ADDENDUM REPORT

WILKINSON MURRAY

KEMBLA GRANGE RESOURCE RECOVERY FACILITY

50 WYLLIE ROAD, KEMBLA GRANGE

NOISE AND VIBRATION ASSESSMENT
RWDI # 2104404.04
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1 INTRODUCTION

Kembla Grange Recycling Pty Ltd (Kembla Grange Recycling) is the operator of the Kembla Grange Resource Recovery Facility, which has been successfully operating at 50 Wyllie Rd in Kembla Grange (Lot 10 DP 878167) since 2013. In May 2017, Bingo Property Pty Ltd took ownership of the land and facility.

On 7 March 2016, approval was provided under State Significant Development SSD5300 to expand the facility's capacity to receive up to 230,000 tonnes per annum of construction, demolition, commercial, and industrial wastes. Subsequently, two modifications to the consent were approved to relocate a second weighbridge, enable installation of a larger weighbridge office, establish an indoor processing plant and outdoor picking station and for additional fire safety works including additional water storage and a pump room.

Bingo Industries is seeking to harmonise operational hours across its network of resource recovery facilities, and to enable operations in line with the 24/7 consent approval of their Eastern Creek Recycling Ecology Park. As such, Kembla Grange Recycling is seeking a planning consent modification (the Modification Proposal) to extend operations from day only to 24 hours. This would enable more efficient use of the Kembla Grange facility to sort, pre-process, and accept material during the day, whilst transporting sorted material to the Eastern Creek facility in the evenings and nights. Sorting is not expected to occur during the evening and night periods.

No changes are sought to waste receival tonnages, overall traffic volumes, infrastructure, or existing buildings.

RWDI Australia was engaged by Jackson Environment and Planning Pty Ltd to conduct a noise and vibration assessment to support the Modification Proposal. This report provides an assessment of operational noise and vibration effects associated with the proposed evening and night operations, including traffic noise on the local road network.

The assessment has been conducted in general accordance with the following policies:

- *Noise Policy for Industry (NPfI)* (Environment Protection Authority, 2017); and
- *NSW Road Noise Policy (RNP)* (NSW Department of Environment, Climate Change and Water, 2011).

As no changes are proposed to the infrastructure and buildings on site, construction noise was not addressed as part of the assessment.

No significant sources of vibration have been identified for the proposed evening and night operations. Therefore, a detailed assessment of potential vibration impacts is not considered necessary.

2 PROPOSED DEVELOPMENT MODIFICATION DESCRIPTION

The Modification Proposal is sought primarily for broadening the operational hours under the development consent.

Current approved operational hours are as follows:

- Deliveries and operation of machinery: 7:00 am to 6:00 pm Monday to Saturday and 8:00 am to 4:00 pm Sundays;
- All other operational activities: 6:00 am to 6:00 pm Monday to Saturday, and 8:00 am to 4:00 pm Sundays; and
- Closed public holidays.

The existing and proposed operational hours are summarised in **Table 1**.

Table 1: Existing and Proposed Operational Hours

Hours	Currently Approved	Proposed
Deliveries and Operational		
Monday – Saturday	7:00 am – 6:00 pm	24-hours
Sunday	8:00 am – 4:00 pm	24-hours
No times on public holidays	NA	NA
Other Operational		
Monday – Saturday	6:00 am – 6:00 pm	24-hours
Sunday	8:00 am – 4:00 pm	24-hours
No times on public holidays	NA	NA

During the proposed evening and night hours, the equipment proposed to be operating on site would consist of a front-end loader, an excavator, and heavy vehicle movements for load out activities only. No waste sorting and processing will occur between the hours of 6:00 pm and 7:00 am Monday through Saturday, and between 4.00 pm and 8.00 am on Sundays.

Figure 1 shows a layout of the existing facility.

No changes are sought to overall traffic volumes or the overall numbers of vehicles arriving and departing from the facility. Under the proposed new hours, it is expected one 20 tonne semi-trailer and one 30 tonne truck and dog would access the facility every hour. The evening and night truck movements would replace all existing truck movements associated with product collection during the day. Trucks would access the site from the Princes Motorway, using Northcliffe Drive, Princes Highway, West Dapto Road, and Wyllie Road.

No changes are sought to waste receival tonnages or existing buildings.

The Modification Proposal also seeks to allow for the receival of a small number of additional waste "categories" including:

- Non-chemical waste generated from manufacturing services (including metal, timber, paper, ceramics, plastics, thermosets and composites);
- Glass, plastic, rubber, plasterboard, ceramics, bricks, concrete or metal; and
- Office and packaging waste (including paper, plastics, glass, metal, timber) that is not contaminated or mixed with any other type of waste.

Whilst individually the waste types in the above categories are approved for receival under SSD5300 (with the exception of thermosets and composites and rubber), Bingo Industries are seeking to harmonise the broader definition of waste categories that can be received across its network of resource recovery facilities. These waste materials will be received and sorted in accordance with existing waste management practices. No changes are sought to waste receival tonnages, overall traffic volumes or existing buildings. As such, no impacts are expected from this amendment.

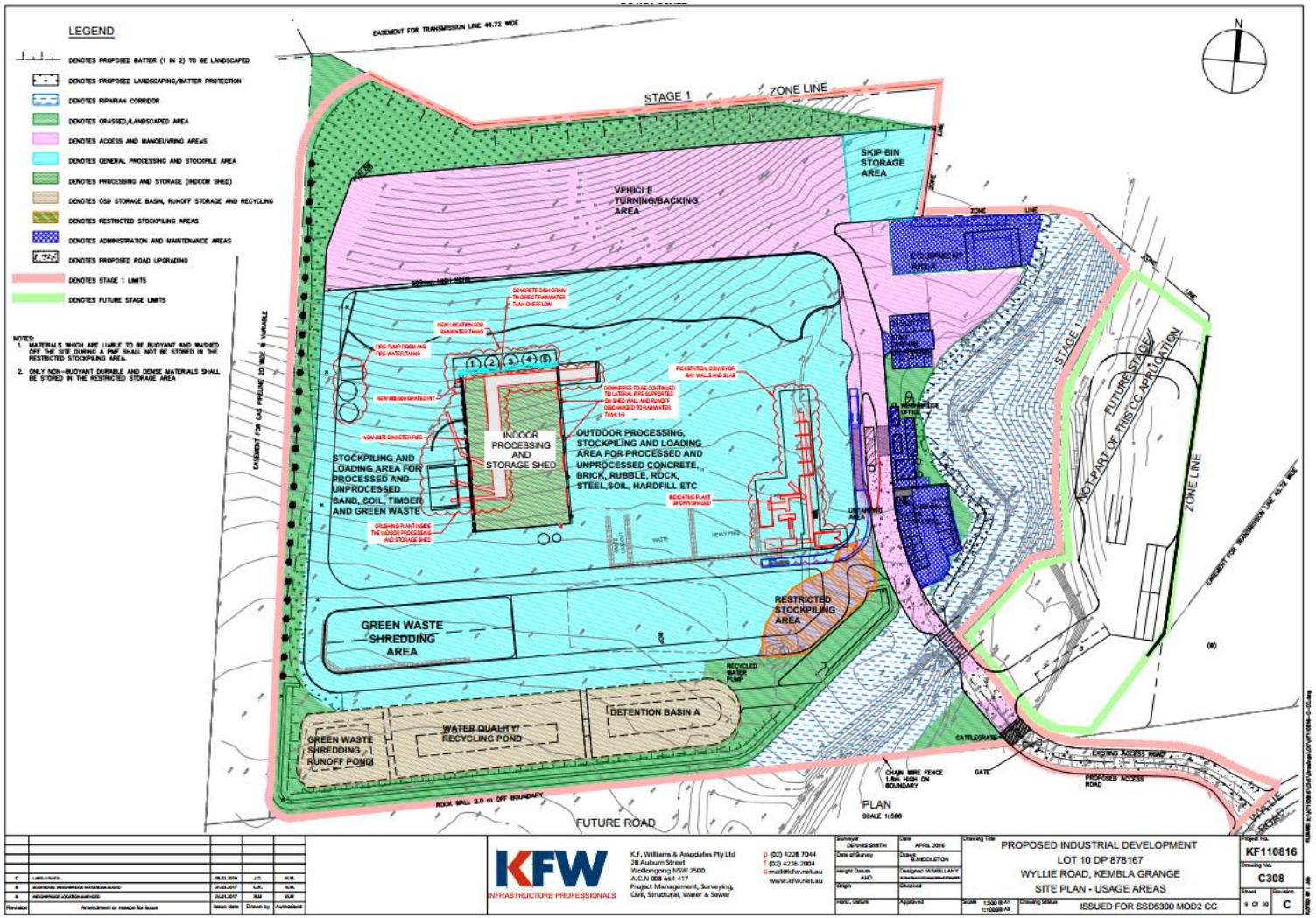

Figure 1: Kembla Grange Resource Recovery Facility Site Layout

3 NOISE SENSITIVE RECEIVERS

The Kembla Grange Resource Recovery Facility is located at 50 Wyllie Rd in Kembla Grange (Lot 10 DP 878167). The noise sensitive receivers identified for the assessment of noise generated by the facility are summarised in **Table 2** and shown in **Figure 2**. Compliance at those receivers would infer compliance at all surrounding noise sensitive receivers.

Table 2: Noise-Sensitive Receivers – Operational Noise Assessment

Receiver ID	Receiver Type	Approx. Distance to Proposed Site Activities	Address / Description
R1	Residential	530 m	6 Bardess Crescent, Farmborough Heights
R2	Residential	500 m	55 Fairloch Avenue, Farmborough Heights
R3	Residential	500 m	65 Fairloch Avenue, Farmborough Heights
R4	Residential	950 m	421 Princes Highway, Kembla Grange
R5	Residential	1,290 m	14A Kingston Town Drive Kembla Grange
R6	Accommodation	460 m	Farmborough Heights Rural Fire Brigade Station
R7	Place of worship	560 m	Macedonian Church Sveta Petka
R8	Active recreation area	620 m	Sir Ian McLennan Oval
R9	Industrial premises	170 m	Veolia Water Technologies
R10	Industrial premises	200 m	Dapto Patrick Autocare - East carpark

Note:
m = metres

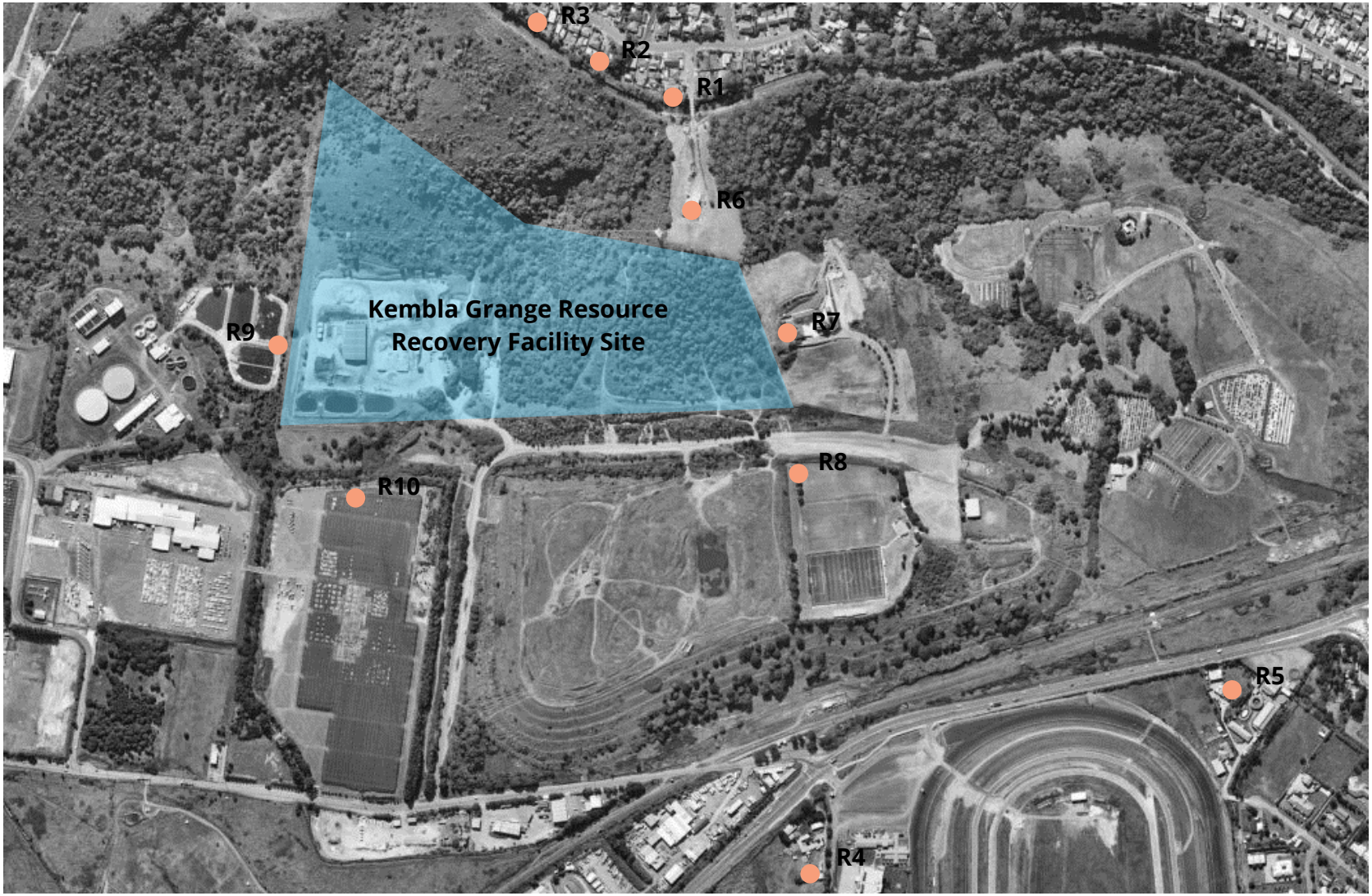

Figure 2: Kembla Grange Resource Recovery Facility Site and Surrounding Receivers

4 OPERATIONAL NOISE CRITERIA

4.1 Development Consent SSD5300 Assessment Criteria

The site is subject to an existing development consent (SSD5300) which prescribes operational noise criteria for the day (7:00 am – 6:00 pm) and morning shoulder (6:00 am – 7:00 am). The development consent noise criteria are summarised in **Table 3**.

Table 3: Development Consent Noise Criteria

Receiver	Noise Criteria		
	Day ($L_{Aeq,15min}$)	**Morning Shoulder** ($L_{Aeq,15min}$)	**Morning Shoulder** ($L_{Aeq,1min}$)
Macedonian Church Sveta Petka	35	35	45
Any dwelling in Farmborough Heights	37	37	47
Any dwelling in the vicinity of Kingston Town Drive	41	41	51

Notes:
Day = 7:00 am – 6:00 pm; Morning Shoulder = 6:00 am – 7:00 am

The Modification Proposal seeks to extend the loading and transportation of sorted material between the hours of 6:00 pm and 7:00 am. As such, the development consent noise criteria for the morning shoulder are relevant to the assessment.

4.2 Noise Policy for Industry

The *Noise Policy for Industry (NPfI)* provides a framework for assessing environmental noise impacts from industrial premises and industrial development proposals in New South Wales.

The *NPfI* recommends the development of Project Noise Trigger Levels (PNTLs), which provide a benchmark for assessing a proposal or site. The PNTLs should not be interpreted as mandatory noise criteria but, rather, as noise levels that, if exceeded, would indicate a potential noise impact on the community.

The PNTL is the lower value of the project intrusiveness noise level and the project amenity noise level. The project intrusiveness noise level assesses the likelihood of noise being intrusive above the ambient noise level and is applied to residential receivers only. The project amenity noise level ensures the total industrial noise from all sources in the area does not rise above a maximum acceptable level.

4.2.1 Project Intrusiveness Noise Levels

The intrusiveness noise level is the noise level 5 dB above the Rating Background Level (RBL) for each time period of interest (day, evening or night) at a residential receiver. The RBL is derived from the measured L_{A90} noise levels (see Glossary of Acoustics Terminology in **Appendix A**).

Intrusiveness noise levels for the Modification Proposal are based on RBLs measured as part of the background noise survey conducted for the Modification 2 application (*Kembla Grange RRF – Revised Noise Assessment*, GHD, October 2018). **Table 4** presents the RBLs measured at the identified residential receiver R1 and the corresponding project intrusiveness noise levels, for the evening and night periods relevant to the Modification Proposal. These were conservatively used for all residential receivers surrounding the facility.

Table 4: Project Intrusiveness Noise Levels – Residential Receivers

	Evening	Night
RBLs	31	30*
Project Intrusiveness Noise Levels ($L_{Aeq,15min}$)	36	35

Notes:

* The night RBL at R1 was measured at 26 dBA. However, a minimum assumed RBL of 30 dBA was used instead as recommended by the *NPfI*.

Evening = 6:00 pm – 10:00 pm; Night = 10:00 pm – 7:00 am

4.2.2 Project Amenity Noise Levels

Project amenity noise levels aim to set a limit on continuing increases in noise levels from all industrial noise sources affecting a variety of receiver types; that is, the ambient noise level in an area from all industrial noise sources remains below recommended amenity noise levels.

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include transportation noise (when on public transport corridors). The amenity noise level aims to limit continuing increases in noise levels which may occur if the intrusiveness level alone is applied to successive developments within an area. The recommended amenity noise level represents the objective for total industrial noise at a receiver location. The project amenity noise level represents the objective for noise from a single industrial development at a receiver location. To prevent increases in industrial noise due to the cumulative effect of several developments, the project amenity noise level for each new source of industrial noise is set at 5 dB below the recommended amenity noise level.

Due to different averaging periods applicable to the $L_{Aeq,15min}$ and $L_{Aeq,period}$ noise descriptors, the values of project intrusiveness and amenity noise levels cannot be compared directly when identifying PNTLs (i.e. the most stringent values of each category). The *NPfI* stipulates that PNTLs should be expressed as $L_{Aeq,15min}$ values and provides the following method to convert $L_{Aeq,period}$ levels into $L_{Aeq,15min}$ levels: $L_{Aeq,15min} = L_{Aeq,period} + 3$ dB.

The project amenity noise levels for the relevant receiver types have been calculated from the recommended amenity noise levels set out in the *NPfI* and are presented in **Table 5**. It assumes the site is situated in an area which would be classified as "suburban" under the *NPfI*.

Table 5: Project Amenity Noise Levels ($L_{Aeq,15min}$)

Receiver Type	Evening	Night
Residential - Suburban	43	38
Accommodation - Suburban	48	43
Place of worship	48* (when in use)	
Active Recreation Area	53 (when in use)	
Industrial Premises	68 (when in use)	

Notes:

* Amenity noise level for places of worship expressed as internal noise levels in the *NPfI*. Because PNTLs used as part of the assessment are expressed as external noise levels, equivalent external amenity noise levels were established by adding 10 dB to the internal amenity noise levels (based on an outdoor-to-indoor noise level reduction of 10 dB with doors open)

Evening = 6:00 pm – 10:00 pm; Night = 10:00 pm – 7:00 am

4.2.3 Project Noise Trigger Levels

As described above, the PNTL is the lower value of the project intrusiveness noise level (applicable to residential receivers only) and the project amenity noise level. Based on the project intrusiveness noise levels provided in **Table 4** and project amenity noise levels presented in **Table 5**, **Table 6** summarises the PNTLs relevant to the Modification Proposal.

Table 6: Project Noise Trigger Levels ($L_{Aeq,15min}$)

Receiver Type	Evening	Night
Residential - Suburban	36	35
Accommodation - Suburban	48	43
Place of worship	48 (when in use)	
Active Recreation Area	53 (when in use)	
Industrial Premises	68 (when in use)	

Note:

Evening = 6:00 pm – 10:00 pm; night = 10:00 pm – 7:00 am

4.2.4 Trigger Levels for Maximum Noise Event Assessment

Noise events at night occurring over a short duration have the potential to cause sleep disturbance despite complying with PNTLs. As the facility is intended to operate at night, maximum noise level events need to be considered for potential sleep disturbance at all identified residential receivers.

In accordance with *NPfI*, maximum noise level events need only be considered for residential receivers. However, it is understood the Farmborough Heights Rural Fire Brigade Station provides accommodation to fire fighters at night and for this reason, it was also considered for the maximum noise level event assessment.

The *NPfI* recommends that, where the night-time L_{AFmax} noise levels from a development exceeds 52 dBA or the RBL plus 15 dB, whichever is the greater, then a more detailed assessment of potential sleep disturbance

impacts is warranted. In consideration of the above, the noise trigger level used for the maximum noise event assessment at the identified residential receivers and the Farmborough Heights Rural Fire Brigade Station is 52 dBA.

4.2.5 Modifying Factor Adjustments

4.2.5.1 Low-Frequency Noise

Where a noise source contains certain annoying characteristics, such as low-frequency noise, the *NPfI* states that a penalty should be applied to measured or predicted noise levels before comparing to the relevant PNTLs.

The *NPfI* provides a method of low-frequency noise assessment based on:

- overall 'C' weighted and 'A' weighted predicted or measured levels; and
- one-third octave predicted or measured levels in the range 10–160 Hertz (Hz).

Two penalties are nominated in the *NPfI*:

2 dB (evening and night)	if the C- minus A-weighted noise level over the same period is 15 dB or more, and where any of the third octave noise levels in **Table 7** are exceeded by up to and including 5 dB and cannot be mitigated.
2 dB (daytime) and 5 dB (evening and night)	if the C- minus A-weighted noise level over the same period is 15 dB or more, and where any of the third octave noise levels in **Table 7** are exceeded by more than 5 dB and cannot be mitigated.

Table 7: One-Third Octave Low-Frequency Noise Thresholds

Hz/dB(Z)	One-Third Octave $L_{Zeq,15min}$ Threshold Level												
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

4.2.5.2 Tonal Noise

According to the *NPfI*, a 5 dB penalty should be applied to tonal noise. The *NPfI* provides a method for determining tonal noise based on one-third octave band analysis.

A 5 dB penalty applies if the level of one-third octave band exceeds the level of the adjacent bands on both sides by:

- 5 dB or more if the centre frequency of the band containing the tone is in the range 500-10,000 Hz
- 8 dB or more if the centre frequency of the band containing the tone is in the range 160-400 Hz
- 15 dB or more if the centre frequency of the band containing the tone is in the range 25-125 Hz

5 OPERATIONAL NOISE ASSESSMENT

5.1 Computer Noise Model

Operational noise emissions associated with the Modification Proposal were modelled using the CadnaA acoustic noise prediction software and the CONCAWE noise prediction algorithm. The CONCAWE noise propagation model is used around the world and is widely accepted as an appropriate model for predicting noise over significant distances. Factors addressed in the noise modelling are:

- Equipment noise level emissions and locations;
- Shielding from ground topography and structures;
- Noise attenuation due to geometric spreading;
- Ground absorption;
- Atmospheric absorption; and
- Noise enhancing meteorology.

5.2 Meteorological Effects

At relatively large distances from a source, the resultant noise levels at receivers can be influenced by meteorological conditions, particularly temperature inversions and gradient winds. Where these factors are a feature of an area their effect on resultant noise levels should be taken into account.

The *NPfI* defines standard meteorological conditions and noise-enhancing meteorological conditions to be considered for the assessment. The definition of those conditions is provided in Table D1 of Fact Sheet D, which is reproduced in **Table 8** below.

Table 8: Standard and Noise-Enhancing Meteorological Conditions

Meteorological conditions	Meteorological parameters
Standard Meteorological Conditions	Day/evening/night: stability categories A-D with wind speed up to 0.5 m/s at 10 m AGL.
Noise-Enhancing Meteorological Conditions	Daytime/evening: stability categories A-D with light winds (up to 3 m/s at 10 m AGL). Night-time: stability categories A-D with light winds (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL.

Notes: m/s = metres per second; m = metres; AGL = above ground level; where a range of conditions is nominated, the meteorological condition delivering the highest predicted noise level should be adopted for assessment purposes. However, feasible and reasonable noise limits in consents and licences derived from this process would apply under the full range of meteorological conditions nominated under standard or noise-enhancing conditions as relevant. All wind speeds are referenced to 10m AGL. Stability categories are based on the Pasquill-Gifford stability classification scheme.

The *NPfI* provides two options when considering meteorological effects:

1. Conservatively adopt noise-enhancing meteorological conditions without processing meteorological data local to the site; or
2. Determine the significance of noise-enhancing meteorological conditions based on meteorological data local to the site and adopt significant noise-enhancing conditions for the assessment. Where noise-enhancing meteorological conditions are deemed non-significant, standard meteorological conditions may be adopted.

The first option was conservatively adopted for the noise assessment.

5.3 Operational Noise Sources

The major noise sources associated with the Modification Proposal are summarised in **Table 9.**

Table 9: Summary of Noise Sources

Noise Source	Location within Site	Assessment Period
1x 30 tonne excavator	Outdoor loading area for processed concrete, brick, rubble, rock, steel soil, hardfill, etc. (approx. 40 m east of the indoor processing and storage shed)	Evening, night and morning shoulder
1x 20 tonne front-end loader	Outdoor loading area for processed concrete, brick, rubble, rock, steel soil, hardfill, etc. (approx. 40 m east of the indoor processing and storage shed)	Evening, night and morning shoulder
Semi-trailer / truck and dog	Internal site road between gated entrance (off Wyllie Road) and the outdoor loading area for processed concrete, brick, rubble, rock, steel soil, hardfill, etc. (approx. 40 m east of the indoor processing and storage shed)	Evening, night and morning shoulder

Notes:
Evening = 6:00 pm – 10:00 pm; Night = 10:00 pm – 6:00 am; Morning shoulder = 6:00 am – 7:00 am

The noise assessment, where predictions are compared against PNTLs expressed as $L_{Aeq,15min}$ levels, is based on a typical "busy" 15-minute period. For assessment purposes, the excavator and front-end loader were assumed to be operating simultaneously and continuously for an entire 15-minute period. This is conservative as the excavator and front-end loader would operate solely for loading out trucks (i.e. no waste sorting and processing would occur between the hours of 6:00 pm and 7:00 am).

Based on the proposed traffic generation for the site, the noise model assumes two truck movements[1] (20 tonne semi-trailer or 30 tonne truck and dog) per 15-minute period. Provided the time taken to load each truck and the improbability of two trucks accessing the site at the same time, this is considered a conservative assumption.

[1] One movement = truck arrival or departure

Trucks were assumed to be travelling at 25 kilometres per hour (km/hr) between the gated site entrance (off Wyllie Road) and the loading area. For the rest of the time, during the loading process, trucks were conservatively assumed to be idling.

Table 10 provides typical sound power levels and spectra of the equipment, based on measurements previously conducted by RWDI. **Table 11** provides the same source levels with spectra in one-third octave band levels.

To add a level of conservatism and to account for potential scraping of bucket attachments on the hardstand and impact noise from heavy material (concrete, rocks, metal, etc.) being dumped into trucks, the nominated sound power levels for the excavator and front-end-loader each incorporate the equivalence of scraping/impact noise at a level of 115 dBA for a combined duration of 15 seconds in each 15-minute period. This assumes maximum noise level events ranging 110-117 dBA (**Section 5.6**) and the implementation of best work management practices to minimise noise (**Section 6**).

Table 10: Sound Power Levels and Spectra (Octave Band Levels)

Noise Source	Octave $L_{Zeq,15min}$ Levels								Broadband[1]		Reference
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	dBZ[2]	dBA[3]	
30 tonne excavator (typical operating cycle incorporating scraping/impact noise)	111.5	114.5	105.5	106.5	99.5	97.5	94.5	91.5	117.2	107.4	RWDI database
20 tonne front-end loader (typical operating cycle incorporating scraping/impact noise)	102.5	117.5	100.5	102.5	104.5	99.5	93.5	85.5	118.1	108.3	RWDI database
Semi-trailer / truck and dog stationary[4]	109	106	101	99	93	90	87	84	111	100	RWDI database
Semi-trailer / truck and dog travelling at 25 km/hr[4]	113	110	105	103	97	94	91	88	115	104	RWDI database

Notes:

1 Broadband level containing all frequencies between 20 Hz and 20 kHz

2 Unweighted level

3 Broadband A-weighted level

4 Semi-trailer and truck and dog are assumed to have the same sound power level and noise spectrum for the purpose of the assessment

Table 11: Sound Power Levels and Spectra (One-Third Octave Band Levels)

Noise Source	Octave $L_{Zeq,15min}$ Levels																							Broadband[1]	
	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	dBZ[2]	dBA[3]
30 tonne excavator	105.7	106.7	107.7	109.9	110.9	107.9	102.4	99.4	99.7	102.2	102.5	100.2	96.3	94.0	93.3	93.5	92.8	91.8	90.7	89.7	88.7	87.7	86.7	85.7	117.2	107.4
20 tonne front-end loader	91.0	96.0	101.0	110.5	115.5	109.8	98.5	92.8	93.5	97.0	97.7	98.4	99.8	100.5	98.8	96.3	94.6	92.6	90.6	88.6	85.9	82.9	80.2	77.5	118.1	108.3
Semi-trailer / truck and dog stationary	105	104	103	102	101	99	97	95	95	95	94	92	89	87	86	86	85	84	83	82	81	80	79	78	111	100
Semi-trailer / truck and dog travelling at 25 km/hr	109	108	107	106	105	103	101	99	99	99	98	96	93	91	90	90	89	88	87	86	85	84	83	82	115	104

Notes:

1 Broadband level containing all frequencies between 20 Hz and 20 kHz

2 Unweighted level

3 Broadband A-weighted level

4 Semi-trailer and truck and dog are assumed to have the same sound power level and noise spectrum for the purpose of the assessment

5.4 Assessment of Annoying Noise Characteristics

5.4.1 Low-Frequency Noise

A low-frequency noise assessment was conducted to ascertain whether any of the identified receivers should be subject to a modifying factor correction due to dominant low-frequency content.

A C-weighted noise level minus A-weighted noise level assessment was carried out to determine the potential presence of unbalanced spectra containing major components within the low-frequency range of the spectrum at receivers surrounding the Modification Proposal. The assessment was based on noise-enhancing meteorological conditions.

Table 12 summarises the C-weighted noise level minus A-weighted noise level assessment results.

Table 12: C- Minus A-Weighted Noise Levels

Receiver ID	$L_{Ceq,15min}$ Noise Level - $L_{Aeq,15min}$ Noise Level (dB)
R1	12.3
R2	14.5
R3	14.2
R4	13.8
R5	14.0
R6	14.9
R7	14.0
R8	14.7
R9	13.3
R10	7.2

The results indicate that the C-weighted minus A-weighted noise level is less than 15 dB at all the identified receivers. As such, they are unlikely to be exposed to unbalanced spectra. This is consistent with low-frequency noise assessments of similar projects with distances comparable to the receivers surrounding the Proposed Modification.

Therefore, no modifying factor correction for low-frequency noise is warranted for the Modification Proposal.

5.4.2 Tonal Noise

Predicted one-third octave band levels were analysed to assess potential tonal noise emissions at the identified receivers. **Figure 3** plots the predicted one-third octave band spectra at all the receivers.

The analysis revealed that none of the predicted one-third octave band levels were found to exceed the levels of the adjacent bands on both sides by:

- 5 dB or more if the centre frequency of the band containing the tone is in the range 500-10,000 Hz
- 8 dB or more if the centre frequency of the band containing the tone is in the range 160-400 Hz
- 15 dB or more if the centre frequency of the band containing the tone is in the range 25-125 Hz

Therefore, it can be concluded that no tonal noise is expected at any of the receivers surrounding the site and no modifying factor correction for tonal noise is warranted for the Modification Proposal.

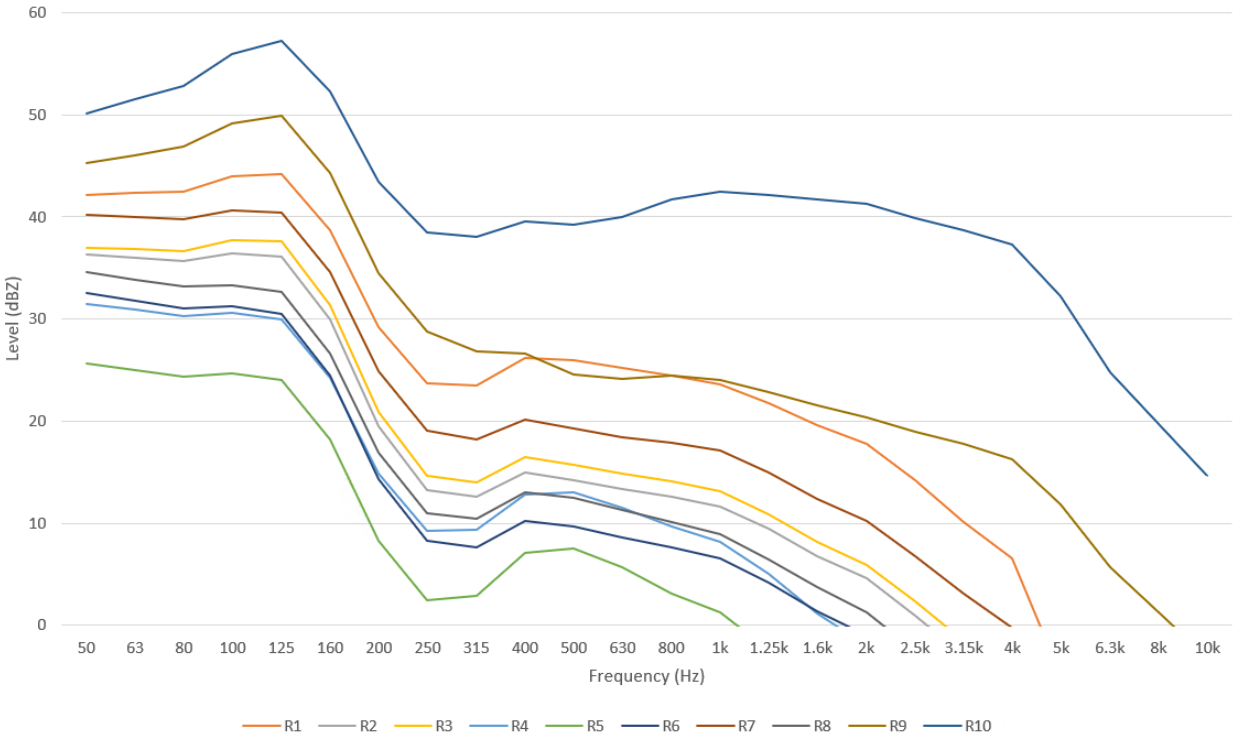

Figure 3: Predicted One-Third Octave Band Levels

5.5 Operational Noise Predictions

Based on the above assumptions, worst case $L_{Aeq,15min}$ noise levels at the identified receivers have been predicted under noise-enhancing meteorological conditions as identified in the *NPfI*. The results for the evening, night and morning shoulder assessment periods are summarised in **Table 13**.

Night noise contours are presented in **Figure 4**.

Table 13: Predicted Operational $L_{Aeq,15min}$ Noise Levels

Receiver ID	Predicted $L_{Aeq,15min}$ Noise Levels			$L_{Aeq,15min}$ Noise Criteria		
	Evening	Night	Morning Shoulder	Evening	Night	Morning Shoulder
R1	35	35	35	36	35	37*
R2	25	25	25	36	35	37*

Receiver ID	Predicted $L_{Aeq,15min}$ Noise Levels			$L_{Aeq,15min}$ Noise Criteria		
	Evening	Night	Morning Shoulder	Evening	Night	Morning Shoulder
R3	27	27	27	36	35	37*
R4	21	21	21	36	35	35
R5	15	15	15	36	35	41*
R6	20	20	20	48	43	43
R7	30	30	30	48	NA	35*
R8	23	23	23	53	NA	NA
R9	39	39	39	68	NA	NA
R10	52	52	52	68	NA	NA

Notes:
* Development Consent SSD5300 assessment criteria
Evening = 6:00 pm – 10:00 pm; Night = 10:00 pm – 6:00 am; Morning shoulder = 6:00 am – 7:00 am

Noise predictions associated with the proposed operation are found to comply with the relevant criteria at all identified receivers and for all assessment periods. As such, the Modification Proposal is not expected to impact on the acoustic amenity of the surrounding receivers.

It is important to note that the noise predictions assume a worst-case 15-minute period where:

- both the excavator and front-end loader on site are operating simultaneously and continuously for an entire 15-minute period - this is conservative as both items would operate solely for loading out trucks;
- two truck movements (truck arrival or departure) would occur on site during the 15-minute period - this is conservative when considering the time taken to load each truck and the improbability of two trucks accessing the site at the same time;
- scraping of bucket attachments and impact noise from heavy material being dumped into trucks would occur for a combined duration of 30 seconds in the 15-minute period at a level of 115 dBA; and
- local meteorological conditions would be noise-enhancing (i.e. source-to-receiver winds of 3 m/s or Stability Category F with winds up to 2 m/s).

Therefore, it is expected noise levels would generally be lower than those reported in **Table 13**.

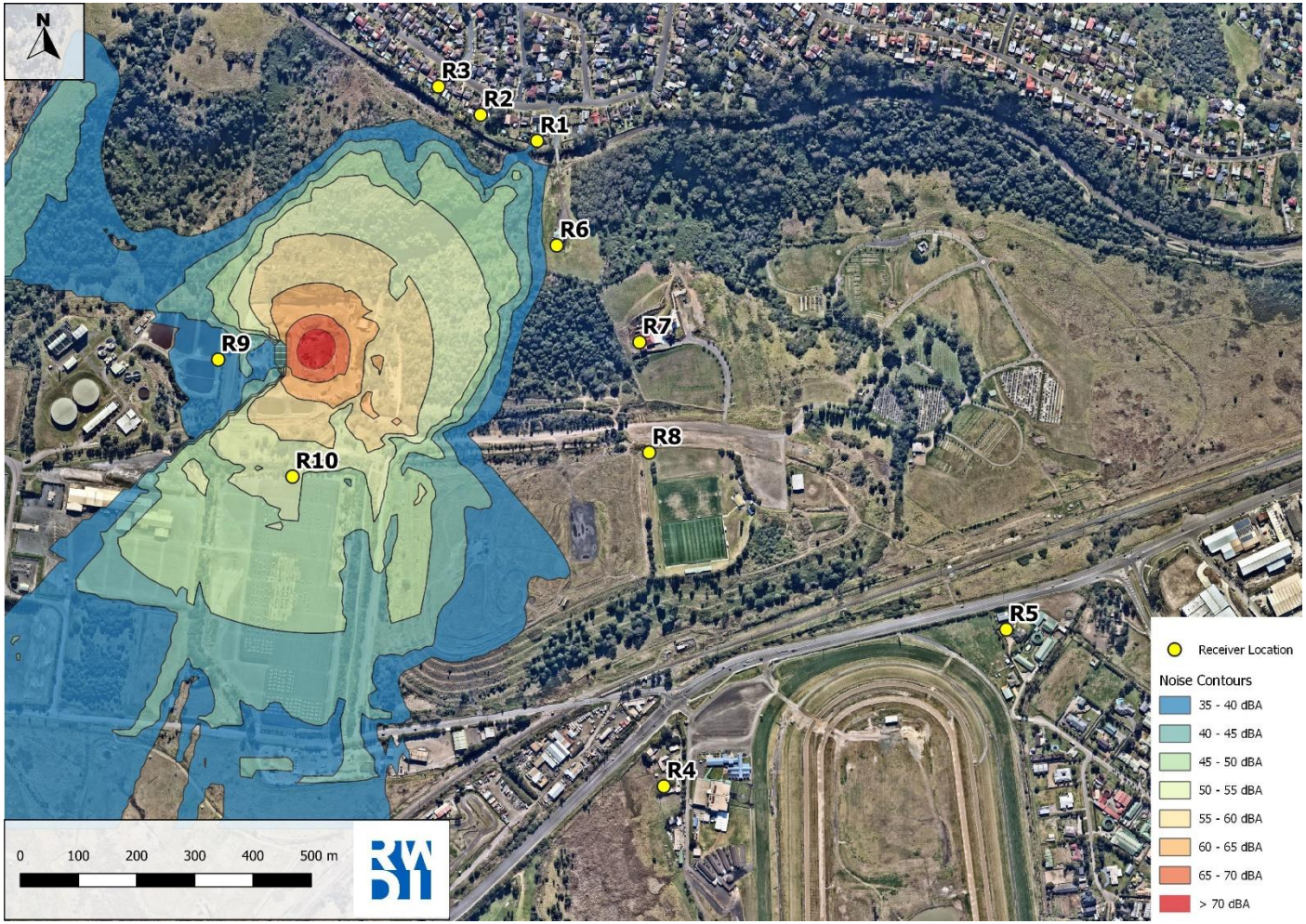

Figure 4: Night Noise Contours under Noise-Enhancing Meteorological Conditions

5.6 Maximum Noise Level Event Assessment

The Modification Proposal is expected to generate loud instantaneous noise events with the potential to generate sleep disturbance at night. Such events would typically consist of, but not limited to:

- front-end loader buckets scraping the concrete hardstand;
- waste material being loaded into trucks, especially when impacting empty truck trailers; and
- waste material being collected using the excavator and front-end loader buckets.

The typical L_{AFmax} sound power level for such events is anticipated to range 110-117 dBA. These levels were obtained from collated measurement data of loading activities from various sites.

It is important to note that the above L_{AFmax} sound power levels reflect noise levels with the implementation of best work management practices (**Section 6**); more specifically, they assume the operator of the excavator and front-end loader would be avoiding dropping materials from height, especially when loading trucks, by "placing" materials so as to minimise impact noise emissions.

Noise predictions presented in the maximum noise level event assessment conservatively assume the upper end of the nominated level range (i.e. 117 dBA).

In consideration of the $L_{Aeq,1min}$ sleep disturbance noise criteria provided in Development Consent SSD5300, $L_{Aeq,1min}$ noise levels are considered equivalent to L_{AFmax} levels for the purpose of the assessment.

Worst case L_{AFmax} noise levels at the identified receivers have been predicted under noise-enhancing meteorological conditions as identified in the *NPfI*. The noise predictions are summarised in **Table 14**.

Table 14: Predicted L_{AFmax} Noise Levels

Receiver ID	Predicted L_{AFmax} Noise Levels		L_{AFmax} Noise Criteria	
	Night	Morning Shoulder	Night	Morning Shoulder
R1	41	41	52	47*
R2	31	31	52	47*
R3	33	33	52	47*
R4	27	27	52	52
R5	21	21	52	51*
R6	26	26	52	52
R7	36	36	NA	45*
R8	29	29	NA	NA
R9	45	45	NA	NA
R10	58	58	NA	NA

Notes:
* Development Consent SSD5300 assessment criteria
Night = 10:00 pm – 6:00 am; Morning shoulder = 6:00 am – 7:00 am

Noise levels associated with maximum noise events at night and during the morning shoulder are predicted to comply at all identified residential receivers, the Farmborough Heights Rural Fire Brigade Station and the Macedonian Church Sveta Petka. As such, no detailed assessment of potential sleep disturbance impacts is warranted.

6 NOISE MITIGATION MEASURES

As outlined above, noise levels associated with the Modification Proposal are expected to comply with all relevant noise criteria. However, consistent with the existing operational environmental management plans/sub-plans for the site, all reasonable and feasible measures should continue to be applied to manage noise levels. These measures should include the following:

- Identification of nearby residences and other sensitive land uses in consideration of evening, night and morning shoulder activities.
- Instruction to all operators on site to maintain best operational practices at all times and made aware of potential adverse noise impacts on the local community.
- Implementation of best work management practices to minimise noise during the evening, night and morning shoulder periods, including but limited to:
  - carrying out activities in a competent manner;
  - avoiding dropping materials from height, especially when loading trucks, by "placing" materials so as to minimise impact noise emissions;
  - turning off truck engine during loading process when possible; and
  - avoiding the operation of the front-end loader while trucks are being loaded on site so as to reduce cumulative noise generated by both the excavator and front-end loader.
- Maintenance of all plant and equipment operating on site or used in connection with the site in a proper and efficient condition.

7 TRAFFIC NOISE ASSESSMENT

7.1 Traffic Noise Assessment – Noise Sensitive Receivers

The Modification Proposal would introduce heavy vehicle movements on the local road network under the new evening and night hours. Trucks would access the site from the Princes Motorway, using Northcliffe Drive, Princes Highway, West Dapto Road, and Wyllie Road.

The closest noise sensitive receivers potentially impacted by project-related truck movements include receivers along Northcliffe Drive (R11-R17) and two receivers in the vicinity of the Princes Highway (R4 and R5), as summarised in **Table 15** and shown in **Figure 5**. Compliance at those receivers would infer compliance at all surrounding noise sensitive receivers.

Table 15: Noise-Sensitive Receivers – Traffic Noise Assessment

Receiver ID	Receiver Type	Approx. Distance to Road	Address / Description
R4	Residential	135 m	421 Princes Highway, Kembla Grange
R5	Residential	45 m	14A Kingston Town Drive Kembla Grange
R11	Residential	28 m	4 Kingston Town Drive, Kembla Grange
R12	Residential	22 m	2 Kingston Town Drive, Kembla Grange
R13	Residential	28 m	2 Trifecta Place, Kembla Grange
R14	Residential	33 m	4 Trifecta Place, Kembla Grange
R15	Residential	45 m	6 Trifecta Place, Kembla Grange
R16	Residential	30 m	8 Trifecta Place, Kembla Grange
R17	Residential	37 m	10 Trifecta Place, Kembla Grange

Note:
m = metres

The traffic noise assessment will focus on receivers R5 and R12, which represent the closest receivers to the Princes Highway and Northcliffe Drive, respectively. Compliance at those two receivers would infer compliance at all other noise sensitive receivers along the route between the site and the Princes Motorway.

Figure 5: Noise-Sensitive Receivers Potentially Affected by Traffic Noise

7.2 Traffic Noise Criteria

Criteria for assessment of noise from traffic on public roads are set out in the *NSW Road Noise Policy (RNP)*. Northcliffe Drive and Princes Highway are both considered as "sub-arterial" roads under this policy.

Table 3 of the *RNP* is reproduced in **Table 16** with the relevant sections highlighted.

Table 16: Road Traffic Noise Criteria – Privately-owned Residences

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from **new** freeway/arterial/sub-arterial road corridors	$L_{Aeq, (15\ hour)}$ 55 (external)	$L_{Aeq, (9\ hour)}$ 50 (external)
	2. Existing residences affected by noise from **redevelopment** of existing freeway/arterial/sub-arterial roads	$L_{Aeq, (15\ hour)}$ 60 (external)	$L_{Aeq, (9\ hour)}$ 55 (external)
	3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local roads	4. Existing residences affected by noise from **new** local road corridors	$L_{Aeq, (1\ hour)}$ 55 (external)	$L_{Aeq, (1\ hour)}$ 50 (external)
	5. Existing residences affected by noise from **redevelopment** of existing local roads		
	6. Existing residences affected by **additional traffic** on existing local roads generated by land use developments		

The proposed evening and night truck movements would essentially replace all existing truck movements associated with product collection during the day. For this reason, the traffic noise assessment does not consider truck movements between the hours of 7:00 am and 10:00 pm as these are expected to reduce with the Modification Proposal in place (i.e. some of the movements currently approved during the day would be moved to the period between 10:00 pm and 7:00 am).

Reference is also made to sections 3.4 and 3.4.1 of the *RNP*. Section 3.4 notes that:

> *"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."*

Section 3.4.1 notes:

> *"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 should be limited to 2 dB above that of the corresponding 'no build option'."*

7.3 Existing Traffic Noise Monitoring

7.3.1 Monitoring Locations

Long-term unattended traffic noise monitoring was attempted but not possible due to access restrictions. As such, short-term noise monitoring was conducted at two locations representative of the identified receivers. Both monitoring locations are summarised in **Table 17**.

Table 17: Traffic Noise Monitoring Locations

Receiver	Monitoring Location
R5	Monitoring conducted on vacant land directly east of the property, approximately 10 m from Princess Highway
R12	Monitoring conducted on Pharlap Avenue adjacent to the property, approximately 22 m from Northcliffe Drive

7.3.1 Monitoring Equipment

Attended measurements were conducted using a Brüel & Kjær Type 2236 Sound Level Meter. This sound level meter conforms to Australian Standard 1259 *Acoustics – Sound Level Meters* as a Type 1 Precision Sound Level Meter which has an accuracy suitable for field and laboratory use. The A-Weighting filter of the meter was selected, and the time weighting was set to "Fast".

The calibration of the meter was checked before and after the measurements with a Brüel & Kjær Type 4230 sound level calibrator and no significant drift was noted.

The Brüel & Kjær Type 2236 and Type 4230 have been laboratory calibrated within the previous two years in accordance with our in-house Quality Assurance Procedures.

7.3.2 Monitoring Results

Monitoring was conducted on the night between Tuesday, 8 and Wednesday, 9 June 2021 as follows:

- Eight short-term 15-minute measurements carried out at R12 between the hours of 10.00 pm and 12.00 am; and
- Six short-term 15-minute measurements conducted at R5 between 12.10 am and 1.40 am.

Table 18 summarises the monitoring results.

Table 18: Traffic Noise Monitoring Results

Receiver	Time	Measured Traffic Noise Levels*	
		$L_{Aeq,15min}$	$L_{Aeq,MonitoringPeriod}$
R12	10:00 pm – 10:15 pm	57	57
	10:15 pm – 10:30 pm	57	
	10:30 pm – 10:45 pm	58	
	10:45 pm – 11:00 pm	58	
	11:00 pm – 11:15 pm	57	
	11:15 pm – 11:30 pm	58	
	11:30 pm – 11:45 pm	56	
	11:45 pm – 12:00 am	56	
R5	12:10 am – 12:25 am	53	52
	12:25 am – 12:40 am	51	
	12:40 am – 12:55am	54	
	12:55 am – 1:10am	53	
	1:10 am – 1:25 am	51	
	1:25 am – 1:40 am	51	

Notes:

* All noise levels have been adjusted to include façade corrections as stipulated by the *RNP*.

* Measured $L_{Aeq,15min}$ noise levels at 14A Kington Town Drive were adjusted to account for additional road setback distance separating dwelling and monitoring location, and shielding from roadside barrier (applicable to dwelling but not monitoring location).

As shown in **Table 18**, based on the measured traffic noise $L_{Aeq,15min}$ levels, an equivalent $L_{Aeq,Period}$ level for the total monitoring period was determined for each location. The resultant $L_{Aeq,Period}$ levels were assumed to be representative of the entire night period (10:00 pm – 7:00 am) and as such, the existing $L_{Aeq,9hour}$ traffic noise levels were established at 57 and 52 dBA for R12 and R5, respectively. This is deemed conservative as traffic noise levels may potentially reduce as the night progresses into the early hours of the morning (e.g. 2:00 am – 6:00 am), thus potentially resulting in lower $L_{Aeq,9hour}$ noise levels.

7.4 Traffic Noise Assessment

Traffic noise levels have been predicted using the *Calculation of Road Traffic Noise (CoRTN)* model (United Kingdom Department of Transport, 1988). The *CoRTN* model takes into account the following factors:

- Traffic flow volumes
- Average vehicle speed
- Percentage of heavy vehicles
- Gradient of road
- Type of road pavement

- Distance from receiver location to road
- Shielding from barriers / building and intervening topography
- Reflections from barriers / buildings
- Angle of view
- Building facade reflection correction
- Ground absorption

As described in the Modification Proposal description, under the proposed new hours, it is expected that one 20 tonne semi-trailer and one 30 tonne truck and dog would access the facility every hour. This is equivalent to 36 heavy vehicle movements (departure or arrival) per night.

Based on the proposed night-time heavy vehicle movements, traffic noise levels at both identified receivers have been predicted and are presented in **Table 19**.

Table 19: Traffic Noise Assessment ($L_{Aeq,9hour}$)

Receiver	Measured Traffic Noise Levels* ($L_{Aeq,9hour}$)	Predicted Traffic Noise Levels from Modification Proposal* ($L_{Aeq,9hour}$)	Predicted Total Traffic Noise Levels (incl. Modification Proposal)* ($L_{Aeq,9hour}$)	Night Road Noise Criterion ($L_{Aeq,9hour}$)
R5	52	44	53	55
R12	57	47	57	55

Note:

* All noise levels have been adjusted to include façade corrections as stipulated by the *RNP*.

As shown in **Table 19**, existing traffic noise levels at receiver R12 are exceeding the relevant night road noise criterion by 2 dB. This would indicate that existing traffic noise levels would result in 2 dB exceedances at the first row of residential receivers fronting Northcliffe Drive (i.e. R11-R17). Noise levels generated by the Proposed Modification would be compliant with the relevant noise criterion and would not contribute to any increase in traffic noise levels at R12 or any of the residential receivers along Northcliffe Drive.

Table 19 shows that noise levels would comply at receiver R5. As such, compliance is expected at all noise-sensitive receivers along the Princes Highway section of the heavy vehicle route.

8 CONCLUSION

RWDI Australia was engaged by Jackson Environment and Planning Pty Ltd to conduct a noise and vibration assessment for the Kembla Grange Resource Recovery Facility, located at 50 Wyllie Rd in Kembla Grange, in support of a planning consent modification application to extend operations from day only to 24 hours. This report has provided an assessment of operational noise and vibration effects associated with the proposed evening and night operations, including traffic noise on the local road network.

The findings of this assessment are as follows:

- Operational noise predictions associated with the proposed evening, night and morning shoulder operations under noise-enhancing meteorological conditions are found to comply with the relevant noise criteria at all identified receivers. As such, operational noise is not expected to impact on the acoustic amenity of the surrounding noise-sensitive receivers.
- Noise levels associated with maximum noise events at night are predicted to comply with the noise trigger level used for the maximum noise event assessment at all identified residential receivers, the Farmborough Heights Rural Fire Brigade Station and the Macedonian Church Sveta Petka. As such, maximum noise events at night are not expected to impact on the acoustic amenity of the surrounding community.
- The Modification Proposal would generate heavy vehicle movements during the evening, night and morning shoulder periods along Northcliffe Drive, Princes Highway, West Dapto Road, and Wyllie Road between the site and the Princes Motorway. Noise levels generated by the Proposed Modification would be compliant with the relevant noise criterion at all identified residential receivers along the Princes Highway and Northcliffe Drive.
- As no changes are proposed to the infrastructure and buildings on site, construction noise was not addressed as part of the assessment.
- No significant sources of vibration have been identified for the Modification Proposal. Therefore, potential vibration resulting from the Modification Proposal is not expected to impact on the amenity of the surrounding receivers.

APPENDIX A: GLOSSARY OF ACOUSTIC TERMINOLOGY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

dB(A) – A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.

Frequency – Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.

Impulsive Noise – Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.

Intermittent Noise – The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night-time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night-time.

Sound Absorption – The ability of a material to absorb sound energy through its conversion into thermal energy.

Sound Level Meter – An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure level.

Sound Pressure Level – The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.

Tonal Noise – Containing a prominent frequency and characterised by a definite pitch