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SUEZ RECYCLING & RECOVERY PTY LTD

ENVIRONMENTAL NOISE ASSESSMENT SPRING FARM ARRF

REFERENCE NO. S10252-R1

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REPORT

for

ENVIRONMENTAL NOISE ASSESSMENT

SPRING FARM ARRF

275 RICHARDSON ROAD,

SPRING FARM, NSW 2570

Prepared for

SUEZ RECYCLING & RECOVERY PTY LTD

275 Richardson Road,
SPRING FARM, NSW 2570

by

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May 2018

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SPRING FARM ARRF
ENVIRONMENTAL NOISE ASSESSMENT

EXECUTIVE SUMMARY

This report presents the findings of an Environmental Noise Assessment of Spring Farm Advanced Resource Recovery Facility (ARRF), 275 Richardson Road, Spring Farm, NSW 2570. The objective of the assessment is to determine whether Spring Farm ARRF would comply with the noise criteria specified in its planning approval if NSW Department of Planning and Environment (DPE) consent to SUEZ Recycling & Recovery Pty Ltd's application for a change in the operational hours.

In summary, the results of the noise assessment indicate no significant exceedances of the noise criteria contained within Project Approval (05_0098). A single measurement suggests that the noise from a truck at or near the weighbridge may exceed the $L_{A1,1\text{-minute}}$ criterion (2.13c). However, 64% of a 15-minute background measurement without a truck also exceeded the criterion, which suggests that the criterion is not a reliable indicator of impacts. With uncertainty considered, the results of the Environmental Noise Assessment are sufficiently accurate to conclude that noise emissions from Spring Farm ARRF would comply with the requirements of Condition 2.13 of its planning approval if NSW DPE consent to SUEZ Recycling & Recovery Pty Ltd's application for a change in the operational hours.

SPRING FARM ARRF
ENVIRONMENTAL NOISE ASSESSMENT

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1.0 INTRODUCTION

This report presents the findings of an Environmental Noise Assessment of Spring Farm Advanced Resource Recovery Facility (ARRF), 275 Richardson Road, Spring Farm, NSW 2570. The objective of the assessment is to determine whether Spring Farm ARRF would comply with the noise criteria specified in its planning approval if NSW Department of Planning and Environment (DPE) consent to SUEZ Recycling & Recovery Pty Ltd's application for a change in the operational hours.

This report commences with a brief overview of the relevant legislation followed by a description of the survey and assessment methodology. The next section presents the results of the assessment and concludes with an evaluation of whether the prospective site noise emissions comply with the noise criteria contained within the planning consent. Appendices contain explanations of the technical terminology used in the report and a listing of model input data.

The study follows the procedures and methodology outlined in our approved *Spring Farm Noise Impact Assessment* Reference SQ7203-L01 and was authorised by Kelly Gee, Compliance Officer at SUEZ Recycling & Recovery Pty Ltd. Mr Toby Dudman MAAS MIOA AASA, Principal Acoustics Engineer from Hibbs & Associates Pty Ltd conducted the site work and assessment. We wish to acknowledge, and express our gratitude, for the assistance provided by Kelly Gee, Sharon Croucher and all the staff at Spring Farm ARRF with conducting the surveys and assessments.

2.0 REPORT LIMITATIONS AND DISCLAIMER

This report was prepared for SUEZ Recycling & Recovery Pty Ltd solely for the purposes set out herein and it is not intended that any other person use or rely on the contents of the Report. The information contained in this report is based on a limited review of the site, interviews with site personnel and review of documentation provided to Hibbs & Associates Pty Ltd at the time of the review. Whilst the information contained in the Report is accurate to the best of our knowledge and belief, Hibbs & Associates Pty Ltd cannot guarantee the completeness or accuracy of any of the descriptions or conclusions based on the information supplied to it or obtained during the investigations, site surveys, visits and interviews. Furthermore, conditions can change within limited periods of time, and this should be considered if the Report is to be used after any elapsed period after its issue.

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Data collected were representative of the working and environmental conditions on the day. Operational or environmental variability can affect results significantly. As such, it is generally recommended that the number of samples taken should be statistically significant. In this case, conclusions and recommendations are based upon a limited data set collected over single day of testing. The Report must be read in its entirety and must not be copied, distributed or referred to in part only.

3.0 SITE DESCRIPTION

SUEZ Recycling & Recovery Pty Ltd is a resource recovery, recycling and waste management company that operates over 100 sites in Australia. Their website [1] describes Spring Farm ARRF as follows:

> *The Spring Farm Advanced Resource Recovery Park (formerly Macarthur Resource Recovery Park and originally Jacks Gully Waste and Recycling Centre) spans 38 hectares and over 100,000 cars and trucks use the park each year. In addition to the Spring Farm Advanced Resource Recovery Facility, the site also contains a landfill and a Materials Recycling Facility (MRF) which is like a giant factory where the recyclable materials that are collected from homes and businesses are taken to be sorted into different types or "streams" such as paper, plastics and aluminium for sale into local and overseas markets, and a resource recovery area for public drop off. Through its council collections contract, the Spring Farm site currently services more than 104,000 households in four adjoining council areas. In addition, the ARRF accepts and then transfers, approximately 10,000 tonnes per annum of commercial & industrial waste from local contractors.*

The landfill ceased operation in May 2016 and capping is complete. There are no noise generating SUEZ facilities at the former landfill. The Advanced Resource Treatment (ART) processing and energy generation facility is not operational. The reception hall of the ART building is a bulking facility. SUEZ has told us that the Project Approval (05_0098) granted by the Minister for Planning for Jack's Gully Alternative Waste Technology Facility (now known as Spring Farm ARRF) on 7 September 2006 and its subsequent modifications (26 August 2010 and 10 December 2015) does not include the MRF. Table 1 lists the significant noise generating SUEZ facilities at Spring Farm ARRF included in this study (i.e. those covered by Project Approval 05_0098). Figure 1 shows an aerial photograph of the site and surrounding area indicating their locations.

Table 1: Noise Sources

	Name	Description
1	ARRF Reception Hall	Refuse Collection Vehicles (RCVs) tip into the hall. A FEL loads trucks with waste for transportation off site.
2	Tank Farm	Liquid Treatment Facility. Pumps loaded and unload tankers. The most significant noise source is a blower. The blower runs at 100% capacity for about 1 to 2-hours once or twice a day.
3	Organics	RCVs deliver green waste into a covered tipping pit. Two FELs load material in/out of composting tunnels (b) and a trommel (c). The trommel is located to the west of the composting tunnels. The Biofilter fan is to the southwest of the composting tunnels
4	On-site vehicles	Trucks of various types

1 SUEZ Recycling & Recovery Pty Ltd company website. http://www.sita.com.au/facilities/arrt-facilities/spring-farm-advanced-resource-recovery-facility/ [Accessed 10/05/2017]

Figure 1: Site Plan

Figure 2: Inside ARRF Waste Bulking

Figure 3: Organics Reception (left) and Tunnel & Trommel (right)

The nearest Noise Sensitive Receptors (NSRs) are existing houses at Commelina Drive to the east of the site and proposed houses in the East Village development to the north. The Project Approval refers to Glenlee Historic House, which is over 1.6 km to the southeast of the site and not shown in Figure 1.

Spring Farm ARRF is in a deep bowl. The ART building is on land that is around 10 m lower than the land at the site entrance. The capped landfill forms steep curved hills either side of the spine road. There is a steep bund on the northern boundary of the site between the site and the proposed housing in East Village. The top of the bund is about 10 m above the ground level at the proposed houses. The terrain almost totally occludes the site sources from the NSRs. The spine road is in a steep valley that gets progressively steeper at the southern end. There is a massive rock wall to the south of the ART building. The terrain provides significant noise attenuation between the site sources and NSRs.

Figure 4: Panorama (northwest to southwest) from Top of Landfill Hill

4.0 REGULATORY FRAMEWORK

Appendix 1 provides explanations of the technical acoustic terminology used in this report. The relevant regulations, standards and guidelines are:

- Protection of the Environment Operations Act 1997 (POEO Act)
- Protection of the Environment Operations (Noise Control) Regulation 2008 (Noise Control Regulation)
- NSW *Industrial Noise Policy* (INP) 2000
- NSW *Noise Policy for Industry* (NPI) 2017
- Australian Standard (AS) 1055:1997 *Acoustics - Description and measurement of environmental noise,*
  - *Part 1: General procedures*
  - *Part 2: Application to specific situations*
  - *Part 3: Acquisition of data pertinent to land use.*

Project Approval 05_0098 provides the noise criteria for the site. Table 2 reproduces Condition 2.13 and its accompanying note. Condition 2.13 has the same noise limits as the site's Environmental Protection Licence (EPL) 12588. EPL 12588 states '*noise from the premises…*', which means that the criteria apply to noise generated from sources within the site boundary. This interpretation is commensurate with the INP and NPI.

Table 2: Condition 2.13 Noise Criteria

Noise Limits	
2.13	The Proponent shall ensure that noise from the project at all existing and proposed residences, including Glenlee House, does not exceed: a) a $L_{Aeq(15\ minute)}$ noise emission criterion of 39 dB(A) during the day/evening; b) a $L_{Aeq(15\ minute)}$ noise emission criterion of 35 dB(A) during the night; and c) a $L_{A1(1\ minute)}$ noise emission criterion of 45 dB(A) during the night.
Note	For the purpose of this condition, day is defined as the period from 7am to 6pm, Monday to Saturday, and 8am to 6pm, Sundays and Public Holidays. Evening is defined as the period from 6pm to 10pm, Night is defined as the period from 10pm to 7am, Monday to Saturday, and 10pm to 8pm, Sundays and Public Holidays. The noise emission limits apply under meteorological conditions of wind speeds up to 3 m/s at 10 metres above the ground level or temperature inversion conditions of 3°C/100 m and wind speed up to 2 m/s at 10 metres above the ground. To determine compliance with this condition, noise from the development must be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary. Noise from the site is to be measured at 1m from the dwelling façade to determine compliance with $L_{A1\ (1\ minute)}$ noise criterion specified in condition 2.13c. However, where is can be demonstrated that direct measurement of noise from the development is impractical, the EPA may accept alternative means of determining compliance (see Chapter 11 of the NSW Industrial Noise Policy). The modification factors in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise levels where applicable.

5.0 PROPOSED OPERATIONAL HOURS

The proposed changes are to Condition 2.14 and 2.15. Table 3 shows the current and proposed Condition 2.14.

Table 3: Current and Proposed Condition 2.14

Condition	Current	Proposed
2.14	The Proponent shall ensure that heavy vehicles associated with the project do not enter or exit the site between 10pm and 7am, unless these movements are due to circumstances beyond the control of the Proponent.	The Proponent shall ensure that heavy vehicles associated with the project do not enter or exit the site between 10pm and 6am, unless these movements are due to circumstances beyond the control of the Proponent.
2.15	Notwithstanding condition 2.14, the Proponent shall ensure that all waste to be processed at the site is received between the following hours: a) 7:00 am to 5:00 pm, Mondays to Fridays, inclusive; b) 8:00 am to 4:00 pm, Saturdays and Sundays; and c) 7:00 am to 2:00 pm on public holidays.	Notwithstanding condition 2.14, the Proponent shall ensure that all waste to be processed at the site is received between the following hours: a) 6:00 am to 6:00 pm, Mondays to Fridays, inclusive; b) 8:00 am to 4:00 pm, Saturdays and Sundays; and c) 6:00 am to 6:00 pm on public holidays that fall on a week day. Waste leaving the site can depart after: d) 4:00 am, Mondays to Friday inclusive; e) 4:00 am on public holidays that fall on a weekday; and f) 6:00 am on Saturday & Sunday

SUEZ estimate that there would be about 6 trucks leaving site between 04:00 and 05:00 hours and about 2 trucks leaving site between 05:00 and 06:00 hours, Monday to Friday. All these trucks would be from the waste bulking facility at the ARRF. There would be no trucks from Organics or the Tank Farm between these hours.

6.0 METHODOLOGY

The assessment follows the guidance contained within the NSW Industrial Noise Policy (as referred in the Project Approval) and is commensurate with current guidance contained within the NSW Noise Policy for Industry (2017). Regarding the note to Condition 2.13 of the Project Approval, it is not possible to test compliance with the noise limits by direct measurement at the NSRs because the site is not operating during the proposed extended hours. The appropriate method to test compliance is by predictive modelling.

Hibbs & Associates Pty Ltd measured noise source levels during a site visit on 02 May 2017. The Acoustic Engineer made measurements of the all the significant noise sources on the site using a Svantek SV979 Class 1 Sound Level Meter (SLM). The Acoustic Engineer built a site-specific noise model using the following International and European Standard methods:

- ISO 9613-2:1996 *Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation*
- ISO 3744:2010 *Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane*
- EN 12354-4:2000 *Building Acoustics - Estimation of acoustic performance of buildings from the performance of elements - Part 4: Transmission of indoor sound to the outside*

The model assumed single sheet trapezoidal profile steel walls for the ART building and a Sound Reduction Index (SRI) provided by manufacturer's published literature [2]. The model uses terrain heights and distances obtained from GoogleEarth. SUEZ Recycling & Recovery Pty Ltd provided the 12-months of weighbridge data from April 2016 to April 2017 and estimates of additional truck movements in the night. The model used these data for moving vehicle sources using the prediction methods contained within:

- BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*
- Department for Environment, Food and Rural Affairs (Defra) (UK) (2005) *Update of Noise Database for Prediction of Noise on Construction and Open Sites*, HMSO.
- Jonasson, H. G. (2006) *Acoustic Source Modelling of Nordic Road Vehicles*. SP Rapport 2006:12

The model adopts the meteorological correction factor K4 from the CONCAWE prediction method [3]. The model adopts the worst-case metrological condition (i.e. highest noise immission level at NSRs) from the two options contained within the note to Condition 2.13. This is the second option and is equivalent to wind speed 2 m/s, Pasquill Class F, Meteorological Category 6.

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2 Corus (2008) *Acoustic performance of pre-finished steel cladding systems*

3 • CONCAWE Report 4/81. (1981) The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities

The noise emissions from the site are primarily from large engines in various forms. There is generally an emphasis on low-frequency emissions. Figure 5 provides the results of the measurements within buildings and the modelled SRI of walls and roofs. Appendix 2 provides a complete listing of model input data.

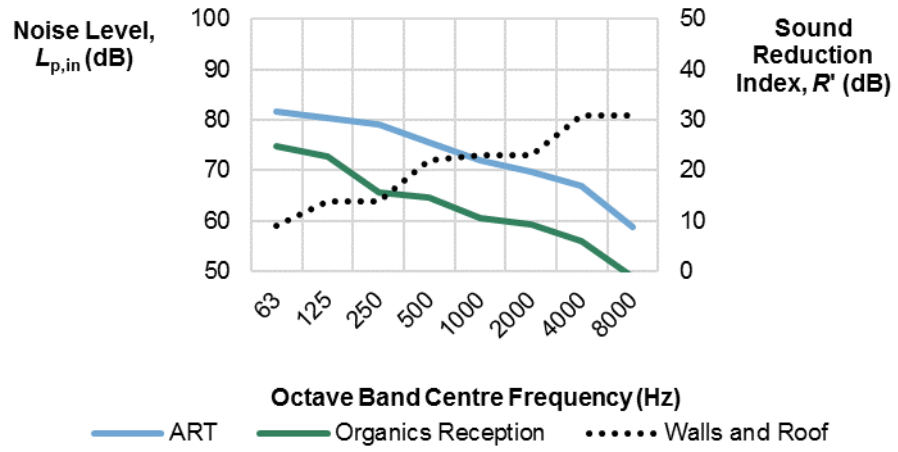

Figure 5: Building Model Input Details

7.0 RESULTS, OBSERVATIONS AND DISCUSSION

Noise emissions from the site will vary throughout the day and from day to day due to the variations in site traffic, amount of operational plant and waste composition. Some of the noisiest activities occur occasionally and for a limited duration. The Project Approval infers that the noise criteria (refer Table 2) applies to the highest level of site noise. It states '*ensure… does not exceed*' and contains no prescriptive method to deal with temporal variation [4]. In this situation, it is appropriate to provide sufficient information on the likely variations for the DPE to determine compliance.

Table 4 provides a summary of the results of the model based on three situations. The three scenarios comprise:

- 'Night' – the 15-minute period of the night-time (as defined Condition 2.13) when the greatest number of waste trucks leave the site from the ARRT and the only plant running at Organics is the biofilter fan
- 'Morning' - the period of the daytime (as defined in Condition 2.13) before midday during normal site operation and the tank farm is loading/unloading a tanker truck
- 'Afternoon' - the period of the daytime (as defined in Condition 2.13) after midday during normal site operation and the tank farm is loading/unloading a tanker truck

Table 4: Model Results

Scenario	Hours	Noise Limit, $L_{Aeq,15min}$ (dB)	Noise Immission, $L_{Aeq,15min}$ (dB) East Village	Noise Immission, $L_{Aeq,15min}$ (dB) Commelina Drive
Night	04:00 - 07:00	35	28	26
Morning	07:00 - 12:00	39	36	35
Afternoon	12:00 - 18:00	39	34	34

The weighbridge data showed that there were more trucks in the morning than during the afternoon. The estimated flows during the night-time (early morning) extension are no greater than the maximum flows measured at the start of the approved hours. The 'Afternoon' scenario represents the afternoon extension on the basis that the maximum 15-minute vehicle flow during the extension hours will be no greater than measured flows during the approved hours. Based on this, the noise immissions at NSRs will be no greater than those during the approved hours but will occur additionally earlier and later in the morning and afternoon.

We have not quantified the noise immissions at Glenlee House. These will be significantly less than those predicted for NSRs at Commelina Drive. Consequently, the assessment demonstrates that there are no exceedances of the noise limits expected at Glenlee House.

4 For example, some European regulators adopt an annual energetic average immission. The equivalent regulator in England (Environment Agency) has promoted (but not officially adopted) a modal average (i.e. most commonly occurring immission).

The night-time criterion of 45 dB $L_{A01,1min}$ relates to the potential for impulsive noises (i.e. bangs and clatters) to disturb sleep. Activities at the ARRT waste bulking and on the spine road are significantly distant and screened from the NSRs such that any impulsive noise emissions during slow truck movements will not generate impulsive immissions. Attenuation due to distance and screening will remove any impulsive character from the source emission.

Figure 6 shows the results of a 15-minute measurement at the location of the closest houses in East Village in the early morning. The ambient noise is an indistinct mix of distant traffic and plant within the MRF. (We have an audio recording of this sample.) Ambient noise levels are objectively low.

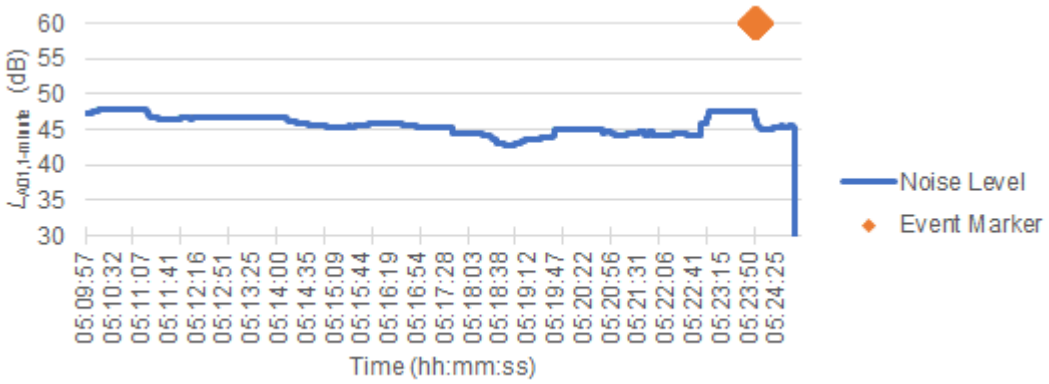

Figure 6: Weighbridge Truck Event Measured at East Village

A truck either leaves the site through the weighbridge or passes the site entrance after leaving a neighbouring site (we could not get a clear view from the measurement location because of the boundary bunding on the boundary of the site and acoustic fencing on the boundary of the housing development) around 05:24 hours. The orange diamond in Figure 6 shows when that is. The noise level during that minute is 48 dB $L_{A1,1\text{-minute}}$, which numerically exceeds the criterion in Condition 2.13 by 3 dB. However, the ambient noise level also exceeds the criterion by similar amounts for about 64% of the rest of the 15-minute measurement that does not include a truck event.

Sleep disturbance by impulses depends upon the prominence of the impulsive peak above the ambient level and the rise time of the peak. The truck event is barely distinguishable above the ambient noise and has a very gradual rise-time. The $L_{A1,1\text{-minute}}$ level exceeds the numerical criterion but the truck event will not disturb sleep and neither will the numerous false-positives (i.e. exceedance of the criterion when there is no event) that occur in the preceding 15-minutes. This suggests that the criterion in Condition 2.13c is not suitable to protect NSRs at this site from potential sleep disturbance.

In summary, the results of the noise assessment indicate no significant exceedances of the noise criteria contained within Project Approval (05_0098). A single measurement suggests that the noise from a truck at or near the weighbridge may exceed the $L_{A1,1\text{-minute}}$ criterion (2.13c). However, 64% of a 15-minute background measurement without a truck also exceeded the criterion, which suggests that the criterion is not a reliable indicator of impacts.

Significant temporal variability in the noise immissions at NSRs is inevitable. We installed noise loggers at fixed positions at the ART and Organics to estimate variations in source emission due to activity. These results indicate a variation of around ±3 to 5 dB. The results in Table 4 represent periods of high activity (i.e. vehicle deliveries at ARRT bulking, organics reception and the tank farm) and the maximum 15-minute average vehicle flow on the spine road during the period. Based on this, the model should represent the upper end of this variation and noise immissions should be up to 3 to 5 dB lower when the site is less busy.

ISO 9613-2:1998 suggests that the prediction method is accurate to around ±3 dB for long-term averages of immission and situations with approximately flat terrain and no screening. We expect greater uncertainty for this site due to the complex terrain and significant barrier screening. The model adds around 3 to 7 dB to the immission levels in meteorological adjustment as required by the note to Condition 2.13. This corresponds to a temperature inversion. Temperature inversions are most common around sunrise and sunset. Consequently, the meteorological adjustment is likely to result in an overestimate of noise immissions outside these times.

8.0 SUMMARY AND CONCLUSIONS

In summary, the results of the noise assessment indicate no significant exceedances of the noise criteria contained within Project Approval (05_0098). A single measurement suggests that the noise from a truck at or near the weighbridge may exceed the $L_{A1,1\text{-minute}}$ criterion (2.13c). However, 64% of a 15-minute background measurement without a truck also exceeded the criterion, which suggests that the criterion is not a reliable indicator of impacts. With uncertainty considered, the results of the Environmental Noise Assessment are sufficiently accurate to conclude that noise emissions from Spring Farm ARRF would comply with the requirements of Condition 2.13 of its planning approval if NSW DPE consent to SUEZ Recycling & Recovery Pty Ltd's application for a change in the operational hours.

SPRING FARM ARRF
ENVIRONMENTAL NOISE ASSESSMENT

APPENDIX 1: ACOUSTIC TERMINOLOGY

Environmental Noise

Acousticians commonly define noise as 'unwanted sound'. The seminal Wilson Report adopted a similar definition:

> *For the purposes of this Report we accept the definition of noise as "sound which is undesired by the recipient*

In Guidelines for Community Noise [5] , the WHO defined environmental (or community) noise as follows:

> *Community noise includes the primary sources of road, rail and air traffic, industries, construction and public works and the neighbourhood.*

Unlike many other pollutants, noise pollution depends not just on the physical aspects of the sound itself, but also the human reaction to it. An environmental noise assessment must consider not only the level of noise but also its temporal and acoustic characteristics in the context of those of the background acoustic environment, as experienced by people, and what that means to them. This approach is the consideration of soundscape as defined in ISO 12913-1:2014 [6].

Noise may audible at a level significantly lower than that likely to cause measurable health effects, such as sleep disturbance. The attitude of the receptor to the source can affect the outcomes of noise intrusion, such as annoyance. In some circumstances, receptors can moderate adverse effects by adopting realistic expectations of the acoustic environment. That is, by accepting that some noise impact to some people for some of the time is an inevitable and tolerable consequence of a technologically developed society.

Notwithstanding the above, the most effective method of impact reduction is to control the source. Responsible operators of noise-generating sites should minimise their noise impacts by the appropriate combination of noise management tools and engineering design of the source. The Polluter Pays Principle (PPP) states that those who create pollution should bear the costs of it. The PPP is a principle of international environmental law and is a fundamental policy of the Organisation for Economic Co-operation and Development. Quiet is vital resource that is necessary for a healthy society. In some circumstances, operators need to accept that there are places and/or times into which regulators should not permit noise to intrude.

Emission, Propagation and Immission

Emission is the noise that 'leaves' (emits from) a source. The noise propagates ('travels') through one medium or several media (e.g. through air, ground, walls etc.) before being received at a noise sensitive receptor. 'Immission' is the correlative of 'emission' and describes the noise received at the receptor.

5 Berglund B. et al. (eds.) Guidelines for Community Noise. WHO 1999.

6 International Standard. ISO 12913-1:2014. Acoustics — Soundscape — Part 1: Definition and conceptual framework.

‘A’ and ‘C’ frequency-weighting filters

The human ear is not equally sensitive to sound at all frequencies. In general, it is less sensitive to sound at low frequencies (i.e. ‘bass’ tones) than it is to mid and high frequencies (i.e. ‘treble’ tones). Furthermore, the extent of this relative sensitivity to sound at different frequencies is different for sounds of different volumes. The ear is less insensitive to low frequencies for sound at high volumes than it is for sound at low volumes. International Standard ISO 226:2003 [7] specifies ‘equal loudness contours’. These describe sound pressure levels and frequencies of pure continuous tones that human listeners perceive as equally loud.

Acousticians commonly measure sound with a frequency-weighting filter applied. The figure below shows the most commonly used weightings: ‘A-weighting’ and ‘C-weighting’. The A and C weightings are based on a tentative American standard published in 1936 [8] but remain in current use. Whilst later research provides better correlation with how humans perceive loudness, the standard approaches for the measurement and assessment of occupational and environmental noise and the criteria for the control of their adverse effects are based on these weightings. Australian Standard (AS) IEC 61672.1:2004 [9] provides specifications for the A and C weightings.

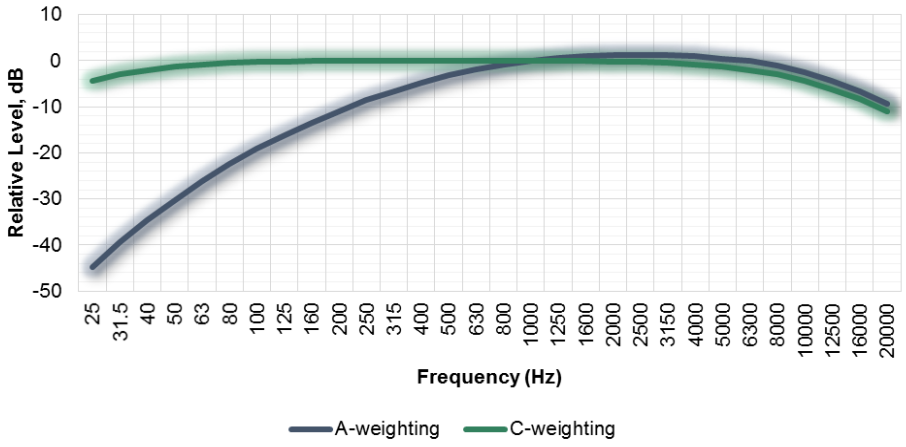

Figure 18: 'A' and 'C' Frequency Weightings

Equivalent Sound Pressure Level, $L_{Aeq,T}$

The equivalent continuous A-weighted sound pressure level (integrated level) that has the same mean square sound pressure (referenced to 20 µPa) over the measurement period, T, as the fluctuating sound(s) under consideration. It represents the energy average noise level for the period of interest. The duration ‘T’ must be stated in the index for the value of the $L_{Aeq,T}$ to be meaningful.

7 International Standard ISO 226:2003 Acoustics - Normal equal-loudness-level contours. ISO, 2003.

8 American Tentative Standards for Sound Level Meters Z24.3-1936. Journal of the Acoustical Society of America, 1936.

9 Australian Standard AS IEC 61672.1-2004. Electroacoustics - Sound level meters. Part 1: Specifications. Standards Australia, 2004.

Sound Exposure Level, L_{AE}

The Sound Exposure Level (SEL) is the level that has the same amount of energy in 1-second (i.e. T = 1-second) as the original noise event. Acousticians use SEL to describe the noise from an intermittent event, such as road, rail and air vehicle pass-bys. Normalisation of the noise emission level means that overall equivalent noise level during a period, $L_{Aeq,T}$, can be calculated from the SELs of the individual events and the quantum of events.

Statistical Indices, $L_{AN,T}$

These are the A-weighted sound pressure level that is exceeded for N% of measurement duration, T. Commonly used percentiles are N = 10, 50 and 90%. The $L_{A50,T}$ is the arithmetic average sound pressure level in the time period T.

The $L_{A90,T}$ is the A-weighted sound pressure level that is exceeded for 90% of measurement duration, T. Acousticians commonly use 'background noise level' to mean $L_{A90,T}$ because it represents the level of noise that is almost always present in-between louder intermittent events. It is mostly unaffected by the noise from intermittent events; for example, from individual car pass-bys on a local road or from occasional bird calls.

Octave and 1/3rd-octave bands

With reference to the explanation of the frequency-weighting filters above, the frequency content of a noise signal affects how humans perceive it and, consequently, how loud it is. In addition to this, a noise signal that has energy concentrated at a single or over a small range of frequencies, i.e. a tone, whine, hum, screech etc.; is more distinctive (and likely to be more annoying) than a noise signal that has energy spread over a wide range of frequencies (which acousticians called 'broadband' noise) like wind, waterfalls and distant road traffic.

Furthermore, the propagation characteristics of noise outdoors can be very frequency-dependent. For example, high-frequencies attenuate far more rapidly than low-frequencies do with increasing distance from a source. The noise insulation provided by building elements (windows, louvres, walls and floors) is, in general, less to low-frequency noise than it is to high-frequency noise. Consequently, knowledge of the acoustic frequency content of a noise signal is commonly necessary to a carry out a complete and robust assessment of environmental noise. Environmental acousticians determine the frequency content of an environmental noise signal in terms of the noise level within each of a set of time-domain bandpass filters, i.e. a set of band levels.

Octave bands are bandpass filters where the upper frequency limit of each band is twice the lower frequency limit. There are three 1/3-octave bands within each octave band. The upper frequency limit of a 1/3rd-octave band is 1.26 times the lower frequency limit. An octave or 1/3rd-octave band is identified by the geometric mean frequency of each band in Hertz (Hz), which is also called its' centre frequency. The frequency axis of the frequency weighting curves show above lists the centre frequencies of the 1/3rd-octave bands between 25 and 20,000 Hz.

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APPENDIX 2: MODEL SOURCE DATA

Table 5: Model Input Data - Buildings

Source		Source Location					L_W per octave band (dB)								Overall, L_{WA} (dB)
		Area (m2)	X	Y	Z (Gnd)	Z (AGL)	63	125	250	500	1000	2000	4000	8000	
ART Roof		2500	291875	6227069	100	10	102	95	94	83	78	76	65	57	**88**
ART Wall		500	291865	6227091	100	5	95	89	87	76	71	69	58	50	**81**
Organics Reception		175	291827	6227090	100	5	97	95	88	87	83	82	78	71	**90**

Table 6: Model Input Data - Stationary Vehicles / External Sources

Source		Source Location					L_W per octave band (dB)								Overall, L_{WA} (dB)
	Events 15-min		X	Y	Z (Gnd)	Z (AGL)	63	125	250	500	1000	2000	4000	8000	
ART/Organics RCV Delivery (Morning)	2.4		291865	6227091	100	1	108	104	98	96	103	94	90	88	**104**
ART/Organics RCV Delivery (Afternoon)	1.7		291865	6227091	100	1	106	102	97	95	101	93	88	86	**103**
Organics Trommel & FEL	1.0		291783	6227037	100	3	100	98	92	100	97	94	91	79	**102**
Organics Biofilter Fan			291823	6227032	100	0	104	101	96	103	100	97	94	82	**105**
Tank Farm Pump	1.0		292020	6227131	100	0	82	91	86	92	85	83	77	70	**92**
Tank Farm Blower	1.0		292037	6227113	100	0	86	96	105	104	93	84	77	72	**103**

Table 7: Model Input Data - Internal Roads

Source	Source Location						L_W per octave band (dB)								Overall, L_{WA} (dB)
	Veh per 15-min	Length (m)	X	Y	Z (Gnd)	Z (AGL)	63	125	250	500	1000	2000	4000	8000	
Moving RCV/Truck Source							116	109	107	104	100	98	92	88	**106**
Weighbridge Trucks (Night)	2.2	75	291771	6227392	109	1	98	91	89	86	82	80	74	70	**89**
Spine - North (Night)	2.2	110	291850	6227358	109	1	100	93	91	88	84	82	76	72	**90**
Spine - Middle (Night)	2.2	110	291908	6227246	105	1	100	93	91	88	84	82	76	72	**90**
Spine - South (Night)	2.2	110	291900	6227135	100	1	100	93	91	88	84	82	76	72	**90**
Weighbridge Trucks (Morning)	4.9	75	291771	6227392	109	1	102	95	93	90	86	84	78	74	**92**
Spine - North ((Morning)	4.9	110	291850	6227358	109	1	103	96	94	91	87	85	79	75	**94**
Spine - Middle (Morning)	4.9	110	291908	6227246	105	1	103	96	94	91	87	85	79	75	**94**
Spine - South (Morning)	4.9	110	291900	6227135	100	1	103	96	94	91	87	85	79	75	**94**
Weighbridge Trucks (Afternoon)	3.4	75	291771	6227392	109	1	100	93	91	88	84	82	76	72	**91**
Spine - North ((Afternoon)	3.4	110	291850	6227358	109	1	102	95	93	90	86	84	78	74	**92**
Spine - Middle (Afternoon)	3.4	110	291908	6227246	105	1	102	95	93	90	86	84	78	74	**92**
Spine - South (Afternoon)	3.4	110	291900	6227135	100	1	102	95	93	90	86	84	78	74	**92**