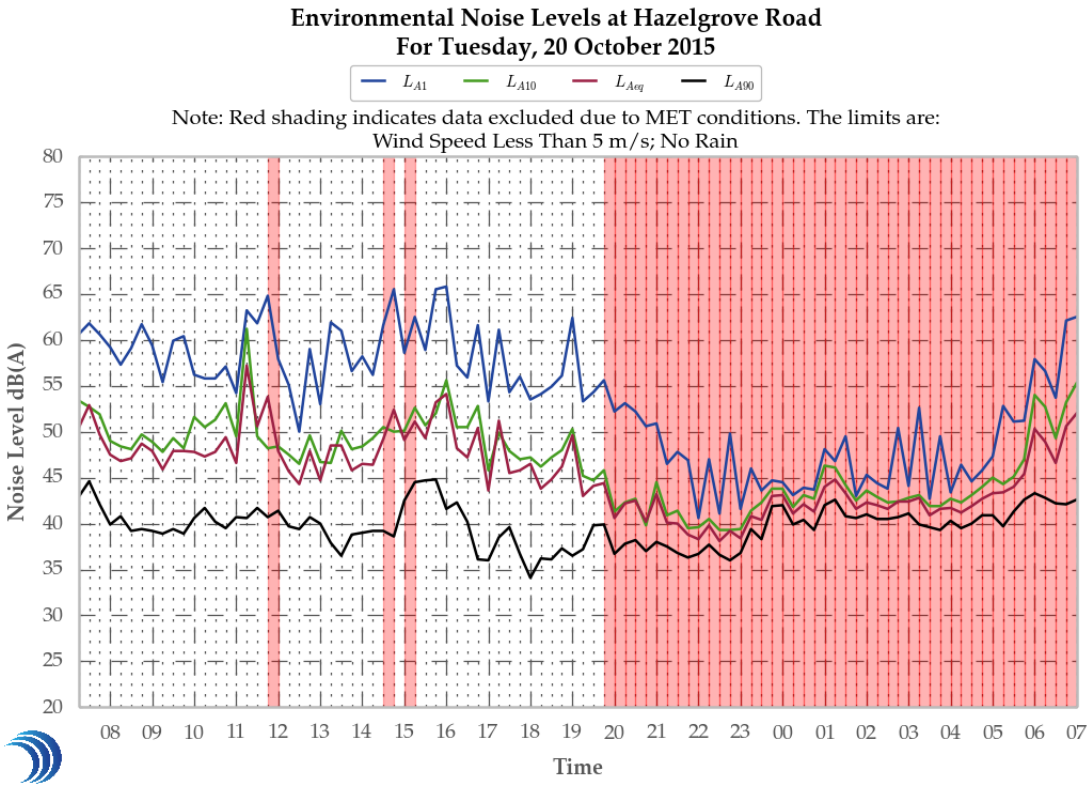


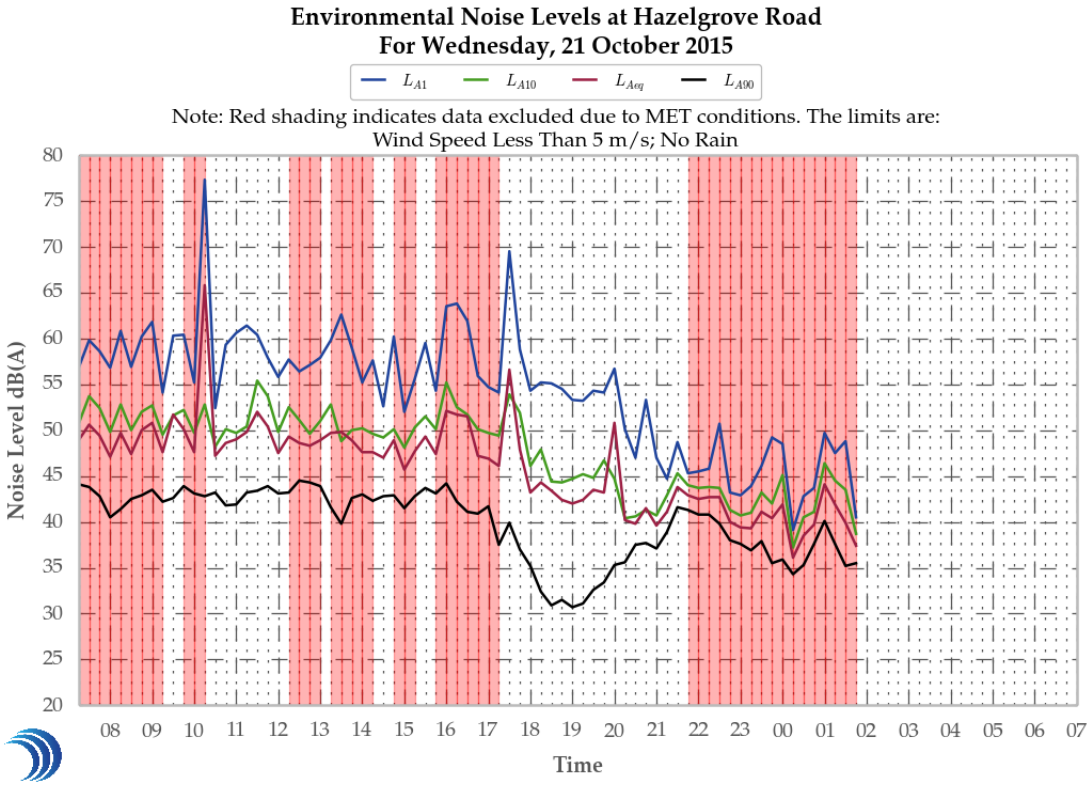
Environmental Noise Levels at Hazelgrove Road
For Sunday, 18 October 2015

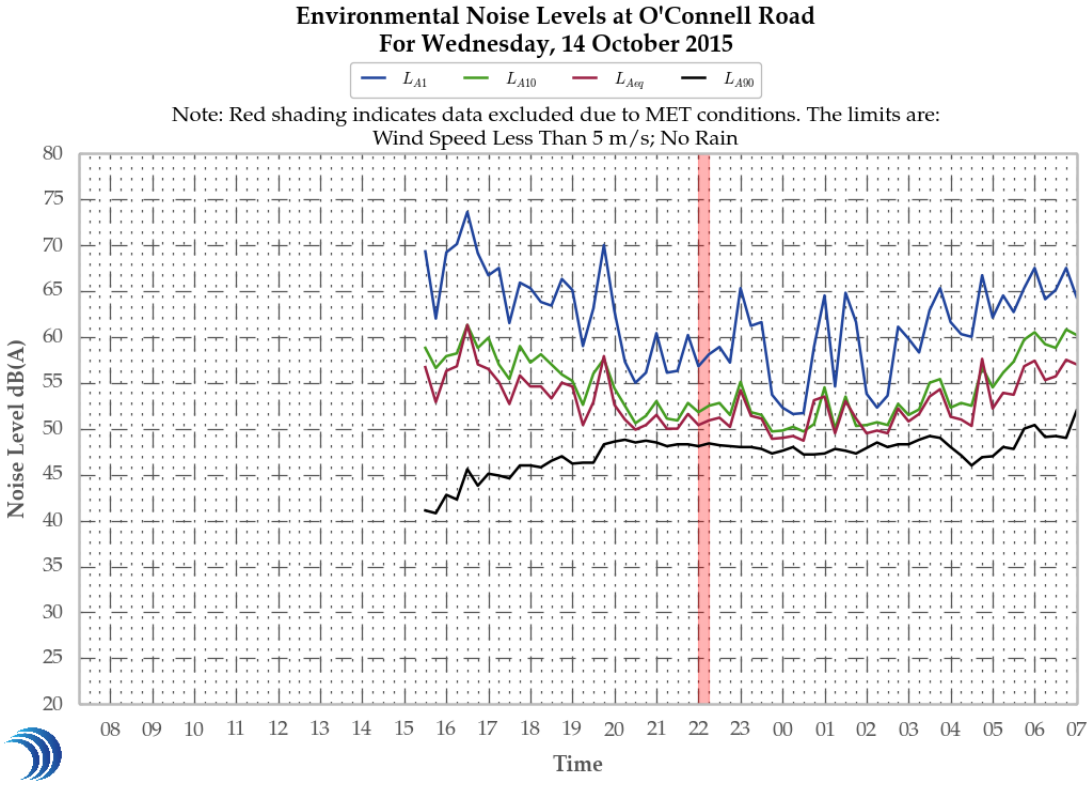


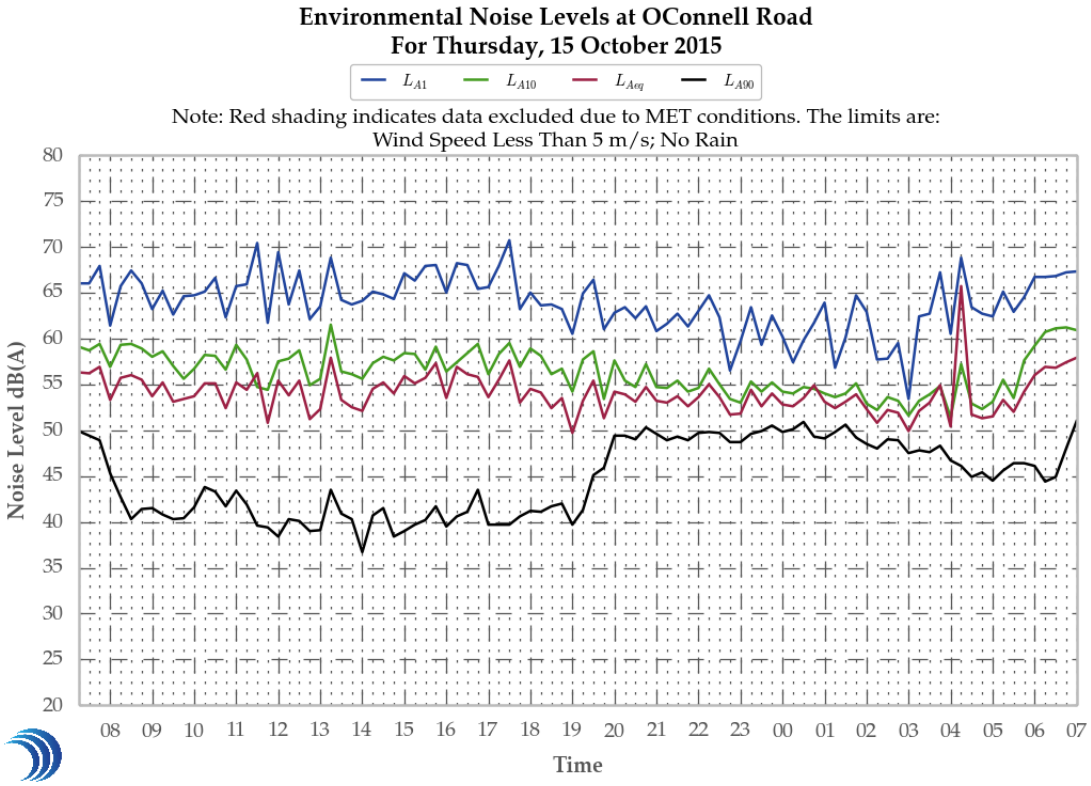
Environmental Noise Levels at Hazelgrove Road
For Monday, 19 October 2015

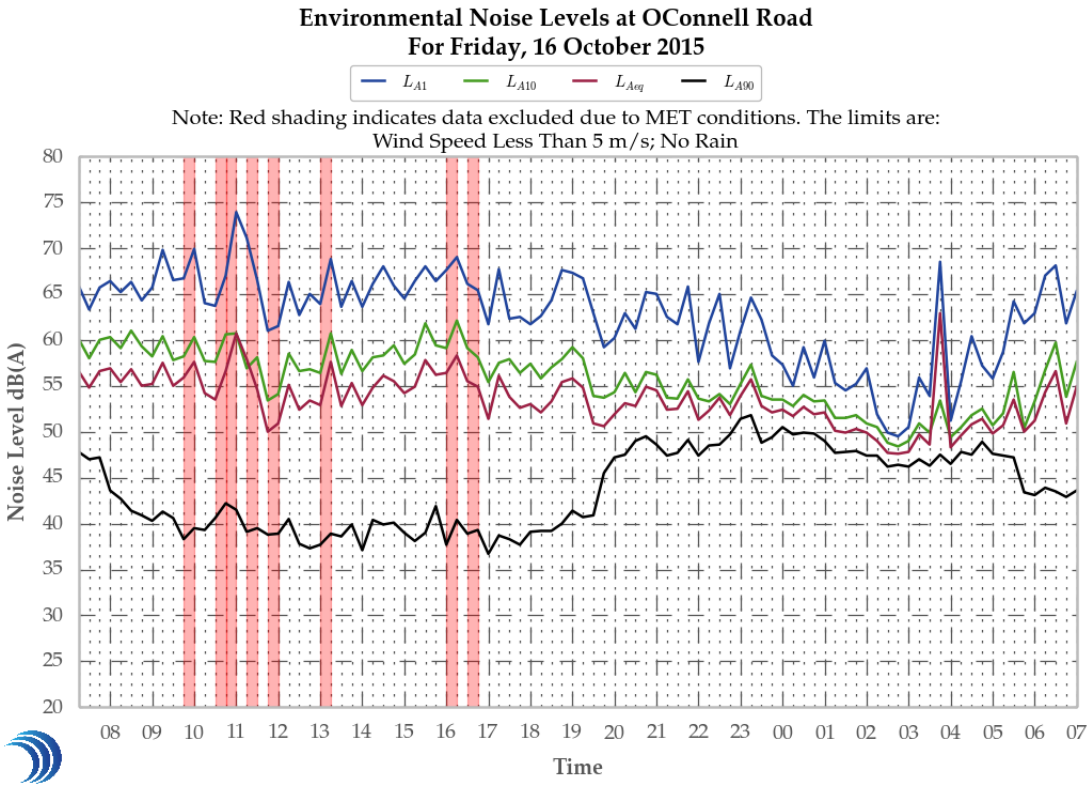


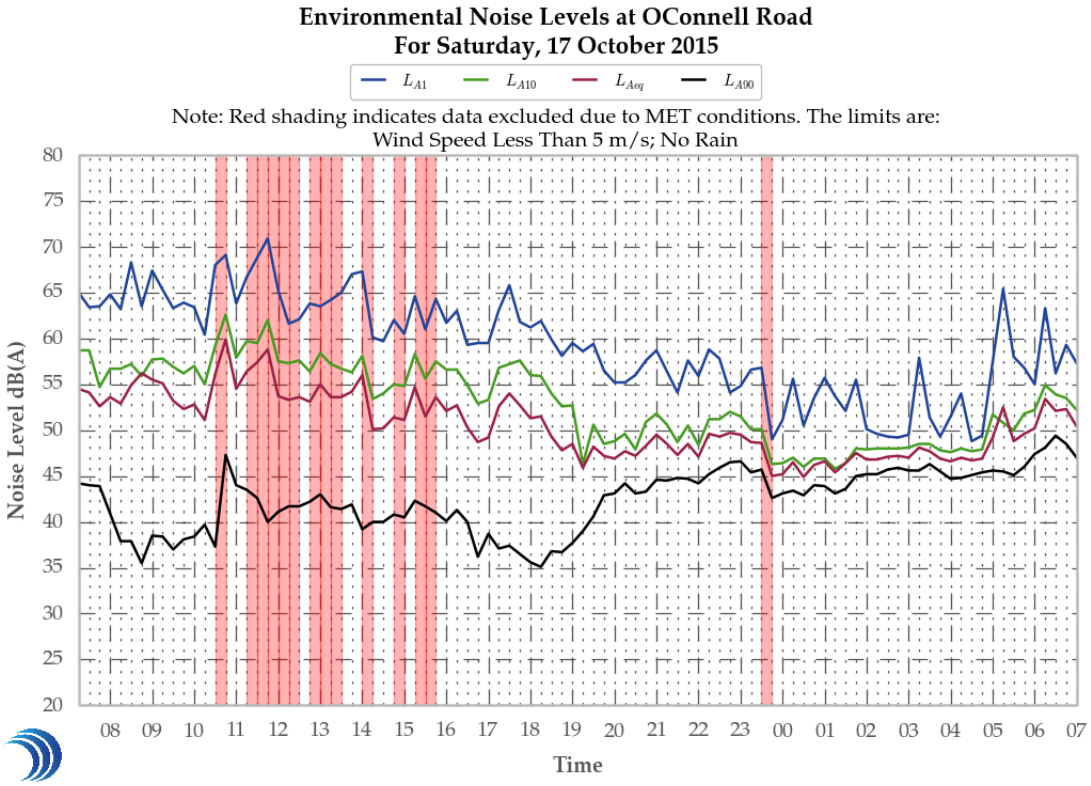

Environmental Noise Levels at Hazelgrove Road
For Tuesday, 20 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time

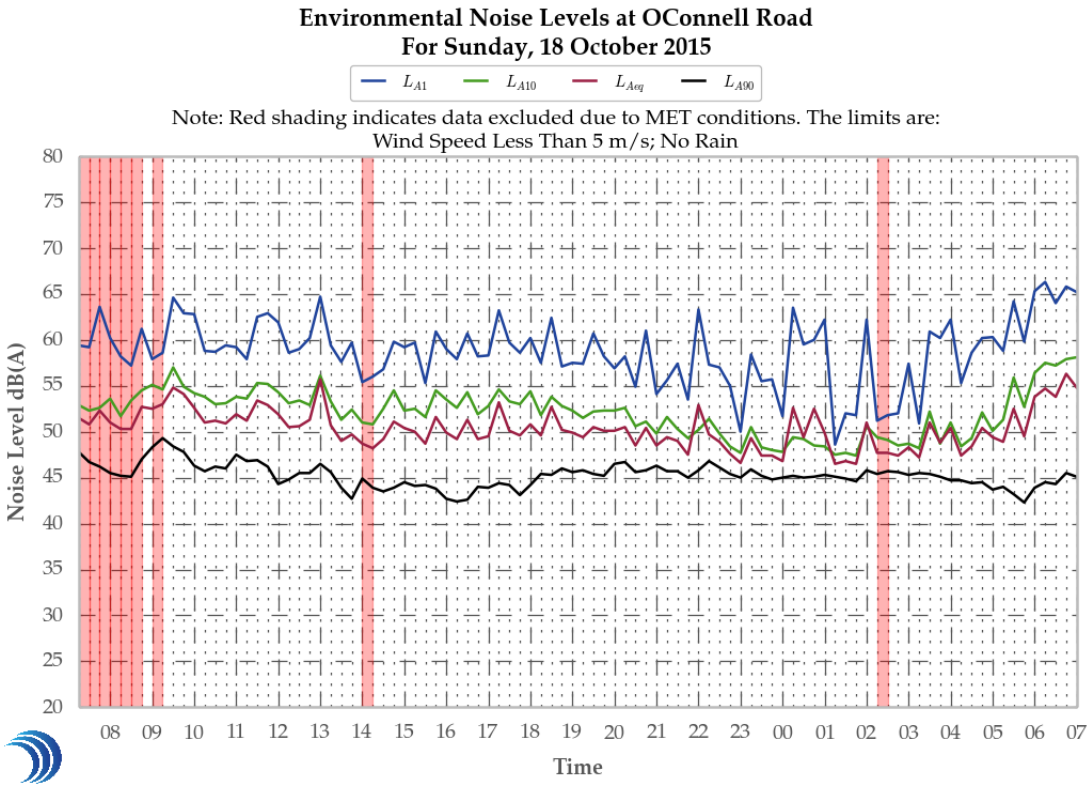

Environmental Noise Levels at Hazelgrove Road
For Wednesday, 21 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time

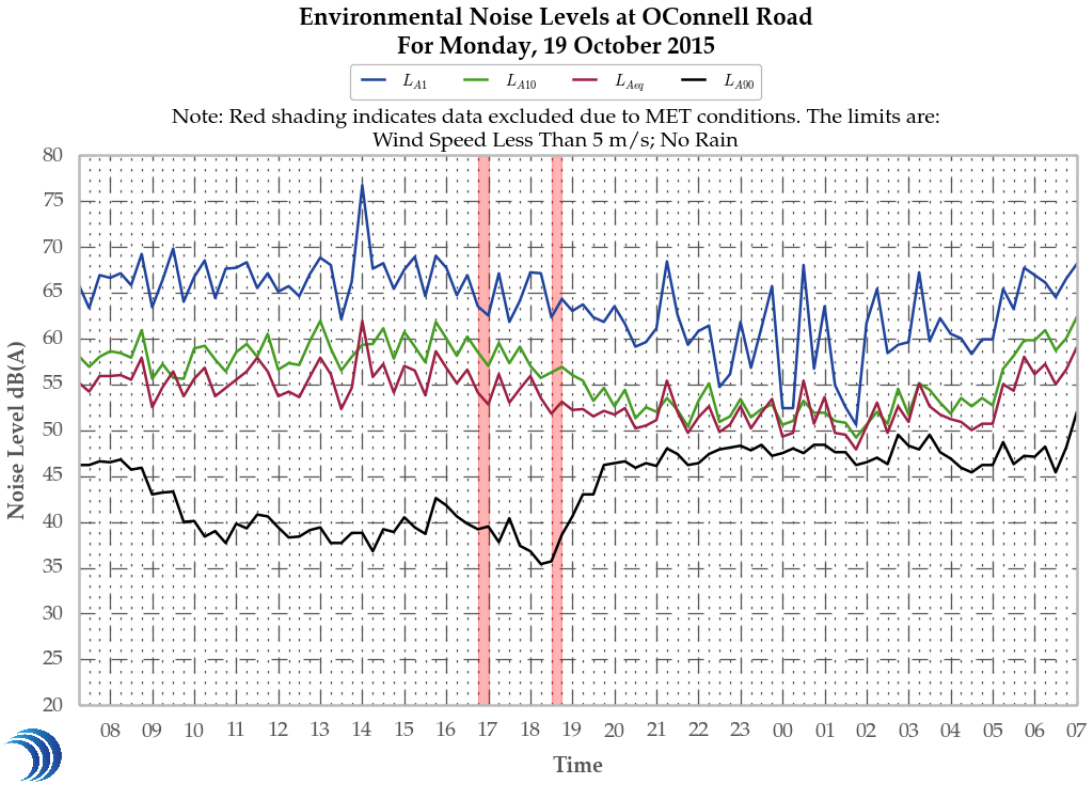

Environmental Noise Levels at O'Connell Road
For Wednesday, 14 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time

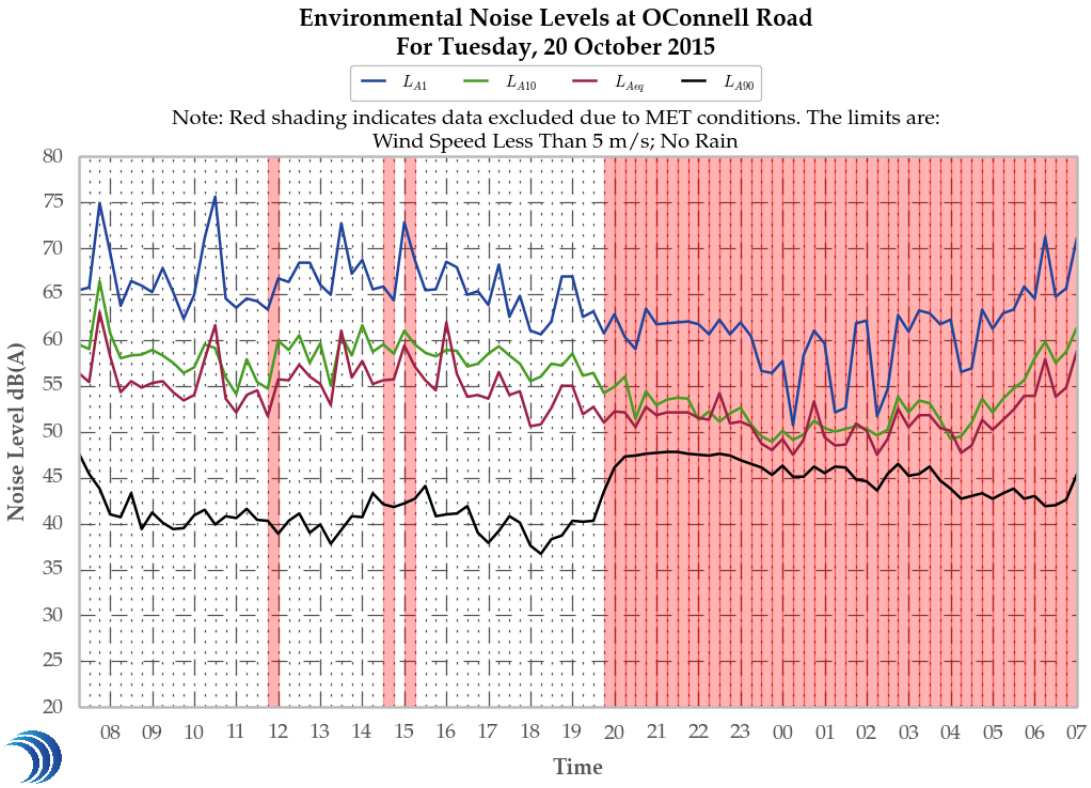

Environmental Noise Levels at OConnell Road
For Thursday, 15 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time

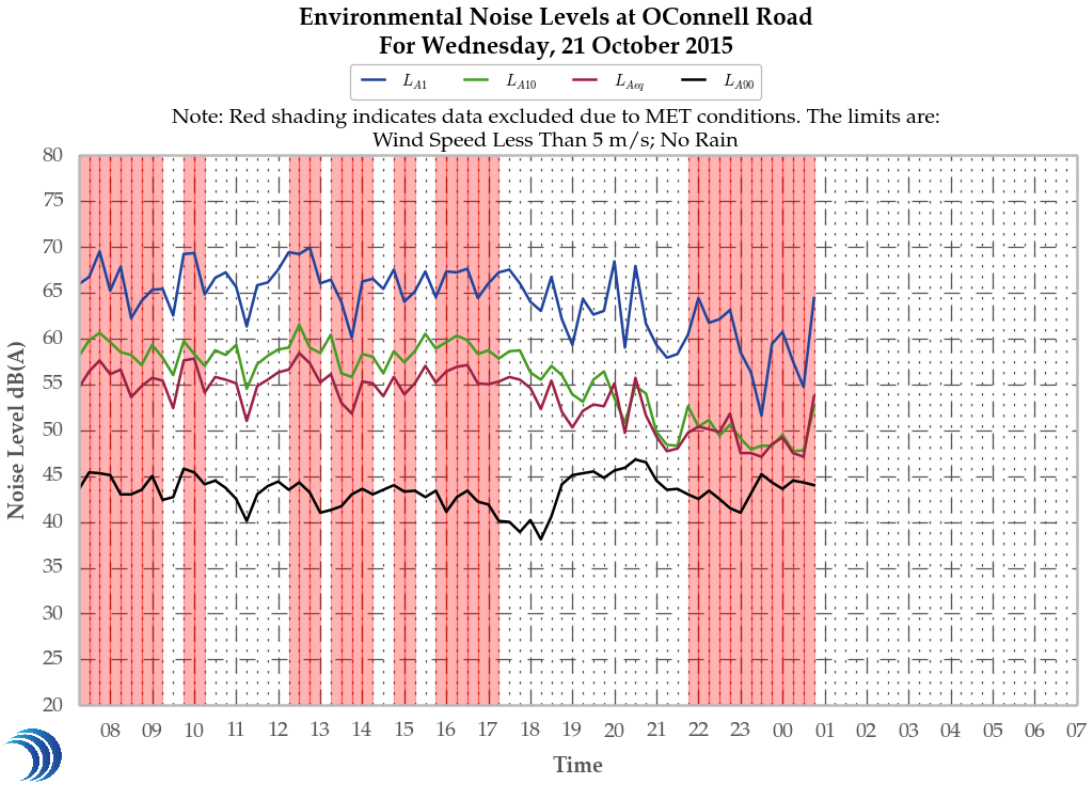

Environmental Noise Levels at OConnell Road
For Friday, 16 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time


Environmental Noise Levels at OConnell Road
For Saturday, 17 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time

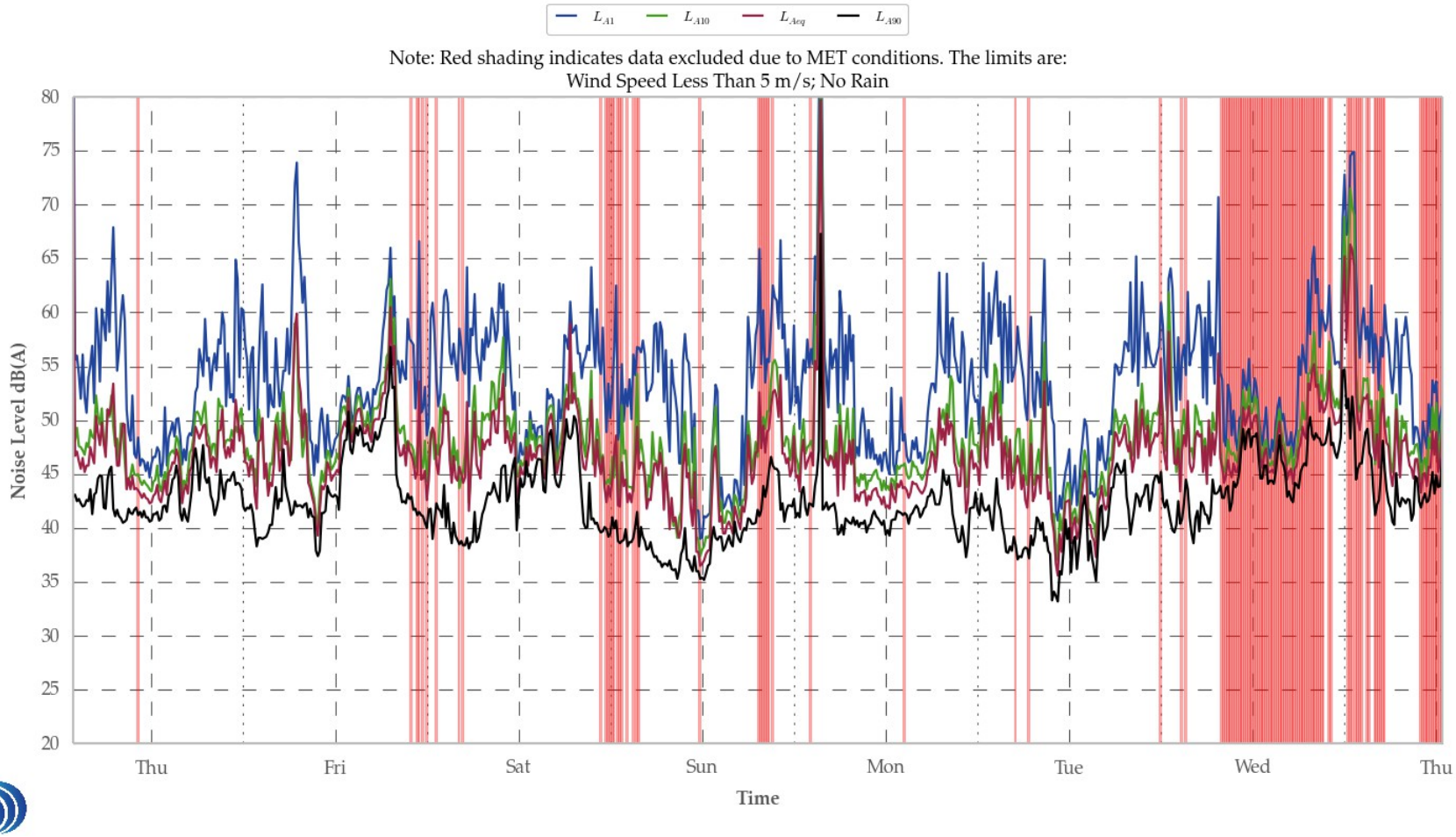

Environmental Noise Levels at OConnell Road
For Sunday, 18 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time


Environmental Noise Levels at OConnell Road
For Monday, 19 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time


Environmental Noise Levels at OConnell Road
For Tuesday, 20 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time


Environmental Noise Levels at OConnell Road
For Wednesday, 21 October 2015
L_{A1} L_{A10} L_{Aeq} L_{A90}
Note: Red shading indicates data excluded due to MET conditions. The limits are:
Wind Speed Less Than 5 m/s; No Rain
Noise Level dB(A)
80 75 70 65 60 55 50 45 40 35 30 25 20
08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00 01 02 03 04 05 06 07
Time

Environmental Noise Levels at Caravan Park
For 14 October 2015 to 22 October 2015



APPENDIX

C SOURCE LOCATION FIGURES

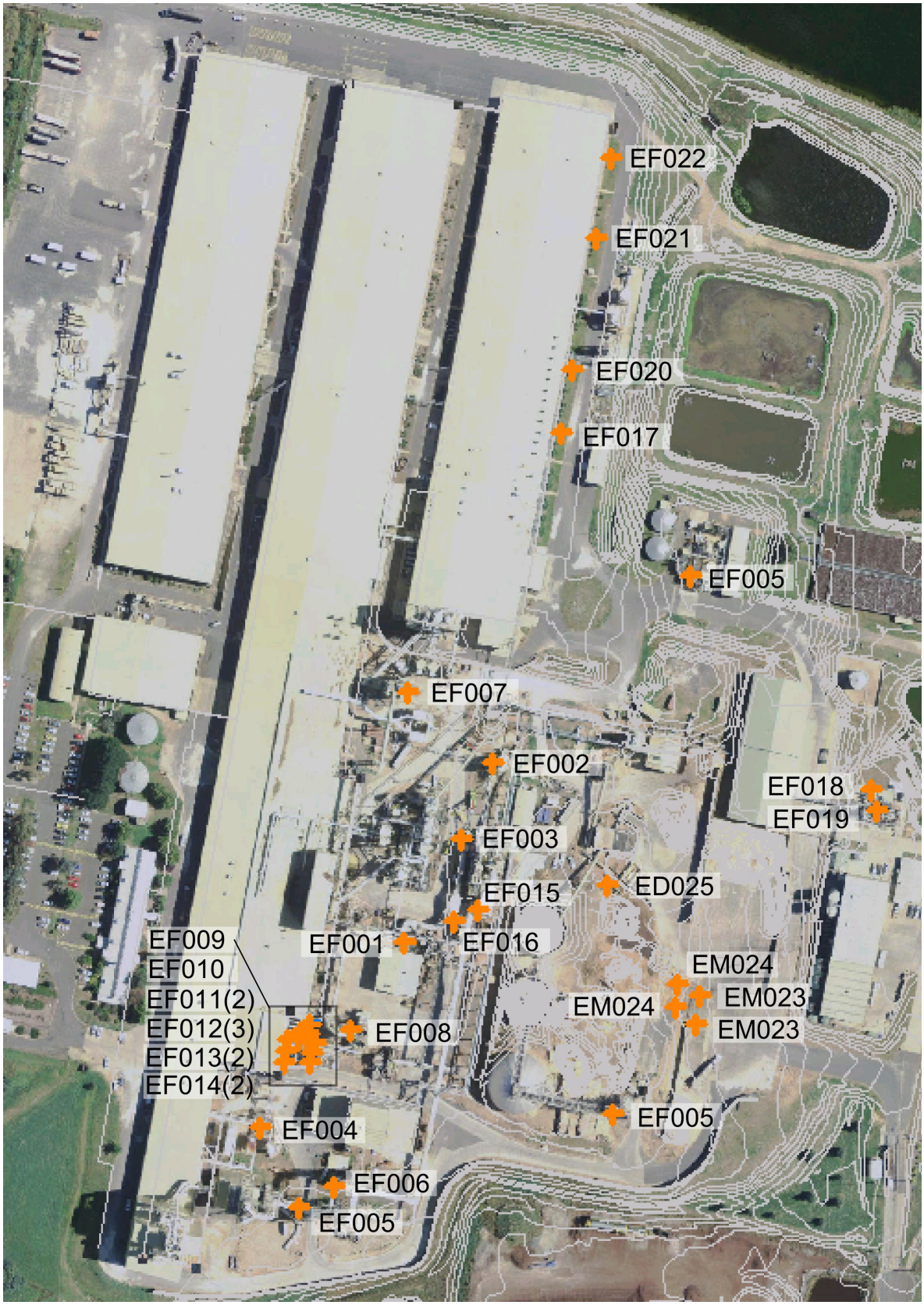


Figure C.1: Modelled Source Locations, Existing Site

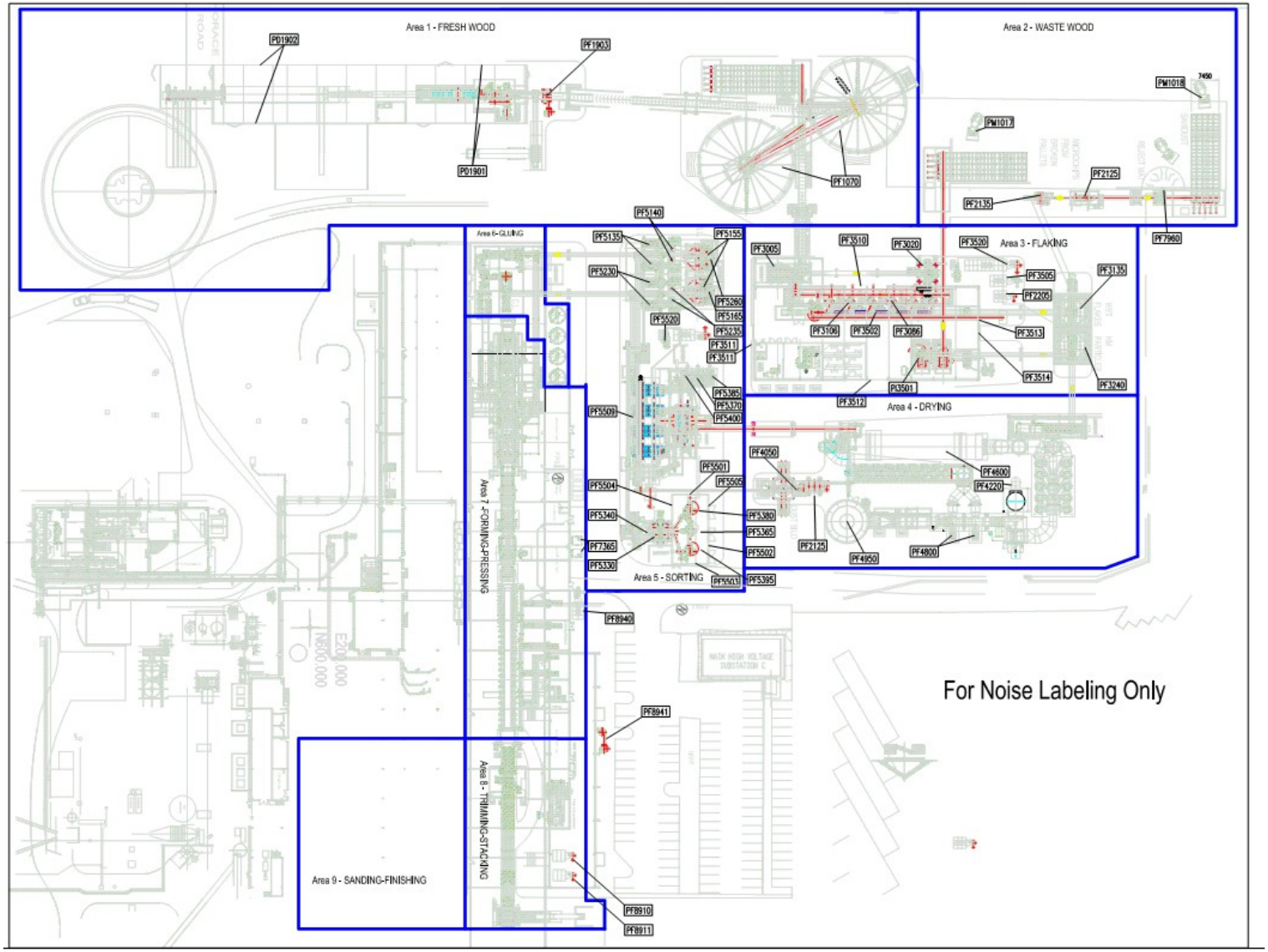


Figure C.2: Modelled Source Locations, Proposed Sources