EPA VICTORIA

Technical guide: Measuring and analysing industry noise and music noise

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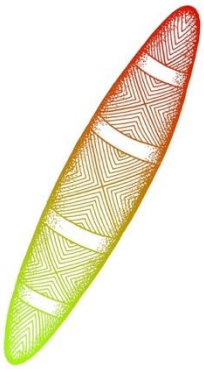

EPA acknowledges Aboriginal people as the first peoples and Traditional custodians of the land and water on which we live, work and depend. We pay respect to Aboriginal Elders, past and present.

As Victoria's environmental regulator, we pay respect to how Country has been protected and cared for by Aboriginal people over many tens of thousands of years.

We acknowledge the unique spiritual and cultural significance of land, water and all that is in the environment to Traditional Owners, and recognise their continuing connection to, and aspirations for Country.

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1. Introduction

1.1. Overview

This technical guide will assist in the assessment of noise including measurement, prediction, analysis and reporting conducted in accordance with Part 5.3 of the Environment Protection Regulations (Victorian Government, 2021); referred to in this document as the **Regulations**). (https://www.legislation.vic.gov.au/as-made/statutory-rules/environment-protection-regulations-2021)

For some types of premises and activities, noise is prescribed by the Regulations as unreasonable when it exceeds a certain level, when it occurs outside specified hours or happens too often. The Regulations prescribe situations which constitute 'unreasonable noise' from residential, commercial, industrial and trade premises, entertainment venues and outdoor entertainment events.

The Regulations refer to an incorporated document, *Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues* (EPA Publication 1826) (https://www.epa.vic.gov.au/about-epa/publications/1826-4) referred to in this document as the **Noise Protocol**. The Noise Protocol specifies the procedures to:

- set noise limits
- assess noise emitted from existing commercial, industrial and trade premises, entertainment venues and outdoor entertainment events
- evaluate the anticipated noise emissions from development proposals (new commerce, industry or trade premises, or proposed extensions of existing premises; new entertainment venues or proposed extensions of existing venues) and proposed outdoor entertainment events.

This technical guide provides additional information to assist with conducting noise assessments required by the Regulations, in accordance with the Noise Protocol. It applies to measurements to determine both unreasonable noise and aggravated noise, under the Regulations.

This document replaces *A guide to the measurement and analysis of noise* (publication 280)

1.2. Audience and purpose

This technical guide is primarily for regulators and acoustic consultants.

This guide should be used when assessing noise and making decisions about compliance with the Regulations. It can also be used by other regulators to support strategic land-use planning and development approvals processes.

The information in this technical guide may be of interest to duty holders who are subject to the Regulations, and more generally to people concerned about noise.

Environmental noise assessment and measurement should only be conducted or supervised by an EPA Authorised Officer or by someone who has demonstrated qualification and experience in conducting noise assessments and measurements (for example a suitably qualified acoustic consultant or practitioner who is eligible for membership of the Australian Acoustical Society (https://acoustics.org.au/).

This guide should be read in conjunction with the Regulations and Noise Protocol. It is used to assess noise from commercial, industrial and trade premises and music noise from entertainment venues and outdoor entertainment events as defined by the Regulations, while giving regard to the noise sources to take into account (or not) as listed in Regulations 117 and 124.

It must not be used for assessing noise from residential premises or noise having regard to frequency spectrum as a prescribed factor (Regulation 120), which should be assessed using:

- Noise guideline: Assessing noise from residential equipment (publication 1973)
- Noise guideline: Assessing low frequency noise (publication 1996)

1.3. Disclaimer

As this technical guide will be updated over time, always refer to the latest version of the document available on EPA's website (www.epa.vic.gov.au) before conducting any relevant noise assessment.

The methods and procedures to set noise limits for industry noise and music noise are contained in the Noise Protocol. The Noise Protocol is an incorporated document of the Regulations and contains obligations that must be complied with.

When conducting an assessment and deviation from the procedures of the Noise Protocol or this technical guide is found necessary, seek advice from the regulator.

2. Glossary of terms

2.1. Terms defined in the Environment Protection Act, the Regulations and in the Noise Protocol

A-frequency weighting	*Noise Protocol*
Alternative assessment criterion	*Regulation 4*
Alternative assessment location	*Regulation 4*
Authority	*Regulation 4*
Background level	*Noise Protocol*
Background-relevant areas	*Noise Protocol*
Base noise limit (noise for commercial, industrial and trade premises)	*Regulation 118(2)*
Base noise limit (music noise from indoor entertainment venues)	*Regulation 125(2)*
Beaufort wind scale	*Noise Protocol*
Commercial, industrial and trade premises	*Regulation 4*
Concert	*Regulation 4*
Day and evening period (music noise from indoor entertainment venues)	*Regulation 123*
Day period (noise for commercial, industrial and trade premises)	*Regulation 116*
dB(A)	*Regulation 4*
Earth resources premises	*Noise Protocol*
Effective noise level	*Regulation 4*
Evening period (noise for commercial, industrial and trade premises)	*Regulation 116*
Extraneous noise	*Noise Protocol*
Fast time weighting	*Noise Protocol*
Frequency	*Regulation 4*
Frequency spectrum	*Regulation 4*
Indoor entertainment venue	*Regulation 4*
L_{A90}	*Noise Protocol*
L_{Aeq}	*Noise Protocol*
Linear, linear weighting	*Noise Protocol*
Live music entertainment venue	*Regulation 4*
L_{OCT10}	*Noise Protocol*
L_{OCT90}	*Noise Protocol*
Major urban area	*Regulation 4*
Measurement point	*Regulation 4*
Music	*Regulation 4*
Music noise	*Regulation 4*
Night period (noise for commercial, industrial and trade premises)	*Regulation 116*
Night period (music noise from indoor entertainment venues)	*Regulation 123*
Noise	*Act Sect. 1*
Noise limit	*Regulation 4*
Noise sensitive area	*Regulation 4*
Noise sensitive residential use	*Regulation 4*

Octave band	*Noise Protocol*
One-third octave band	*Noise Protocol*
Operating time periods (noise for commercial, industrial and trade premises)	*Regulation 116*
Operating time periods (music noise from indoor entertainment venues)	*Regulation 123*
Outdoor entertainment event	*Regulation 4*
Outdoor entertainment venue	*Regulation 4*
Rural area	*Regulation 4*
Rural area method	*Noise Protocol*
Sensitive room	*Noise Protocol*
Traffic noise L_{Aeq}	*Noise Protocol*
Urban area method	*Noise Protocol*
Urban area method	*Noise Protocol*
L_{Aeq}	*Noise Protocol*
Linear, linear weighting	*Noise Protocol*
Live music entertainment venue	*Regulation 4*
L_{OCT10}	*Noise Protocol*
L_{OCT90}	*Noise Protocol*
Major urban area	*Regulation 4*
Measurement point	*Regulation 4*
Music	*Regulation 4*
Music noise	*Regulation 4*

2.2. Other terms in use in this guide

Agent of change principle	Principle underlying in clause 53.06 of the Victoria Planning Provisions to manage the relationship between live entertainment venues and noise sensitive residential uses. Responsibility for noise attenuation is assigned to new uses or new developments.
Aggravated noise	Noise prescribed in the Regulations as being aggravated noise for the purpose of section 168 of the Act.
Atmospheric conditions favourable to the propagation of sound	Atmospheric conditions that result in increased noise at the measurement point. Examples include temperature inversions (when the air temperature increases with altitude) and wind blowing from the noise source to the measurement point.
Background equivalent location	Location where the background noise represents the likely background level at the assessment location in the noise sensitive area (refer Noise Protocol clause 40).

Background noise	The mix of background sounds that characterises the baseline sound environment, in the absence of the noise under investigation. These background sounds do not include infrequent events that do not represent the general acoustic conditions (for example construction activities). When applying the Noise Protocol, the background noise is characterised by the background level, measured using statistical levels L_{A90} and L_{OCT90}.
C_{tr}	A spectrum adaptation term that applies to the sound insulation rating of a building element (R_W or $D_{nT,w}$), to reflect its performance for noise characterised mainly by low and medium frequency sounds. Australian Standard AS/NZS 1276.1 sets out testing methodologies for the sound insulation properties of building elements and spectrum adaptation values and explains their use. C_{tr} has a negative value, and (R_w+C_{tr}) is lower than or equal to R_w. (Similarly, [$D_{n,T,w}$+C_{tr}] has a lower value than $D_{n.T.w}$)
Cumulative noise	The total noise at a noise sensitive area, including all contributions from premises of the same type affecting this area (all contributions from commercial, industrial and trade premises for industry noise or, for music noise, all contributions from indoor entertainment venues).
Directivity	The property of a sound source to radiate sound with greater intensity in some directions than others. Directivity generally increases with frequency (for example loudspeakers are more directional at high frequencies than they are at low frequencies).
$D_{nT,w}$ (Weighted Standardised Field Level Difference)	A rating value for the in-situ sound insulation performance of a building element. It is determined from a field measurement of the difference in noise level on each side of the building element and calculated following the procedures from Australian Standard AS/NZS 1276.1. The higher the value of $D_{n,T,w}$, the better the sound insulation performance. $D_{n,T,w}$ relates to the R_w laboratory measurement, However, due to the inevitable secondary sound transmissions occurring in-situ, the value of $D_{n,T,w}$ is usually several decibels lower than the value of R_w.
Dockland Noise Attenuation Area	The area referred to in Schedule 12 to the Design and Development Overlay to the Melbourne Planning Scheme.
Duty holder	The owner, occupier or person in control of the industry premises, entertainment venue or outdoor entertainment event being assessed.

Engineering calculation method	A calculation algorithm relying on a combination of acoustic principles and empirical relationships. A suitable engineering calculation method must have been validated against extensive measurement, and the set of conditions for which it is fit for purpose be documented in a verifiable reference, together with the uncertainty of calculation.
Entertainment venues	These include both outdoor entertainment venues and indoor entertainment venues.
Free field conditions	Noise measurement conditions for which the sound pressure levels recorded at the microphone are not affected by the reflection of sound on surfaces other than the ground.
Industry, Industry premises	Commercial, industrial and trade premises, as defined in Regulation 4.
Industry noise	Noise from commercial, industrial and trade premises.
Noise impulsive in character	Noise consists of impulses emitted in combination with continuous (or transient) industry noise.
Noise impulsive in nature	Noise that consists of impulses only, without industry noise occurring between each impulse.
Point source	A noise source whose dimensions are small compared to the distance to the measurement point and radiates sound as if it were a single point.
R_w (Weighted Sound Reduction Index)	A rating value for the sound insulation performance of a building element. It is measured and calculated in very controlled conditions in a laboratory using the procedures from AS/NZS 1276 and AS 1191. The related field measurement is the $D_{nT,w}$. The higher the value of R_w, the better the sound insulation performance. The related field measurement is the $D_{nT,w}$.
Sound insulation	The ability of a construction or building element to limit noise transmission through the building element. The sound insulation of a material can be described by the R_W or $D_{nT,w}$ of the system.
Sound path	Pathway followed by sound when it travels from a source to a measurement point.
Spot measurement	Survey measurement, typically of very short duration, conducted using a handheld sound level meter to get an indication of the sound levels as they vary within the area surveyed.

Structure-borne noise	Noise caused by the vibration of elements of a structure. The source of vibration that results in structure-borne noise is within the building where it is perceived, or within a structure with common elements that transmit vibration.
Utility, Utilities	'Utility installation' as defined in the Victoria Planning Provisions and includes infrastructure used for telecommunications; to transmit or distribute gas or oil; to transmit, distribute or store power, including battery storage; to collect, treat, transmit, store, or distribute water; or to collect, treat, or dispose of storm or flood water, sewage, or sullage.

3. Industry noise

3.1. Noise limits

The Regulations specify the periods of time (day, evening and night) for which different noise limits apply to commercial, industrial and trade premises impacting on noise sensitive areas. To protect sleep in the night period, the noise limits are more stringent than they are during the day and evening periods. Activities to be protected during the day and evening include conversation, communication conducive to learning and relaxing at home.

Box 1: Application of the noise limits

Noise limits for industry noise:

- set the level of noise above which the noise would be unreasonable as prescribed in the Environment Protection Regulations 2020 (Regulation 118)
- apply within noise sensitive areas and are determined in accordance with the Noise Protocol (Part I:A)
- apply to the cumulative noise from all industry impacting on noise sensitive areas (Regulation 119).

If the noise limits are exceeded, the duty holder must reduce the noise emitted to comply with the Regulations. Where the cumulative noise from multiple industry premises exceeds the noise limits in a noise sensitive area, each industry must take all reasonable steps, including working with other industries to reduce their emissions, to ensure that the contribution from each of the premises, when combined, does not exceed the noise limit for the noise sensitive area. Criteria that apply to individual premises in this situation are presented in section 3.3.1 and assessment procedures in section 3.3.2.

Duty holders also need to comply with the general environmental duty under section 25 of the *Environment Protection Act 2017* (the Act).

The Noise Protocol provides two methods to establish the noise limits. The method used depends on the location of the noise sensitive area (not the location of the noise-emitting premises):

- the **urban area method** (Part I:A section 1, clauses 1 to 15) applies if the noise sensitive area is within a major urban area, as defined in Regulation 4
- the **rural area method** (Part I:A section 2, clauses 16 to 36) applies if the noise sensitive area is not within a major urban area.

The Noise Protocol sets noise limits for testing and maintenance of emergency equipment (Part I:A, section 3, clauses 37 and 38) since these activities are usually infrequent, limited in time and can generally be scheduled at less sensitive times such as during the day period. This provision is relevant to equipment that is used only in relation to emergencies as defined in Regulation 117(2). It does not apply to equipment that may be operating in circumstances other than emergencies, testing and maintenance.

Part I:A, section 5 of the Noise Protocol (clauses 52 to 55) details variations to the noise limits that may apply to earth resources premises (mines, quarries) and landfill operations in both major urban and rural areas for specific open-air activities such as site preparation and rehabilitation (clause 53). These variations can be considered where there is significant open-air surface activity during site preparation, particular operational activities, or rehabilitation associated with earth resources premises or landfills. These variations set out the exceptions to normal operations where noisier work might be considered necessary and variations from the noise limits can be justified.

3.1.1. Urban area method

The urban area method is detailed in Noise Protocol clauses 1 to 15 and summarised in

Figure 1. Urban settings include a wide variety of land uses, and background noise can vary greatly. To reflect this complexity, the noise limits are based on the mix of land use zones surrounding the noise sensitive area, and the **background level**.

3.1.2. Rural area method

The rural area method is detailed in Noise Protocol clauses 16 to 36. This method is simpler than the urban area method, because background noise in rural settings is generally lower than in major urban areas and land use zones are typically larger.

As illustrated in

Figure 1, the rural area method includes ways to determine noise limits for:

- commercial, industrial and trade premises other than utilities and earth resources premises (clauses 16 to 28)
- utilities (clauses 29 to 32), and
- earth resources premises (clauses 33 to 36).

Specific procedures (clauses 21 to 28) apply to **background-relevant areas** where the background noise may be higher than usual for rural settings, such as near a busy road, or in naturally noisy locations, such as coastal areas with surf. These procedures may involve traffic noise measurements, refer to section 3.1.6.

3.1.3. Base noise limits and night period limit

Regulation 118(2) specifies base noise limits, which define, for each of the day, evening and night period, the lowest value the noise limit can take. The base noise limits for rural areas are lower than those for major urban areas.

Regulation 118(3) specifies that the noise limit for the night period must not exceed 55 dB(A). This limit is to protect sleep and reduce the risk of harm to human health. It applies to both urban and rural areas, regardless of the land use zoning or background level.

3.1.4. Aggravated noise

Noise from industry premises is **aggravated noise** if the effective noise level exceeds (Regulation 121):

- the lower of the noise limit plus 15 dB or 75 dB(A) for the day period
- the lower of the noise limit plus 15 dB or 70 dB(A) for the evening period
- the lower of the noise limit plus 15 dB or 65 dB(A) for the night period.

3.1.5. Establishing Background levels

Noise limits in major urban areas and in background-relevant rural areas are set depending on the background level. This level represents the background sounds in the absence of intrusive noise from any industry.

The background level must represent the background environment within noise sensitive areas at the time when the highest exposure to industry noise occurs. For example, if the premises does not operate between midnight and 7am, the background level that informs the noise limit for the night period must represent the background sounds occurring between 10 pm, the start of the night period, and midnight, when the operations of the premises end.

The background level is determined from measurements conducted outdoors within the noise sensitive area being assessed. If this is not possible or practicable, for example, due to the continuous operation of the industry, measurements are taken at a **background equivalent location**.

In major urban areas where only the industry premises being assessed impacts on the noise sensitive area considered, background level measurements are not necessary if it can be shown that the industry noise is at or below the base noise limits defined in Regulation 118(2), which represent the lowest values the noise limits can take (refer to section 3.1.3).

When determining the noise limits in rural areas, a measurement of the background levels is only required for background-relevant areas (refer to section 3.1.2). In this situation, the background level assessment can only result in an increase of the value of the noise limits (see Noise Protocol clause 24). For a given period, day, evening or night, it is not necessary to measure the background level if the cumulative noise of all industry impacting on noise sensitive areas meets the base noise limit or distance-adjusted level obtained from clause 20 of the Noise Protocol.

A background level measurement may also be used to ensure that, in rural areas, the noise limits are not set below the background level.

Measurement of the background level

For both the major urban area method and the rural area method, the background level is determined for each period as the arithmetic average of the $L_{A90,1\,hour}$ for each hour of that period for which the commercial, industrial or trade premises being assessed normally operates (refer Box 2).

The measured background level used to determine the noise limit must:

- be measured outdoors within the noise sensitive area, or at a background equivalent location
- include all noise sources except industry noise which appears to be intrusive at the measurement point
- exclude data affected by rain or windy weather and atypical or extraneous noise events, such as nearby construction activities or insect noise.

Noise Protocol clauses 39 to 51 set out the method for measuring and determining the background level.

Background levels are usually obtained from unattended noise monitoring conducted over several days (long-term measurement). In some circumstances, however, short-term attended

measurements can be used. More information on long and short-term background level measurements is provided below.

Background equivalent location

A background equivalent location can be nominated when it is not possible to obtain a background level at the assessment location, for example if the background noise cannot be measured due to the presence of intrusive industry noise.

The background equivalent location should be carefully selected so the background level represents the background at the relevant noise sensitive area in the absence of intrusive industry noise, considering the time of the day and the influence of surrounding background noise sources.

Specific consideration should be given to contributions of the main sources of background noise, such as distant traffic, for both the noise sensitive area and the background equivalent location. For example, if the measurement point is located near a road, an appropriate background equivalent location would be located further down the same road, where the intrusive industry noise cannot be heard.

The selection of a background equivalent location must be justified in the assessment report.

Using previous background level measurements

Data from recent background noise measurements for the relevant noise sensitive area or for a background equivalent location may be used to inform the noise limit provided:

- it has been measured following the procedures of the Noise Protocol
- it is reported in a verifiable reference that also documents the measurement conditions and the precise measurement location
- the adequacy of using this data has been thoroughly reviewed and is justified in the assessment report.

Long-term background level measurement

Long-term measurement of background levels involves continuous measurement of $L_{A90,1\ hour}$ for several days. This is to ensure enough valid data is collected to represent the background level for the day, evening and night periods during weekdays and weekends, as relevant to the operation of the premises being assessed.

A longer monitoring period may be necessary when the background measurement is affected by atmospheric conditions such as:

- if wind or rain affected the measurement over many hours or days, resulting in data being discarded, or
- if wind direction influences the background level at the noise sensitive area.

The measured $L_{A90,1\ hour}$ sound levels may be affected by wind direction where the noise sensitive area is located within a few hundred metres of a busy freeway: they can be greater if the noise sensitive area is downwind from the freeway and lower when it is upwind.

The procedures to determine the background level from long term measurements are detailed in Box 2.

Short-term background level measurement

When the background level cannot be measured over the full day, evening or night period within the considered noise sensitive area and a suitable background equivalent location cannot be nominated, the background level can be determined from two separate L_{A90} measurements of at least 10 minutes. It is best to allow at least 30 minutes between these two measurements. Infrequent louder events, such as a car horn, a dog barking or a car passing nearby, should be excluded from the measurements as these sounds can result in the measurement not representing the background level.

The background level is obtained using the arithmetic average of the two separate measurements.

The time for the short-term measurement must be chosen carefully, to ensure that the measurement represents the average $L_{As90,1\ hour}$ which would be determined using a long-term measurement if this had been possible. When the background is dominated by traffic noise and is not influenced by meteorological conditions, the daily pattern of traffic volumes can be used to decide on appropriate times for conducting short-term background level measurements. For example, in built-up urban areas, the background level for the night period from 10 pm to 7 am would usually be represented by short measurements obtained around 1 am.

If the wind direction influences the background level, long-term background level measurement should be used.

The reasons for adopting a short-term measurement and the precise times for the two measurements must be documented and justified in the assessment report.

Box 2: Determining the background level from long term measurements

Step 1: Review and validate the measured $L_{A90,1\ hour}$ data.

- Discard data affected by rain or measured with wind speed greater than Beaufort scale 3 (19 km/h) (Noise Protocol clause 41).
- For data measured with wind speed within Beaufort scale 3, consider the potential effect wind may have on the propagation of sound from sources of background noise, as well as on extraneous noise.
- Discard data that has been affected by extraneous noise or wind and does not represent the normal background in the noise sensitive area considered.
- If a day, evening or night period (or the part of a period that is relevant to the operation of the industry) is incomplete because data have been discarded due to adverse weather or extraneous noise, discard all data for this period.

Step 2: Calculate period-average $L_{A90,1\ hour}$ values for each period of each day.

- Use all valid measurements from step 1.
- For each individual measurement day, calculate the arithmetic average the values of $L_{A90,1\ hour}$ across each day, evening and night period, or across the part of a period that is relevant to the operation of the industry.
- When calculating this period-average $L_{A90,1\ hour}$, do not combine the average across different days of the week.

Step 3: Select appropriate background level for each period, considering the days and times that the industry normally operates.

- Compare the values of the period-average $L_{A90,1\ hour}$ calculated for each measurement day and period.
- Select the lowest value of the period-average $L_{A90,1\ hour}$ that occurs on a week day, considering weekends as follows:
    - **Saturday** – if the industry normally operates on weekends with the same operations as weekdays, include the Saturday period-average $L_{A90,1\ hour}$ in the weekday comparison for the day, evening and night periods.
      If industry operations on Saturday are different from weekday operations (for example, reduced capacity or using different equipment), the background level can be determined for both weekday and Saturday separately. For the latter, select the lowest value of the period-average $L_{A90,1\ hour}$ that occurs on a Saturday.
    - **Sunday** – as the evening period on Sunday is 7 am to 10 pm, the period-average $L_{A90,1\ hour}$ for Sunday is determined separately. In which case, select the lowest value of the period-average $L_{A90,1\ hour}$ that occurs on a Sunday.
    - **Public holidays** – as for Sunday, the evening period on a public holiday is 7 a.m. to 10 p.m. The period average $L_{A90,1\ hour}$ established for a Sunday can be used to inform the background level for a public holiday.

When the background measurement is affected by wind direction, select the lowest of the representative period-average $L_{A90,1\ hour}$ as the background level. For example, select the lowest period-average $L_{A90,1\ hour}$ that occurs when wind direction is favourable to the propagation of sound from the industry being assessed (as would be the case when the wind blows from the industry towards the noise sensitive area).

3.1.6. Road traffic noise measurement for background relevant areas (rural area method)

For high traffic noise areas (where the background noise is affected by high traffic noise), the Noise Protocol (clauses 25 to 28) can require road traffic noise measurement.

This applies only to the assessment of proposed developments (clause 25) and is not relevant when assessing existing premises (as illustrated in example 2 of Appendix F). It does not apply when assessing extensions or upgrades to existing premises.

It does not apply when the noise sensitive area considered is located in an industrial zone (whether an IN1Z, an IN2Z or an IN3Z), in a commercial 2 zone (C2Z), or in a Special Use Zone (SUZ) for which 'accommodation' is prohibited. For a special use zone, refer to the local planning scheme: if the schedule for the zone indicates that 'accommodation' is categorised in Section 3 in the table of uses, it is a prohibited use. For example, the table of uses in Schedule 2 of the Special Use Zone in Local Planning Provision 37.01 of the Ararat Planning Scheme (Ararat Rural City, n.d.), specifies that any use which is not in Section 1 or 2 of this table is prohibited. This is the case for 'accommodation'.

Road traffic noise measurement is to be conducted in accordance with Australian Standard AS 2702 *Acoustics – Methods for the measurement of road traffic noise*.

A measurement of the traffic noise L_{Aeq}, in free field conditions, for which the noise levels are not affected by the reflection on any surface other than the ground is preferred. If this is not possible or practicable, a reflection adjustment should be applied to the measurement.

The traffic noise L_{Aeq} value is the value measured over the day, evening or night period, as relevant to the operating hours of the premises investigated. For example, if the premises operate on weekdays only, from 7 am until 7 pm, the traffic noise L_{Aeq} for the day period will be the $L_{Aeq,11\ hours}$ measured from 7 am until 6 pm and the evening period traffic noise L_{Aeq} will be the $L_{Aeq,1\ hour}$ measured from 6 pm to 7 pm.

Class 1 (Type 1) equipment should be used for this measurement. AS 2702 allows for using Class 2 (Type 2) sound level meters but this would result in increased measurement uncertainty, that may affect the accuracy of the assessment.

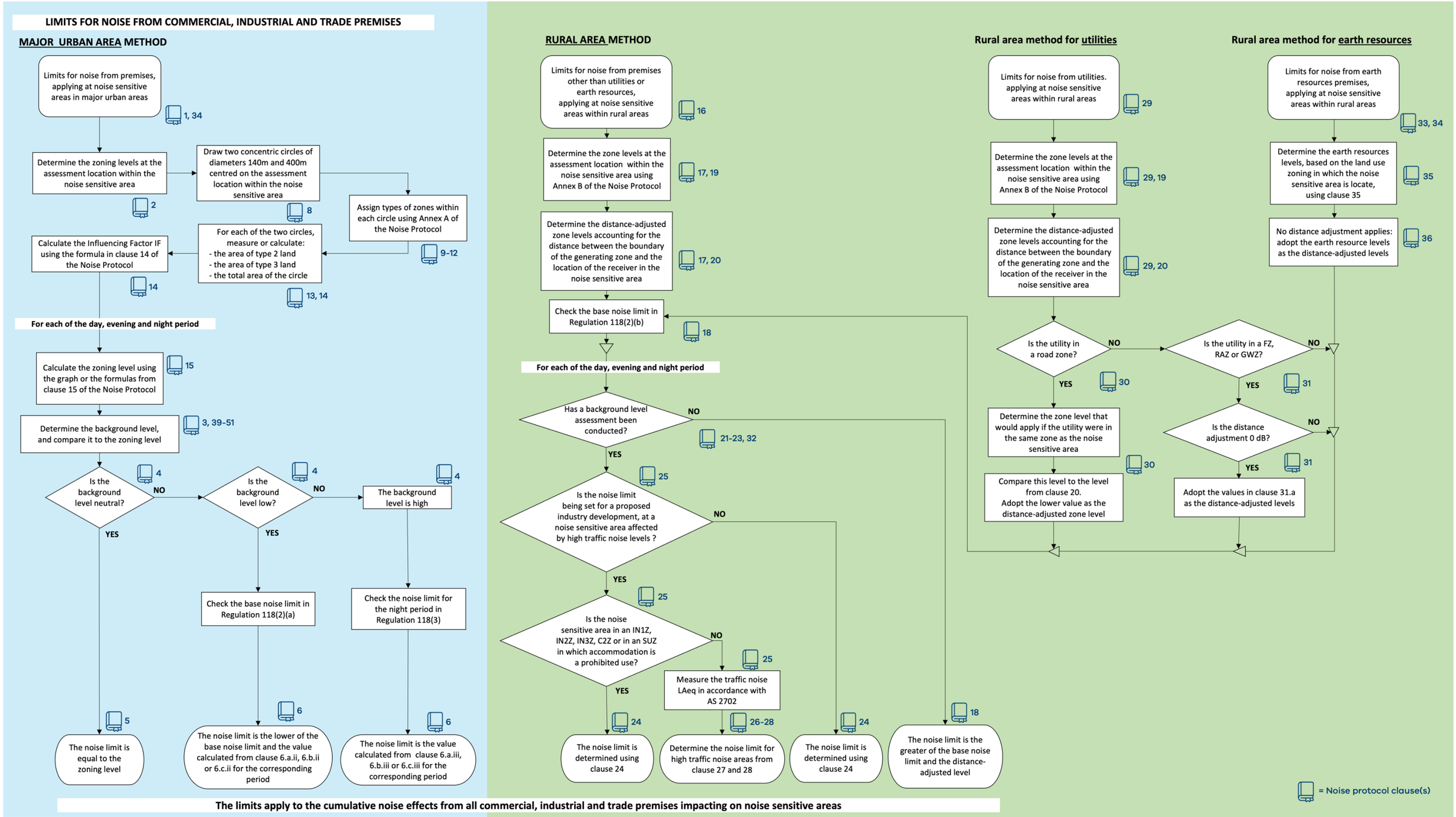

Figure 1: Process to determine the limits for noise from commercial, industrial and trade premises

3.2. Assessing industry noise

3.2.1. Assessment location

Industry noise must be assessed at a location in a noise sensitive area (as defined in Regulation 4) where the maximum effective noise level occurs (Noise Protocol clause 56). For existing premises, the effective noise level is based on the noise level measured when the industry assessed is in operation, adjusted for duration, noise character and measurement position (Noise Protocol clause 63 and sections 3.2.4, 3.2.5 and 3.4.4 of this guide). For proposed new industry, or extension of existing premises, predicted noise levels can be used in lieu of measurement, refer to section 3.5 of this guide. Adjustments may still apply, as relevant to the proposed operations and equipment planned.

The assessment location must be chosen so the highest effective noise level within the noise sensitive area is obtained, as relevant to the operating time of the noise sources. It can be determined based on:

- a review of all industry noise sources potentially affecting the noise sensitive area (this review should be used to select the most suitable location, time and operating conditions for the assessment)
- observations and spot measurements made during a visit to the noise sensitive area (refer to Appendix A).

The reasons for selecting the assessment location should be documented in the assessment report.

To protect activities that can take place outdoors during the day and evening (for example, conversation or normal recreational activities, such as entertaining or relaxing), the assessment location should be within the outdoor space of the noise sensitive area most exposed to the noise source. If it can be reasonably expected that activities to be protected will mainly occur indoors (for example, sleep at night), the assessment location should be outdoors, near or outside the sensitive room exposed to the highest noise levels.

Other factors that determine the choice of the assessment location include:

- the distribution of noise around the noise source
- potential variations in noise level due to the built environment or topography
- adjustments that may apply to reflect the duration and character of the noise anticipated in noise sensitive areas (refer to sections 3.2.4 and 3.2.5).

When assessing industry noise impacting on noise sensitive area where learning occurs, for example in child care centres, kindergartens, primary schools or secondary schools, consideration should also be given to the operating hours of the noise sensitive areas.

The flow chart in

Figure 1 can be followed to determine a suitable assessment location. The reasons for selecting an assessment location must be documented and justified in the assessment report.

3.2.2. Alternative assessment location and criteria for noise measurement

Alternative assessment location

An alternative assessment location is used when it is not practical to measure the industry noise where the maximum effective noise level occurs. It is used as a substitute location to facilitate the measurement of noise from existing industry.

The noise protocol specifies four reasons for which an alternative assessment location can be used (Noise Protocol clause 57): multiple premises impacting on noise sensitive areas, atmospheric conditions affecting the assessment within noise sensitive areas, access limitations impairing the suitability of the assessment location and presence of extraneous noise.

While an alternative assessment location may be either within or outside a noise sensitive area, the industry noise received at the alternative assessment location must represent the noise exposure within the sensitive area. The assessment report must justify the choice of the assessment location, particularly when it is not within the noise sensitive area.

If an alternative assessment location is used, alternative assessment criteria must be established for each period relevant to the operation of the premises being investigated.

The effective noise level measured at the alternative assessment location is compared against the alternative assessment criteria to determine whether the noise limits are exceeded.

Circumstances where an alternative assessment location may be specified are described in Noise Protocol clause 57 and include: multiple noise sources, atmospheric conditions, location suitability and the presence of extraneous noise.

Multiple noise sources

Where noise sensitive areas are affected by industry noise from more than one premises, an alternative assessment location can be used to assess an individual industry (refer to Noise Protocol clause 57(a)). The alternative assessment location should be located so that it represents the industry noise from only that individual premises.

The alternative assessment location should be located sufficiently far away from the noise source being investigated for it to appear as a point source. Section 3.3.1 details the procedures to determine the alternative assessment criteria that apply separately to each industry and the assessment is conducted following the stepped approach detailed in section 3.3.2.

Similar considerations apply when investigating noise from a single noise source within facilities that comprise of several noise sources (for example, a large plant with several pieces of equipment), or when the noise levels from the industry under consideration are not uniform in all directions (this can occur due to the distribution of noise sources or topography). In these cases, measurements at multiple locations may be needed. The number of alternative assessment locations and their position is informed by a survey of the noise sensitive areas surrounding the industry.

Atmospheric conditions

Atmospheric conditions, including temperature and wind gradients and atmospheric instability may have a significant influence on the noise level at the measurement point. This can be particularly important when the distance between the noise sensitive area and the

industry noise source exceeds 100 metres. At more than 500 metres, atmospheric conditions are likely to be the major source of variability in the noise level.

An alternative assessment location should be used when atmospheric conditions affect the noise levels within noise sensitive areas A measurement location unaffected by atmospheric conditions that is closer to the industry is advised. Atmospheric conditions that would result in the maximum effective noise levels within noise sensitive areas must be factored in the derivation of the alternative assessment criteria (Noise protocol clause 61 and 62).

If an appropriate alternative assessment location cannot be found, a specific measurement procedure applies (refer to section 3.4.2).

Suitability of the location

An alternative assessment location should be used when a measurement point in a noise sensitive area is not readily accessible or when a more suitable measurement point is required (for example, if the sound paths from the noise source are obstructed by non-sensitive buildings or structures within the noise sensitive area).

Presence of extraneous noise

Extraneous noise can affect the ability to conduct measurements. For example, when the industry noise levels are relatively low, extraneous noise sources such as local traffic, aircraft flyover, wildlife or rustling leaves may dominate the noise within the noise sensitive area. In this case, an alternative assessment location unaffected by extraneous noise can be used.

Alternative assessment criteria

If the assessment is conducted at an alternative assessment location, the measured effective noise levels are compared against alternative assessment criteria (Regulation 118(1)(b)).

These criteria apply at the selected alternative assessment location. The values of the alternative assessment criteria are set for each period to ensure that when the criteria are met, the noise emission will not exceed the relevant noise limits that apply within noise sensitive areas (Noise protocol clause 61).

The base noise limits set out in Regulation 118(2) and the maximum value of 55 dB(A) for the night period of Regulation 118(3) which apply to the noise limits within noise sensitive areas are not relevant when setting the alternative assessment criteria. In relation to the maximum noise limit of 55 dB(A), when an alternative assessment location is closer to the premises being assessed, the distance to the noise sensitive area is greater. As a result, the noise will attenuate to a greater degree due to geometrical spreading and other frequency-dependent attenuation over this extra distance. This additional attenuation means that in some instances, the alternative assessment criterion for the night period can be greater than 55 dB(A) and industry noise that meets this criterion at the alternative assessment location would meet the noise limit at the noise sensitive area.

For example, if:

- the noise limit that applies within the noise sensitive area for the night period is 53 dB(A)
- additional attenuation from the alternative assessment location to the noise sensitive area due to geometrical spreading over distance and other factors is 5 dB.

The alternative assessment criterion for the night period will be set to 58 dB(A).

An effective noise level of 57 dB(A) measured at the alternative assessment location. The effective noise level would not exceed the alternative assessment criterion, and it is equivalent to an effective noise level within the noise sensitive area of 52 dB(A), which is below the regulatory limit.

The determination of the alternative assessment criteria must account for the differences between the sound paths from the industry being assessed to the noise sensitive area, and the sound paths to the alternative assessment location. Consideration must be given to factors that affect the propagation of sound, such as separation distance, directivity of the noise sources, ground cover, atmospheric conditions, barriers, buildings and other structures that can shield or reflect noise (Noise protocol clause 62). Because most of these phenomena are frequency-dependent, the determination of the alternative assessment criteria should take into account the frequency spectrum of the noise.

To ensure the alternative assessment criteria represent the maximum effective noise levels occurring within noise sensitive areas, their derivation must consider atmospheric conditions favourable to the propagation of sound from the industry to the affected areas.

The alternative assessment criteria must also consider the adjustments for noise character (refer to section 3.2.5) and the cumulative noise when other industry premises affect the same noise sensitive area.

The alternative assessment criteria must be determined using a suitable noise calculation algorithm (refer to section 3.5.2). The selected methodology must be substantiated by using:

- a recognised noise calculation algorithm that has been validated for the circumstances of the assessment (refer to section 3.5.2)
- robust assumptions that are justified and traceable.

The alternative assessment criteria must also make provision for potential uncertainties introduced by the calculation. The choice of the noise calculation algorithm, the assumptions made, and the uncertainty must be clearly documented in the assessment report.

An example of alternative assessment is given in Appendix G.

3.2.3. Effective noise level

The effective noise level is the indicator used for assessing industry noise and is defined as an $L_{Aeq,30min}$ in Noise Protocol clause 63. It is assessed at a point within the noise sensitive area and is adjusted to account for:

- duration of emission of the noise investigated (refer to section 3.2.4)
- noise character (refer to section 3.2.5)
- measurement position (refer to section 3.4.4).

When assessing noise from existing premises, the effective noise level is determined for each period (relevant to the operations of the industry) using measurements conducted at the assessment location within a noise sensitive area, or at an alternative assessment location. The measurements must be conducted in accordance with clauses 71 to 90 of the Noise Protocol.

When predicting noise from proposed new industry or extension of existing premises, the effective noise level is determined from acoustic calculations conducted in accordance with clause 70 of the Noise Protocol, refer to section 3.5 of this guide.

Assessing aggravated noise

The measurement of the effective noise level to determine if noise is aggravated, as defined in Regulation 121, is also conducted in accordance with the Noise Protocol. This guide also applies.

3.2.4. Duration adjustment

The duration adjustment applies when noise emissions from the industry under consideration do not occur over the whole of a continuous 30-minute period. The duration adjustment is calculated from the proportion of time the industry is operating over the measurement duration (% on-time). The total time of operation includes times when the industry noise at noise sensitive areas is masked by background or extraneous noise.

Figure 2 shows the value of the duration adjustment for different emission durations. It may be used as an alternative to the duration adjustment equation given in clause 80 of the Noise Protocol.

The duration adjustment does not apply to the individual components of the industry noise. For example, if the noise consists of a continuous rumble with an occasional tonal component, a duration adjustment is not applied to account for the limited time during which the tone occurs.

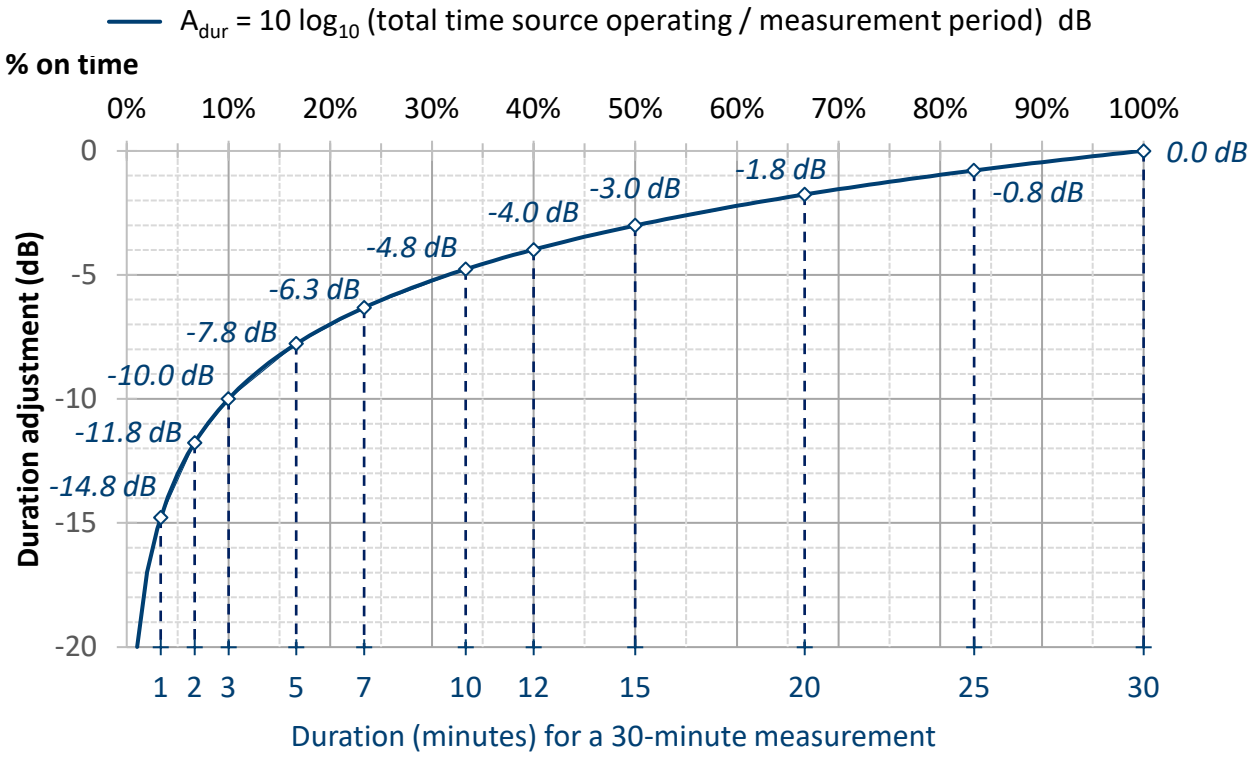

Figure 2: Duration adjustment based on the percentage on-time of the noise source

Duration associated with impulses

Noise protocol clause 86 stipulates that, when determining the duration adjustment, each impulse within the 30-minute assessment period is deemed to be audible for 10 seconds immediately after the occurrence of the impulse noise.

This provision:

- applies when the noise is *impulsive in nature* (noise that consists of impulses only, without industry noise occurring between each impulse).
- is not relevant to noise which is *impulsive in character* and consists of impulses emitted in combination with continuous (or transient) industry noise for which the duration adjustment is calculated from the length of time for which the continuous or transient noise is emitted.

For noise that is impulsive in nature, the total time for which the source is considered to be operating is calculated by summing:

- for each individual impulse, which is not followed by another impulse for at least 10 seconds: a duration of 10 seconds
- for multiple impulses that are separated by less than 10 seconds: the time between the occurrence of the first impulse and 10 seconds after the last impulse.

An example is given in Appendix B.

The character adjustment for impulsiveness (Noise protocol clause 85) still applies and a tonal adjustment applies where relevant (clauses 82 to 84). The character adjustments are described in section 3.2.5.

3.2.5. Adjustments for noise character

Character adjustments relate to the following features that increase annoyance and are relevant to:

- tonal noise (such as humming, droning, whining or squealing)
- noise impulsive in character (for example noise including banging or hammering)
- intermittent noise (when the industry noise being assessed varies and gets louder then drops back to the original lower level; it does not apply when the noise is emitted and stops, even several times across the 30-minute assessment period).

The methods to determine their values are detailed in Noise Protocol Part I:B section 3.4 (clauses 82 to 88) as summarised in

Table 1).

For assessment of existing premises, the value of a character adjustment can be determined from observations made during the measurement and/or analysis of the measured data.

When assessing proposals for new industry or for extension of existing industry, the likely potential character adjustments must be included in the determination of the effective noise level, refer to section 3.4 of this guide. The adjustment(s) to apply, and their value, are to be determined based on knowledge of the noise source(s).

For assessment of existing industry and proposed developments, the value of a character adjustment must be justified in the assessment report. The decision and reasons for discarding or not using character adjustments must also be documented in the assessment report.

Table 1: Summary of adjustments to measurements of industry noise to account for noise character

Adjustment for noise character		Value	Noise Protocol clauses
A_{tone}	Tonality	+2.0 dB or +5.0 dB	82 to 84
A_{imp}	Impulsiveness	+2.0 dB or +5.0 dB	85 and 86
A_{int}	Intermittency	+3.0 dB or +5.0 dB	87 and 88

Character adjustments based on observations made during the measurement

If tonal or impulsive noise character is evident when listening to the industry noise, the relevant adjustments must be applied, unless the tonal or impulsive character of the noise is sporadic.

Tonal or impulsive character can be considered as sporadic when it is due to atypical events that do not reflect the general character of the noise and are very short and infrequent, hence occurring over a limited time such as less than a cumulative 30 seconds across any 30-minute assessment period. For example, a squealing tonal noise caused by equipment malfunction may not be included in the assessment if it sporadic. However, the general environment duty and unreasonable noise provision in section 166 of the Act would still apply and may warrant mitigation measures to be taken.

If impulsiveness is a characteristic of the noise being assessed, the impulse adjustment is:

- +2 dB for impulsiveness that is just detectable when listening intently to the noise; or
- +5 dB for impulsiveness that is readily detectable.

If the industry noise being assessed has tonal character, the tonal adjustment is:

- +2 dB for tonal character that is just detectable, such that it is noticed when listening intently to the noise; or
- +5 dB for tonal character that is prominently audible such that it is noticed even when not paying specific attention to the noise.

The objective method for tonal adjustment in Annex C of the Noise Protocol is not to be used to identify whether a tone is present. It should be used when tonal noise is heard, but observations, or listening to the noise, do not provide certainty with regards to the value to apply for the tonal adjustment (Noise Protocol clause 84). An example of objective assessment for tonal adjustment is given in Appendix C.

Character adjustment based on analysis of the measured data

If the noise being assessed varies in level, increasing rapidly and maintaining the higher level for at least one-minute on two occasions during the measurement interval, the intermittency adjustment is determined by a review and analysis of the measured data.

The value of the intermittency adjustment is based on the change in level from the lower level to the higher level and the time period being assessed. (Noise Protocol clause 87 and 88).

3.3. Assessing industry noise from multiple premises

3.3.1. Assessment criteria for multiple industry

The noise limits apply to the cumulative noise from all industry premises contributing to the effective noise level (Regulation 119). As result, the effective noise level must include the combined noise from all industry sources at the assessment point in the noise sensitive area.

Where two or more premises emit or are likely to emit noise which contributes to the effective noise level, each industry must take all reasonable steps to ensure that the individual contributions, when combined, do not exceed the noise limit for the noise sensitive area for each of the day, evening or night period.

In other words, the noise limit must be 'shared' between all premises contributing to the noise within the noise sensitive area. To achieve this, the noise emissions of each individual industry should be controlled to meet noise levels lower than the noise limits.

Existing premises

In both major urban areas and rural areas, if multiple existing industries affect noise sensitive areas, the first consideration is to apply an equal sharing principle:

- When assessing the emissions of a single premises within several industry premises, the noise level to meet is reduced by an amount calculated from the number of premises contributing to the noise, where *N* is the total number of industry premises.

  A value of 10 x log10(*N*) is subtracted from the noise limit to establish the assessment criteria that applies to each individual premises. This value is in decibels and examples are shown in Table 2.

  The number of industry premises *N* to be considered must not only include all existing premises, but also consider other industries that are likely to be developed in the foreseeable future, for example consider the vacant allotments in an industrial or commercial zone.

Table 2: Example of values of 10 x log10(N), rounded to one decimal point.

N	10 x log10(N)
1	0.0 dB
2	3.0 dB
3	4.8 dB
4	6.0 dB
5	7.0 dB

N	10 x log10(N)
6	7.8 dB
7	8.5 dB
8	9 dB
9	9.5 dB
10	10.0 dB

The equal sharing principle may be too simplistic in complex situations where the amount of noise each individual premises contributes to the cumulative noise within sensitive areas varies to a large degree. This can be the case if, for example,

- there is a large diversity in the size or nature of the industries affecting noise sensitive areas,
- the distance from each individual premises to the noise sensitive area varies greatly, or

- the practicability of noise control varies greatly between the different premises.

Rather than applying the equal sharing principle, noise reductions achievable from each site need to be investigated to obtain a suitable outcome. It may then be relevant to adopt individual criteria that give regard to the circumstances of each premises.

Proposed new industry or extension of existing premises in major urban areas

For new industries, plant expansion or major new sources in major urban areas, including new industry areas in an urban growth zone, the equal sharing principle applies. The contribution of the proposed development should be abated to meet, for each of the day, evening, or night period, a level set below the relevant noise limit by 10 x log10(*N*) decibels, where *N* is the total number of existing and likely contributing industry premises.

New individual noise sources located within existing premises should be chosen, sited, or abated so that the noise contribution within noise sensitive areas is 10–15 dB below the noise limit.

When considering the noise design for the proposal, the applicant, acoustic consultant and approval body should discuss the noise design objectives at an early stage.

Proposed new industry or extension of existing premises in rural areas

In rural areas, new industry plant or operations should be designed so that their emissions are less than the noise limits.

Circumstances for which the equal sharing principle applies for new industry developments include:

- where there is existing industry impacting on noise sensitive areas
- sites where there are multiple small commercial, industrial or trade premises.

The contribution of the proposed development should then be abated to meet, for each period of the day, a level set below the relevant noise limit by 10 x log10(N) decibels, where N is the total number of existing and likely contributing industrial plant installations (refer Table 2).

Otherwise, a future-proofing approach should be adopted in areas where there is a likelihood of further industrial growth, as is the case for:

- industrial premises in an Industrial 1 zone (IN1Z) or in an Industrial 2 zone (IN2Z), with at least two other allotments in the same zoned piece of land
- industrial premises on an allotment greater than 10 ha in any zone where expansion is likely.

The contribution from an individual site to the noise within noise sensitive areas in rural areas should be no greater than the noise limit minus five decibels (for each period of the day). This 5 dB reduction from the noise limit is provided on the presumption of three premises in the industrial zone will ultimately affect the noise sensitive areas. Where there is a high potential for industry development, to prevent the combined noise from exceeding the noise limits as more industries are developed over time, a lower level may be required.

3.3.2. Assessing multiple premises

Where two or more premises contribute, or will contribute, to the industry noise within the noise sensitive area, both the cumulative noise and the contribution from each individual industry needs to be assessed separately.

The assessment should follow, for each of the day, evening, or night period, the following steps:

1. Assess the effective noise level for all industry combined at the noise sensitive area.
2. If the noise limit is exceeded, nominate an alternative assessment location (refer to section 3.2.2) and assess the contribution of the premises under investigation against the relevant alternative assessment criterion, giving regard to the balance of contributions from the other industry premises (refer to section 3.3.1).
3. If the effective noise level at the alternative assessment location exceeds the alternative assessment criterion, take all reasonable steps to meet the alternative assessment criteria. This includes working with other industries to reduce their emissions so that the noise limit is not exceeded within the noise sensitive area.

To establish an adequate balance of contributions, step three involves considering the circumstances of each individual industry and the noise reductions achievable from each site. Particular attention should be given to:

- the diversity in the size or nature of the industries affecting the noise sensitive area
- the difference in the distance separating the various premises from the noise sensitive area
- the practicability of noise control of each premises.

If there are existing noise sources and a new proposed use would bring noise levels in the area above the noise limits, the approval body will need to investigate what noise reductions are achievable from those existing sites to obtain a suitable outcome.

3.4. Measuring industry noise from existing premises

This section provides the general procedures that should be followed when conducting measurements of industry noise. Detailed requirements for equipment and measurement methodology are provided in Appendix A.

This guide applies to the measurement of the effective noise level to determine unreasonable noise (Regulation 108) and aggravated noise (Regulation 121).

3.4.1. Measurement point

The measurement point is the point where the microphone is located when conducting a noise measurement. Follow the flow chart in Figure 3 when deciding where to locate the measurement point within a noise sensitive area or at an alternative assessment location (refer to section 3.2.2).

The noise limits are set as outdoor levels because activities within noise sensitive areas can occur in outdoor areas or indoors with windows open. As a result, priority is given to outdoor noise measurements. The Noise Protocol Part I:B section 3.1, describes the requirements for the measurement point for both outdoor measurement (clauses 71 to 73) and indoor measurement (clauses 74 and 75).

Measuring indoors is not always practicable as it requires access to buildings and can disturb the occupants. If necessary, it is acceptable to deploy the microphone on a balcony or via a boom held inside and passed outside through an open window. A reflection adjustment must then be applied to the noise measurement.

When an outdoor measurement within the noise sensitive area is neither possible nor representative of the noise exposure experienced within a sensitive room, the preferred option is to conduct outdoor measurements at an alternative assessment location. This location can be away from the noise sensitive area, at a location that represents the noise exposure at the noise sensitive area (refer to section 3.2.2).

When an outdoor measurement within the noise sensitive area or at an alternative assessment location cannot be made or does not represent the noise exposure within the noise sensitive area, an indoor measurement must be conducted, as detailed in section 3.4.3.

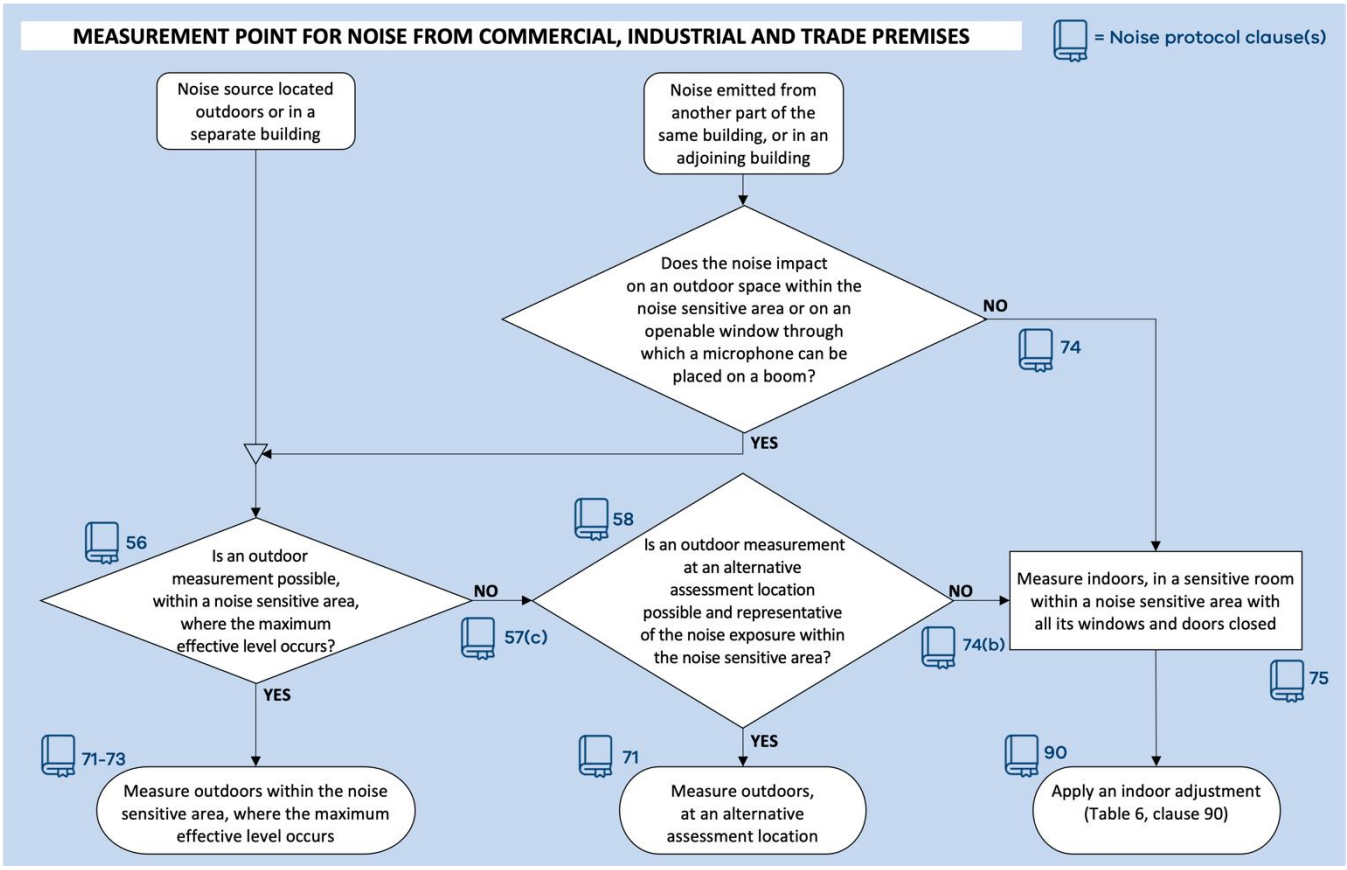

Figure 3: Measurement point for noise from commercial, industrial and trade premises

3.4.2. Measurement point affected by atmospheric conditions

If the noise levels within the noise sensitive area are influenced by atmospheric conditions, the Noise Protocol (clause 76) specifies that measurements must be conducted at an alternative assessment location.

However, if an alternative assessment location is not available, the Noise Protocol specifies that the effective noise level can be determined from three measurements taken within a 30-day period at the noise sensitive area (clauses 77 and 78).

The reason for adopting this approach must be justified in the assessment report, which must demonstrate that an alternative assessment location was not suitable.

- The measurements must reflect the worst-case scenario of exposure. The following method must be followed:
- When preparing for measurements, review the anticipated operation conditions of the noise sources, and the weather forecast.
- Conduct attended measurements during the 30-day period on days when the noise source is operating in its loudest conditions, and the atmospheric conditions are favourable to the propagation of sound from the noise source to the noise sensitive area.
- If there is a limited time to complete the measurements within 30 days from the first measurement, choose any day with appropriate atmospheric conditions that will allow for valid measurements (no rain, low winds).
- Adjust each of the three measurements for duration, character and measurement position, as relevant (refer sections 3.2.4, 3.2.5 and 3.4.4).

- Calculate the arithmetic average of the three adjusted measurements to obtain the effective noise level.

3.4.3. Indoor measurement

When the noise is to be assessed indoors, consider the building orientation and the transmission path of the noise into sensitive rooms.

Internal noise levels depend on the noise reduction provided by the building envelope which varies from one building to another, as the design, materials and construction methods may differ. Noise levels can also vary from one room to another within the same building. The quality of the building maintenance also plays a very important role in how it sustains its acoustic performance.

Noise levels within a building are also affected by acoustic effects of the room, such as reverberation and non-uniformity in the sound levels, which depend on the dimension and the configuration of the room, as well as on the internal finishes and furniture. Also, noise from appliances, building services and indoor activities can affect the noise levels indoors.

An outdoor measurement point is to be used in most cases because owners and operators of the industry premises being assessed generally have no control over these factors that affect the noise levels inside buildings. Clause 74 of the Noise Protocol describes the circumstances when the measurement point must be located indoors:

a. the noise, including vibration induced noise (structure-borne noise), is transmitted into the affected room through a solid wall, floor or ceiling from another part of the same building or an adjoining building

b. an outdoor measurement that represents noise exposure within the noise sensitive area cannot be undertaken, neither within the noise sensitive area, nor at an alternative assessment location, even when a microphone is placed through a window opening on a boom.

In some circumstances, an outdoor measurement point might not represent the noise exposure in affected sensitive rooms and an indoor measurement point is required. For example, where:

- the most exposed part of the noise sensitive area is the side of a building that acts as a noise barrier to the outdoor spaces located behind it; or
- the building envelope has been designed and constructed to include specific noise control treatments, such as acoustic glazing; or
- the noise sensitive area does not include an outdoor area and has fixed windows, which could be the case for an apartment in a high-rise building.

Indoor measurements can only be made in a sensitive room. The room should be unoccupied but ready for occupancy.

To accurately represent the exposure to the noise being assessed, the influence of internal noise sources such as appliances, ventilation and air conditioning systems and other building services must be minimised by turning them off, or by conducting measurements when they are not operating.

The measurement point(s) should be at least 1 metre from the walls or other major reflecting surface, 1.2 to 1.5 metres above the floor and about 1.5 metres from windows. Measurement at the centre of the room should be avoided as far as possible.

When conducting an indoor measurement, the expected occupancy positions within the sensitive room should be considered and regard given to the adjustments for noise character, refer to section 3.2.5.

The measurement point should be at the position where the greatest effective noise level occurs, or at a point representing the noise at this position. This may require investigating how sound is distributed across the room when the noise has strong low frequency content (octave band 250 Hz and below), which may result in noise levels varying significantly between measurement points due to room effects.

The adjustment for an indoor measurement described in section 3.4.4 is applied to represent the effective noise level outdoors, which is compared to the noise limit.

It is necessary to measure the indoor noise levels in octave bands or one-third octave bands if a site-specific indoor adjustment is used based on the noise reduction performance of the building envelope.

3.4.4. Adjustments for measurement position

When the noise has been measured indoors or near a sound reflecting surface other than the ground, adjustments may be made to account for the measurement position. These adjustments only apply when the noise has been measured. They do not apply to predicted levels from proposed developments.

Table 3: Summary of adjustments to measurements of industry noise to account for measurement position

Adjustments for measurement position		Value	Noise Protocol clauses
A_{ref}	Reflection	- 2.5 dB	89
A_{ind}	Indoor	Varies (see Table 6 of Noise Protocol)	90

Reflection adjustment

The value for the reflection adjustment is consistent with that given in Australian standard AS 1055:2018. The reflection adjustment is a negative adjustment that accounts for the incident sound waves and sound waves being reflected back off the reflecting surface being measured simultaneously. The reflection adjustment applies only to outdoor measurements.

Indoor adjustment

When the assessment based on an outdoor measurement is not possible, the effective noise level is determined from an indoor measurement (refer to section 3.4.3). The indoor adjustment applies and is used to assess the industry noise against the noise limits that are outdoor noise levels (Noise Protocol clause 90).

The indoor measurement and indoor adjustment specified in the Noise Protocol are not intended to be used to check the effectiveness of the design response or the construction of

buildings affected by industry noise, as may be required, for example, by a planning permit for a new noise sensitive use.

The value of the indoor adjustment varies with the noise reduction performance of the building envelope and the transmission path for the noise intruding into the sensitive room considered (Table 6 in Noise Protocol clause 90).

When assessing industry noise against the regulatory noise limits –

- **if the noise reduction performance of the building envelope is known** or can be determined in octave (or in one-third octave band), the indoor adjustment should be calculated, considering the frequency spectrum of the noise measured.
- The assessment must give regard to the uncertainty associated with the method used to determine the noise reduction performance of the building envelope. Potential secondary transmission paths (flanking) and sound leakage should also be considered.

  Situations where the noise reduction performance of the building envelope may be known include:

  - where the building envelope was required to include noise control treatments to meet a given acoustic performance, and has been constructed, designed and maintained to meet this specification
  - if the noise reduction performance has been measured, using a test procedure based on recognised Australian or international standards (for example ISO 16283-3)
  - when the acoustic design of the building, details of the materials and construction and of the building condition are known, allowing for a prediction of the noise reduction performance of its envelope.
    In this situation, the prediction must:

    i. be conducted using the methods of international standard ISO 12354-3 or an equivalent method
    ii. consider the room effect represented by the room equivalent sound absorption area; the equivalent sound absorption area of the room can be determined from the room volume and a measurement of its reverberation time using a test procedure based on recognised Australian or international standards such as AS/NZS 2460, or from calculations made using a valid engineering calculation method (refer, for example, to section 6.5.2 of Bies, Hansen & Howard, 2018)
    iii. consider the uncertainty associated with inputs to the prediction, such as material acoustic data, must be considered.

- **if the noise reduction performance of the building envelope is not known**, the indoor adjustment is determined from a generic value.

  As contemporary constructions can generally be expected to provide better sound insulation against external noise (refer Box 3 below), the generic value of the indoor adjustment is set to:

  - 20 dB where the building envelope meets or exceeds energy efficiency requirements set out in the Building Code of Australia (BCA) 2006; or
  - 15 dB where the building envelope does not meet energy efficiency requirements set out in the BCA 2006.

Box 3: Applying the generic values for the indoor adjustment

Energy efficiency measures were introduced for all building classifications other than housing in BCA 2006 Volume One (ABCB, 2006), and the provisions for housing were then increased in stringency to 5 star or equivalent (ABCB, 2016). While this requirement was aimed at improving the thermal performance of buildings, it also resulted in a better quality of construction with regards to the insulation against external noise.

If the noise reduction performance of the building envelope is not known, a building designed and constructed in 2006 or later, and that is adequately sealed and maintained, is deemed to satisfy the requirement for an indoor adjustment of 20 dB. This adjustment also applies to buildings that have been subject to alterations conducted in 2006 or later and which required the entire building to be brought into conformity with the building Regulations, for example alterations that represent more than 50% of the volume of the original building (refer to clause 233 of the Building Regulations 2018 and equivalent clause 608 of the Building Regulations 2006).

The 20 dB indoor adjustment is relevant for buildings constructed or altered earlier if the quality of the design and construction is equivalent to or better than that required for new buildings in the BCA 2006. For example, an apartment building designed and constructed in 2005 would be eligible for an indoor adjustment of 20 dB since the requirements for energy efficiency for new class 2 buildings in the BCA 2006, already applied in Victoria since 1 July 2004 (ABCB, 2004).

Lightweight constructions

The most effective constructions for sound insulation are heavy constructions such as dense concrete or masonry, or two-leaf sandwich panels with a wide cavity filled with fibrous insulation and no rigid connections between the leaves, which can reach a performance equivalent to that of heavy constructions and would translate to a similar value of the sound insulation rating R_w+C_{tr} or $D_{n,T,w}+C_{tr}$.

Light weight constructions such as light weight prefabricated panel, rigid foams or polystyrene panels are usually less effective at reducing noise intrusion, particularly at lower frequencies.

If the building envelope consists in a lightweight construction and the spectrum of the noise is such that the noise reduction performance of the building envelope is limited, the 20 dB generic value for the indoor adjustment may result in an over-estimate. This may occur, even if the building meets the energy efficiency requirement of the BCA 2006.

In this situation, it is preferable to determine the indoor adjustment based on predictions of the noise reduction performance of the building envelope. If there is not sufficient information for these predictions, it may be suitable to use the generic 15 dB value for the indoor adjustment, subject to a detailed justification in the assessment report.

Building condition inspection

When conducting an indoor measurement, it is important to inspect the building to ensure that there is no air passage or air leakage that would result in a transmission path for sound into sensitive rooms and affect the internal noise levels. This may affect the value of the indoor adjustment for buildings for which a 20 dB adjustment would apply (when adequately sealed), particularly if:

- there are openings or vents (such as openings for natural ventilation, chimneys or flues) that do not close airtight or have not been acoustically treated to reduce the intrusion of external noise
- windows and external doors are not fitted with compressible seals and do not close airtight
- there are gaps, especially at the junction of constructing elements, for example roof eaves, or around penetration of pipes and ducts
- the building has not been maintained in a good condition and its acoustic performance is compromised, for example due to building movement resulting in gaps.

These observations should be reported in the assessment report.

The handbook *Sound transmission and insulation in buildings*, published by the Australian Buildings Codes Board (ABCB, 2018) provides general guidance on how to achieve acceptable acoustic outcomes within buildings. While it deals essentially with acoustic design within buildings, this handbook provides good acoustic design principles and guidance for the treatment of joints and penetration. These can inform a strategy for inspecting the quality of construction with regards to its performance to reduce the intrusion of external noise

3.5. Proposed new industry or extension of existing premises

3.5.1. Predicting industry noise

The noise limits and assessment methods of the Noise Protocol apply to proposed new industry or extension of existing premises.

Consistent with the General Environmental Duty, proposals that present a risk of noise must be designed and constructed to incorporate measures to reduce the harm from noise emissions at the commencement of operation.

Not incorporating design features to meet the noise limits at the outset may result in difficult and expensive retrofitting measures required later to address excessive noise. Also, after installation, options for noise reduction measures, such as adopting quieter equipment or relocating equipment, can be limited or more expensive to implement than they would be during the design phase.

For proposed new industry or extensions of existing premises, the effective noise level must be calculated following the requirements in clause 70 of the Noise Protocol.

Box 4: Adjusting predicted noise levels

The duration and noise character adjustments that will apply to the noise levels experienced in noise sensitive areas must be considered in relation to the operations and equipment planned for the proposed new industry or extension of existing premises.

The values adopted for these adjustments must be justified and should be determined from verifiable data, such as manufacturer specifications based on accredited tests, or results of assessments conducted at installations equivalent to the proposal.

If it is unclear whether an adjustment should be used, a conservative approach should be adopted, and an adjustment should be applied by default. Similarly, if there is doubt about the specific character adjustment value, a higher value for this adjustment should be adopted.

The assessment report must detail the choices made for all adjustments. This includes providing justification for when some character adjustments are not applied.

When predicting noise from a proposed new industry or extension of existing premises, the simplest situation is generally when the proposal includes one or few noise sources:

- located outdoors
- that can be modelled as point sources emitting sound equally in all directions
- with unobstructed line of sight to noise sensitive areas.

For such situations, if there is a short distance between the noise source(s) and the noise sensitive areas (for example, less than 50 m), noise levels can be estimated from simple calculations that consider the attenuation of sound with distance and potential reflections on rigid surfaces.

Otherwise, a more comprehensive noise calculation algorithm that accounts for the factors that can affect the propagation of sound should be used. While several algorithms suitable to predict industry noise in complex situations are available, the procedure adopted should be fit for purpose for the situation to be modelled. The selection of the noise calculation algorithm should be justified in the assessment report, which should provide the reference for the literature documenting the circumstances for which the algorithm has been developed and validated.

3.5.2. Noise calculation algorithms

Sound paths and other factors that can affect the propagation of sound include geometrical spreading, source directivity, meteorological and ground effects, air attenuation, shielding and diffraction of sound by obstacles and barriers, multiple reflections of sound, and reflections on non-rigid surfaces.

A validated engineering calculation method should be used to obtain the predicted noise levels. Examples include the procedures for outdoor propagation of sound of international standard ISO 9613-2 and the CONCAWE noise model (CONCAWE, 1981). Other calculation methods can be used, provided their ability to accurately predict noise levels for the specific situation under investigation has been validated and documented, together with the calculation uncertainty, in a verifiable reference.

For noise sources confined within buildings, the noise reduction provided by the building should be predicted based on calculation methods of recognised standards, such as international standard ISO 12354-4. Calculations based on material data for the sound insulation performance of the building envelope obtained from laboratory measurement must consider the risk of diminution in performance of field installations and the secondary sound transmission paths. Similar considerations apply to material data determined from mathematical modelling, the uncertainty of which should also be factored in the assessment.

Noise sources that are not point sources must be adequately modelled. For example, area sources such as roof, walls, windows, door or louvres, can be divided into small area sections, each represented by a point source at its centre.

Computer modelling should be used in complex situations, such as when there are many noise sources or noise sensitive areas, or in the case of complex topography. It can be particularly useful to generate noise contour maps that provide a better understanding of the spatial distribution of noise levels. Several commercial software packages allow for calculations using recognised algorithms. The choice of a software is dependent on whether it uses an appropriate noise prediction model for the specific circumstances under investigation. This must have been established by the developer or the distributor of the program and documented in verifiable references.

3.6. Reporting requirements

3.6.1. Assessment report

The assessment report should document the methodology used clearly and accurately with sufficient details to ensure that:

- the noise assessment (measurements, calculations, analysis) can be replicated by another suitably qualified acoustic practitioner
- any deviation from the procedures of this guide found necessary during an assessment is justified
- all assumptions and uncertainties are documented, together with details on how they have been taken into account in drawing conclusions for the assessment.

Measurement results and input data for calculations must be from verifiable sources that are clearly referenced.

The information provided for each assessment location should include, as a minimum:

- details of noise source and the aim of the investigation
- details of operating conditions of the industry premises being assessed and all other relevant site-specific data
- details of assessment location, including the address of assessment location and/or GPS coordinates
- the determination of background levels for each of the day, evening and night periods, detailing weekdays and weekends as relevant, and where applicable, justification for the selection of a background equivalent location
- applicable noise limits
- zoning maps and calculation of zoning levels in the case of industry noise
- details of other noise sources contributing to the effective noise levels

- results and interpretation, including relevant noise level data such as spectral data, where applicable
- determination of the effective noise levels, including details of all adjustments – and justification for when some character adjustments have not been applied
- a statement of whether (or not) the effective noise levels comply with the noise limit for each time period of concern.

3.6.2. Reporting requirements for noise measurements

For all noise measurements (background and industry noise), the following needs to be reported:

- dates and times of noise measurements
- list of all equipment used – including brand, model, serial number and calibration status, as well as any specific settings used
- microphone position and orientation
- microphone height above ground level or floor level
- distance from sound reflecting surfaces
- date, time and measured levels for field calibration checks conducted
- atmospheric conditions at the time of measurement (refer to section 3.4.2)
- other relevant information – for example, field notes/observations, description of building facade, and photographs of microphone position demonstrating that it is in an appropriate location.

If an alternative assessment location has been used for industry noise measurements, the assessment report must provide:

- justification for the selection of an alternative assessment location
- details of the calculation of the alternative assessment criteria, including the basis for the noise calculation algorithm used, the underlying assumptions and the methods for accounting for potential uncertainties.

If an indoor measurement has been used for industry noise measurements (refer to section 3.4.4), the assessment report must provide:

- reason for an indoor measurement
- room dimensions and description of the internal finishes and furniture, details on internal noise sources

details of the room in which the measurement has been conducted, including dimensions, furniture, and potential internal noise sources

- location(s) of the indoor measurement point(s) and justification for its (their) selection

justification for the value of the indoor adjustment used.

3.6.3. Reporting requirements for industry noise predictions

The assessment report for proposed new industry or extension of existing premises (refer to section 3.5) should include details and justification of:

- the noise calculation algorithm used
- all inputs to the calculations, including sound power, frequency spectrum and directivity of the noise sources

- all assumptions made, including operating conditions, noise mitigation measures, topography, atmospheric and ground conditions
- the values adopted for potential duration and character adjustments, including justification for when some adjustments are not applied.

The assessment report should also discuss the uncertainties associated with the calculations, the input data and the assumptions made. It should detail how these uncertainties have been taken into account in drawing conclusions for the assessment.

Box 5: Rounding rules

The effective noise levels, noise limits, alternative assessment criteria, zoning levels and background levels must be reported to the nearest whole number.

For effective noise levels:

1. Report the measured level to one decimal place.
2. Apply adjustments as relevant.
3. Round the final result to the nearest decibel. When the decimal is .1 to .4, it is **rounded down** to the nearest integer. When the decimal is .5 or higher, it is **rounded up** to the nearest integer.

For example, when the only adjustment necessary is a reflection adjustment (–2.5 dB):

- If the measured noise level is 58.85 dB, the adjusted measured noise level is calculated as 58.9 – 2.5 = 56.4 dB.
  The effective noise level is then reported as the nearest integer value (56 dB).
- If the measured noise level is 58.97 dB, the adjusted measured noise level is calculated as 59.0 – 2.5 = 56.5 dB.
  The effective noise level is then reported as the nearest integer value (57 dB).

4. Noise from entertainment venues and outdoor entertainment events

The Regulations (Part 5.3, Division 4) and the Noise Protocol (Part II) set out requirements for the assessment of music noise from entertainment venues and events. Limits for music noise from entertainment venues are set to protect noise sensitive areas from unreasonable noise levels of music noise from:

- outdoor entertainment venues
- outdoor entertainment events
- indoor entertainment venues.

The music noise limits, and the accompanying assessment methods, differ for indoor venues and outdoor venues and events. These differences reflect the set up and operation of the venue and event types, and the approaches to managing music noise emissions.

Box 6: Application of the limits for music noise

Limits for music noise from indoor entertainment venues

- set the level of noise above which the music noise would be unreasonable as prescribed in the Environment Protection Regulations 2021 (Regulation 125)
- apply within noise sensitive areas and are determined in accordance with the Noise Protocol (Part II:A.2, clauses 95 to 102)
- apply to the cumulative noise from all indoor entertainment venues that contribute to the effective noise level at the noise sensitive area (Regulation 126).

If the noise limits are exceeded, the duty holder must reduce the noise to comply with the noise limits when assessed at the noise sensitive area.

Where the cumulative noise from multiple indoor entertainment venues exceeds the noise limits at the noise sensitive area, each venue must minimise the emission of music noise to comply with any alternative assessment criterion calculated in accordance with the Noise Protocol (clauses 113 and 114).

Limits for music noise from outdoor entertainment venues and events

- set the level of noise above which the music noise would be unreasonable as prescribed in the Environment Protection Regulations 2021 (Regulation 130)
- apply within noise sensitive areas and are determined in accordance with the Noise Protocol (Part II:A.1, clauses 91 to 94).

The duty holder must manage each operation at the outdoor entertainment venue, or event, to ensure the noise limits are not exceeded.

Other noise emissions from venues, such as noise from mechanical plant, refrigeration systems and kitchens, are subject to the requirements that apply to commercial, industrial and trade premises, as defined in Part 5.3 of Division 3 of the Regulations.

Noise from patrons at entertainment venues is only subject to the Regulations when it is directly associated with the music sources for example, patrons singing along with the music, audience applause, or “disc-jockey” (DJ) announcements. Nevertheless, patron noise needs to

be managed as required in any relevant permits and approvals, such as planning permits or liquor licenses, and in relevant guidelines.

Box 7: Victoria Planning Provision for live music entertainment venues

Clause 53.06 of the Victoria Planning Provisions (VPP) (https://planning-schemes.delwp.vic.gov.au/schemes/vpps) sets the framework that applies for managing noise from live music entertainment venues. It gives effect to the agent of change principle, which assigns responsibility for noise attenuation to new uses or new developments (either the venue or the residential use) when introduced into an existing environment. Planning Practice Note 81 (DELWP, 2016) provides guidance for the implementation of the agent of change principle.

Regulation 122 reflects the **agent of change principle** specified in VPP clause 53.06 (DELWP, 2018). This planning provision defines:

- **live music entertainment venues**, which can be either indoor entertainment venues or outdoor entertainment venues
- **noise sensitive residential use**, which needs to be protected from noise.

Both these definitions are adopted by the Regulations. Also, **sensitive room** is defined in the Noise Protocol for when the agent of change principle set out in VPP clause 53.06 applies (refer to glossary of terms in the Noise Protocol). A noise sensitive residential use is qualified as pre-existing when, in application of VPP clause 53.06, it is not the agent of change.

Where VPP clause 53.06 applies:

- When the venue is the agent of change, its music noise emissions are assessed at pre-existing noise sensitive residential uses (Regulation 103) in accordance with part II.B of the Noise Protocol.
- When the noise sensitive residential use is the agent of change, the assessment is to be consistent with the design response for the purpose of VPP clause 53.06, as approved in any relevant planning permit. The measurement point may be located inside a sensitive room with windows and doors closed. However, there are circumstances in which the assessment may involve measuring outdoors, such as when:
  - the design response for the purpose of VPP clause 53.06 was based on specific outdoor levels of music noise
  - the noise reduction of the building envelope is known (refer sections 5.3.4 and 6.3.4), including when it has been specified as part of the design response for the purpose of VPP clause 53.06
  - attenuation measures adopted in response to VPP clause 53.06 are to reduce noise levels in outdoor areas (for example setback or acoustic fencing, or if the residential developer has provided improvement of noise attenuation in the venue).

4.1. Outdoor entertainment venues

Outdoor entertainment venues are defined in the Regulations as a premises where music is played in the open air, which cannot feasibly be totally enclosed due to their size and with

substantial provision for spectators. This definition includes an outdoor entertainment venue established on private land (such as a farm or other rural property). By contrast, outdoor entertainment events are held on public land as described in section 4.2.

In relation to music noise from outdoor entertainment venues, Regulation 4 defines **concert** as an operation at an outdoor entertainment venue or an outdoor entertainment event if the effective noise level exceeds 55dB(A) (or 45dB(A) if measured indoors) assessed as an L_{Aeq} of 15 cumulative minutes at any measurement point in a noise sensitive area at least once during the 24-hour period.

The operation of an outdoor entertainment venue is controlled by a combination of measures which include:

- standard operating hours, outside which operations are not allowed without a permit issued by EPA (Regulation 128 and item 76 in schedule 1 of the Regulations)
- a noise limit that applies during the standard operating hours, which is set to protect normal conversation within noise sensitive areas (Noise Protocol clause 91)
- requirement for a permit from EPA for
- any extended operation of a duration of more than eight hours, whether a concert or not (Regulation 128(1) and item 76 in schedule 1 of the Regulations)
- more than 6 concerts in a financial year (item 77 in schedule 1 of the Regulations).

Section 5 of this guide discusses the procedures to follow when measuring and assessing music noise from outdoor entertainment venues.

4.2. Outdoor entertainment events

Outdoor entertainment events are defined in Regulations as events held on public land where music is played. These types of events are typically held infrequently and usually include temporary buildings or structures such as marquees, tents or temporary soundstages. Community festivals and street parties that include music are common examples of outdoor entertainment events.

The definition of **concert** in Regulation 4 also applies to outdoor entertainment events.

The operation of an outdoor entertainment event is controlled by a combination of measures and requirements which include:

- standard operating hours, outside which operations are not allowed without a permit issued by EPA (Regulation 129 and item 76 in schedule 1 of the Regulations)
- a noise limit that applies during the standard operating hours, which is set to protect normal conversation within noise sensitive areas (Noise Protocol clause 91)
- requirement for a permit from EPA for
- extended concerts of a duration of more than eight hours (Regulation 129(1) and item 76 in schedule 1 of the Regulations)
- concerts held during certain hours
- more than 6 concerts at the same location in a financial year (item 77 in schedule 1 of the Regulations).

Section 5 of this guide discusses the procedures to follow when measuring and assessing music noise from outdoor entertainment events.

4.3. Indoor entertainment venues

An indoor entertainment venue is a premises where music is played, and is neither a residential premises, nor an outdoor entertainment venue. The Regulations provide examples of the types of premises that are indoor entertainment venues, including a live music entertainment venue, hotel, night club, and health and fitness centre.

Outdoor areas at an indoor entertainment venue, such as a beer garden at a hotel, are included within the definition of indoor entertainment venue. A marquee at an outdoor entertainment venue or event is not an indoor entertainment venue.

For indoor entertainment venues, noise sources can be confined within the building where the venue is situated. Indoor entertainment venues can therefore operate more frequently and across longer operating time periods than outdoor entertainment venues and events.

Regulation 123 defines the operating time periods for indoor entertainment venues. Clause 95 of the Noise Protocol specifies the noise limits that apply during the different periods:

For the day and evening period, the limit is based on the A-weighted background noise level. The limit is set to protect normal domestic and recreational activities, conversation, learning and child development within noise sensitive areas by limiting the overall intrusiveness of the music noise.

A more stringent limit applies during the night period to protect sleep. The limit considers the frequency spectrum of the music noise and is set to control its emergence over the background noise.

Section 6 of this guide discusses the procedures to follow when measuring and assessing music noise from indoor entertainment events.

5. Music noise from outdoor entertainment venues and events

5.1. Music noise from outdoor entertainment venues and events

Clause 91 of the Noise Protocol specifies a noise limit for outdoor venues and events which is not based on the background noise. The music noise is assessed as an L_{Aeq}. The limit applies during standard operating hours specified in the Regulations and is set at a level above which conversation usually requires additional vocal effort. The noise limits for outdoor entertainment venues and events are:

- 65 dB(A) when the measurement point is located outdoors
- 55 dB(A) when the measurement point is located indoors.

Operations outside the standard operating hours are subject to a permit from EPA.

Music noise from an outdoor entertainment venue or event is **aggravated noise** if the effective noise level of the music noise exceeds 80dB(A) at any time (Regulation 131).

5.1.1. Outdoor entertainment venues within the Docklands noise attenuation area

The limits set out in clause 91 of the Noise Protocol do not apply to noise sensitive areas located within the Docklands noise attenuation area (DNAA) that are affected by music noise from outdoor entertainment venues also within the DNAA.

Instead, clause 93 and 94 of the Noise Protocol reflects the noise standard in Schedule 12 of Design and Development Overlay in the Melbourne Planning Scheme (refer Box 8) and takes the maximum noise level of 45 dB(A) indoors as the noise limit, which applies indoors in sensitive rooms with windows and external doors closed.

The Noise Protocol provides a definition of sensitive room to use when assessing noise from an outdoor entertainment venue within the DNAA, when the noise sensitive area is also within the DNAA (refer to glossary of terms in the Noise Protocol). This definition is consistent with the requirements of the Melbourne Planning Scheme for this area.

Outdoor spaces of noise sensitive areas within the DNAA, such as an apartment balcony, are not protected from music noise from an outdoor entertainment venue within the DNAA.

If either the outdoor entertainment venue or the noise sensitive area is located outside the Docklands Noise Attenuation Area, the noise limits set out in clause 91 of the Noise Protocol apply.

Box 8: Schedule 12 of the Melbourne planning scheme design and development overlay
https://planning-schemes.api.delwp.vic.gov.au/schemes/melbourne/ordinance/43_02s12_melb.pdf

This schedule to the Melbourne planning scheme establishes a Noise Attenuation Area in the design and development overlay (DDO 12) with the following design objectives (City of Melbourne, n.d.):

- *'To ensure that new or refurbished developments for new residential and other noise sensitive uses constructed in the vicinity of the Docklands Major Sports and Recreation Facility include appropriate acoustic measures to attenuate noise levels, in particular music noise, audible within the building.*
- *To ensure that land use and development in the vicinity of the Docklands Major Sports and Recreation Facility is compatible with the operation of a Major Sports and Recreation Facility.'*

The schedule sets out specific requirements for the design and construction of 'any new or refurbished development or any conversion of part or all of an existing building that will accommodate new residential or other noise-sensitive uses' within the Noise Attenuation Area.

These requirements include a noise standard set, to a maximum level 45 dB(A) which applies indoors, in rooms with windows closed, when music is emitted from the Major Sports and Recreation Facility in the Melbourne Docklands area.

5.2. Assessing music noise from outdoor entertainment venues and events

5.2.1. Assessment location

The assessment must represent the greatest intrusion of music noise within the noise sensitive areas (Noise Protocol clause 110 and 119). The assessment location must represent the highest noise levels, as relevant to the allowed hours of operation of the entertainment venue or event.

Other factors that determine the choice of the assessment location include:

- distribution of noise around the venue or event investigated
- potential variations in music noise levels with time
- topography
- influence of meteorological conditions at the time of operation.

Music noise should be assessed where and when the highest effective noise level occurs within noise sensitive areas.

When assessing music noise that may impact upon classrooms or other rooms where learning occurs, such as in child care centres, kindergartens, primary schools or secondary schools, consider the operating hours of the noise sensitive areas.

When predicting the music noise level for an operation of an outdoor entertainment venue or event, appropriate assumptions must be made for the configuration of the venue such as the stage and speaker locations and distribution around the venue, the frequency spectrum of the music noise, the directivity of the music noise sources, and any other factor that may influence the noise in noise sensitive areas.

To represent the loudest music noise level, noise predictions during planning outdoor events or concerts at outdoor venues should consider atmospheric conditions favourable to the propagation of sound from the venue or event to noise sensitive areas. These conditions generally occur when the noise sensitive area is downwind from the venue or event or when a temperature inversion occurs – typically after sunset on clear still nights, when the air cools down with height above the ground that has been storing heat during the day.

5.2.2. Alternative assessment location and criterion for noise measurement

Alternative assessment location

A measurement location closer to the music source may be necessary to facilitate the assessment, such as when:

- a noise sensitive area is affected by multiple entertainment venues or events (Noise Protocol clause 108(a))
- a more suitable measurement point is required (Noise Protocol clause 108(b)), as may be the case if a measurement point within the noise sensitive area is not readily accessible.

Measurement at an alternative assessment location is required where it is not possible to assess the noise at a location that represents the highest levels of music noise within the noise sensitive area (Noise Protocol clause 110); for example, if such a location is not accessible.

While an alternative assessment location may be either within or outside a noise sensitive area, the music noise received at the alternative assessment location must represent the noise exposure within the noise sensitive area. The assessment report must provide justification of the choice of the assessment location, particularly when it is not an outdoor location within the noise sensitive area.

Alternative assessment criterion

If an alternative assessment location is used, an alternative assessment criterion needs to be established for the hours of operation of the venue or event investigated. The effective noise level measured at the alternative assessment location is compared against the alternative assessment criteria to determine whether the noise limits are exceeded.

To set the alternative assessment criterion, regard must be given to the sound paths to the noise sensitive area and alternative assessment location. Consideration must also be given to the factors which may affect the propagation of sound, such as separation distance, directivity of the music noise sources, ground cover, atmospheric conditions, barriers, buildings and other structures that can shield or reflect noise. Because most of these phenomena can be frequency-dependent, the determination of the alternative assessment criterion should consider the frequency spectrum of the noise.

The alternative assessment criterion must be calculated using a suitable noise calculation algorithm. The selected methodology must be substantiated by using:

- a recognised noise calculation algorithm that has been validated for the circumstances of the assessment (refer to section 5.4.2)
- robust assumptions that are justified and verifiable.

The alternative assessment criterion must also make provision for potential uncertainties introduced by the calculation or modelling. The choice of methodology, the assumptions made, and the uncertainty must be clearly documented and reported.

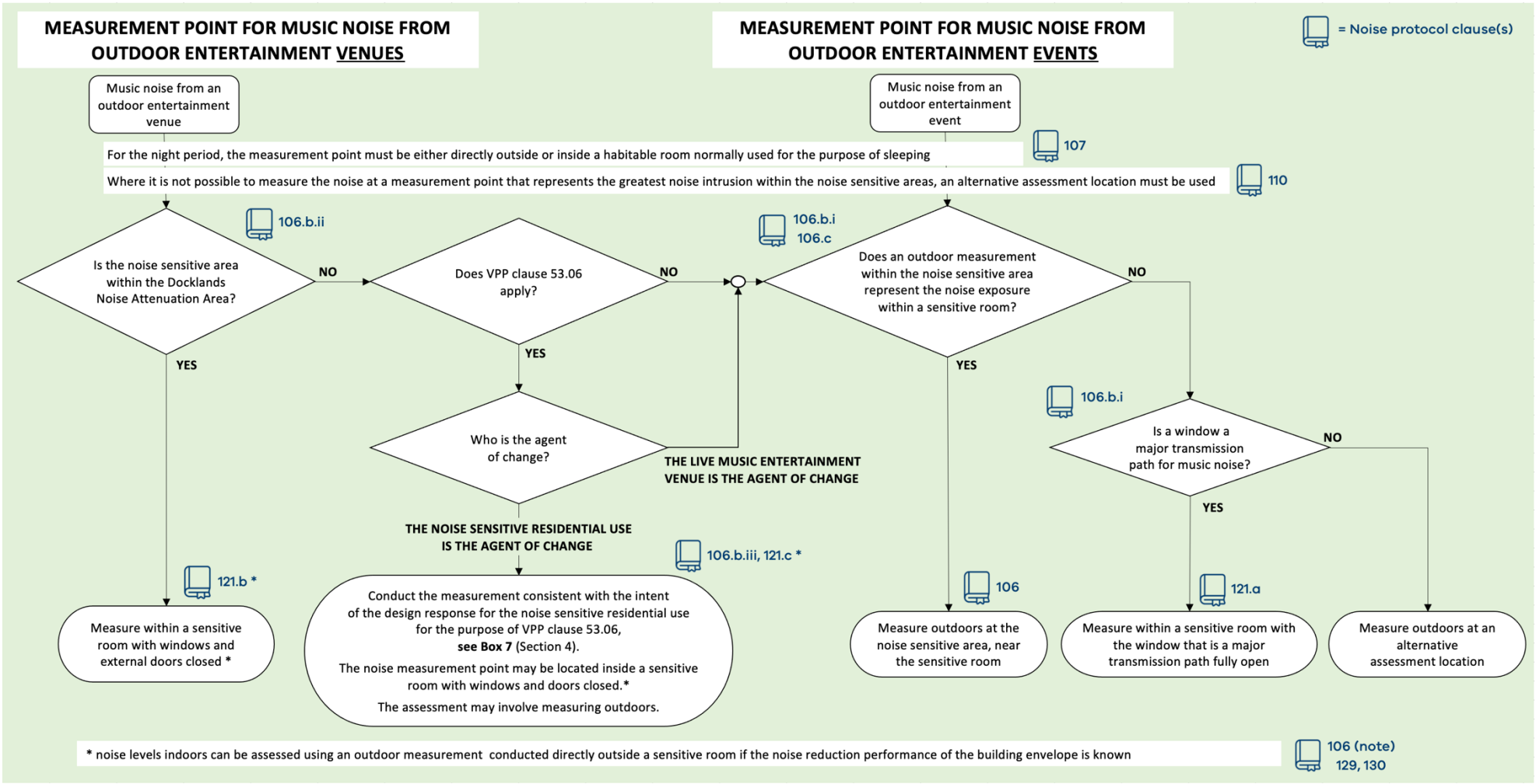

Figure 4: Measurement point for music noise from outdoor entertainment venues and outdoor entertainment events

5.2.3. Indoor assessment

Assessment of the internal noise levels due to music noise from outdoor entertainment venues and events must only be made in accordance with the circumstances specified in Noise Protocol clauses 106.b and 106.c (refer to section 5.3).

5.2.4. Effective noise level

The effective noise level is an L_{Aeq} representing 15 cumulative minutes of audible music within noise sensitive areas. The effective noise level must be measured at a time when the greatest intrusion of music noise into a noise sensitive area is likely to occur.

Extraneous noise and noise not directly associated with the music noise must be excluded from the assessment.

5.3. Measuring music noise from outdoor entertainment venues and events

This section provides the general procedures that should be followed when measuring music noise emitted from outdoor entertainment venues and events. Detailed requirements for equipment and measurement methodology are provided in Appendix A.

This guide applies to measurements of effective noise levels to determine unreasonable noise (Regulation 130) and aggravated noise (Regulation 131).

5.3.1. Measurement of effective noise level

The effective noise level is based on a measurement period of 15 cumulative minutes of audible music at the measurement point. The measurement of music noise can include concurrent sounds associated with the music, such as a crowd singing along or DJ announcements. Measurement of the effective noise level must exclude extraneous noise, noting that sustained applause is considered extraneous noise for the assessment.

The removal of extraneous noise may involve pausing the measurement when the music stops or when extraneous noise occurs. When noise levels with audio recording is conducted, 15-minute samples can be obtained by combining several sequences of music during post-processing.

Measurements should be attended to ensure that observations by the operator can confirm the source of the music noise. It is useful to also conduct unattended measurement with audio recording that will provide information on the variation of the music noise, to assist in planning future events or concerts at the venue, and to provide a record of compliance with the Regulations.

Reflection adjustment

The only adjustment that may apply to the measurement of music noise from outdoor entertainment venues and events is a reflection adjustment.

This adjustment applies when the measurement is conducted outdoors, at a measurement point between 1 and 2 metres from a sound reflecting surface (Noise Protocol clause 120).

5.3.2. Measurement point

The measurement point is the location of the microphone during a noise measurement. In some circumstances, more than one measurement point may be required (for example, when there are multiple noise sources, which can be the case at outdoor festivals with more than one stage).

Unless the conditions for an indoor assessment apply (Noise protocol clauses 106(b) and 106(c), the music noise must be measured outdoors.

If an outdoor measurement within the noise sensitive area is not possible or does not represent the noise exposure experienced in a sensitive room, an alternative assessment location should be used. This location can be away from the noise sensitive area, at a location that is demonstrated to represent the noise exposure (refer to Section 5.2.2).

The flow diagram in Figure 4 provides the step-by-step process to determine an appropriate measurement point for outdoor entertainment venues and events.

5.3.3. Indoor measurements

Measuring indoors is not always practicable as it requires access to buildings and can disturb the occupants. If necessary, it is acceptable to deploy the microphone on a balcony or via a boom held inside and passed outside through an open window. A reflection adjustment must then be applied to the noise measurement.

Indoor measurements are only conducted in specific circumstances described in clauses 106(b) and 106(c) of the Noise Protocol). In other circumstances, an alternative assessment location must be used.

Indoor noise measurements must be conducted in a sensitive room subject to the greatest level of music noise intrusion, considering the building orientation and the transmission path of the noise into sensitive rooms. The requirements for the room conditions under which the measurement is conducted vary with the circumstances that warrant an indoor measurement and are summarized in Table 4.

Table 4: Room conditions for indoor measurements of music noise from outdoor entertainment venues and events

Circumstances	Sensitive room condition for indoor noise measurement	Noise Protocol clauses	Sections of this guide
1. An openable window is a major transmission path for music noise	Window (which is a major transmission path) fully open	106(b)(i) 106(c) 121(a)	5.3 (Figure 4)
2. Noise sensitive area and venue/event within the DNAA	Windows and external doors closed	106(b)(ii) 121(b)	5.1.1
3. Application of the agent of change principle	Windows and doors closed	106(b)(iii) 121(c)	4 (Box 7)

To accurately represent the exposure to the noise being assessed, the influence of internal noise sources such as appliances, ventilation and air conditioning systems and other building services must be minimised by turning them off, or by conducting measurements when they are not operating.

The measurement point(s) should be at least 1 metre from the walls or other major reflecting surface, 1.2 to 1.5 metres above the floor and about 1.5 metres from windows. Measurement at the centre of the room should be avoided as far as possible.

When conducting an indoor measurement, the expected occupancy positions within the sensitive room should be considered.

The measurement point should be at the position where the greatest effective noise level occurs, or at a point representing the noise at this position. This may require investigating how sound is distributed across the room when the noise has strong low frequency content (octave band 250 Hz and below), which may result in noise levels varying significantly between measurement points due to room effects.

5.3.4. Using an outdoor measurement to assess indoor noise levels

An outdoor measurement conducted directly outside a noise sensitive room can be used to assess the effective noise levels indoors under the circumstances specified in Noise Protocol Clause 129.

This approach is only possible when:

- the outdoor measurement of music noise is conducted in octave bands (or one-third octave bands)
- the noise reduction provided by the building envelope is known, also in octave bands (or one-third octave bands); as may be the case when the building has been designed and constructed to achieve a particular acoustic performance, specified in verifiable documentation.

The indoor noise levels can then be calculated by subtracting the noise reduction performance of the building envelope from the external noise levels. The calculation generally involves a correction which is specific to the room as it considers its dimensions, configuration, internal finishes and furniture.

5.4. Proposed operations at outdoor entertainment venues and events

5.4.1. Predicting music noise from outdoor entertainment venues and events

To ensure that the noise limits are met in noise sensitive areas, music noise from planned events and concerts at outdoor entertainment venues may need to be predicted to inform:

- stage location and orientation
- loudspeaker selection and configuration
- highest noise levels at the sound desk (front of house)
- noise management measures, such as noise barriers to obstruct the propagation of noise.

Noise calculation algorithms can be used to predict the noise level at the noise sensitive area, or to set the alternative assessment criterion when an alternative assessment location will be used.

When predicting the music noise level for an operation of an outdoor entertainment venue or event, appropriate assumptions must be made for the configuration of the venue such as the stage and speaker locations and distribution around the venue, the frequency spectrum of the music noise, the directivity of the music noise sources, and any other factor that may influence the noise in noise sensitive areas.

To represent the loudest music noise level, calculations to predict noise from outdoor events or concerts at outdoor venues should consider atmospheric conditions favourable to the propagation of sound from the venue or event to noise sensitive areas. These conditions generally occur when the noise sensitive area is downwind from the venue or event or when a temperature inversion occurs - typically after sunset on clear still nights, when the air cools down with height above the ground that has been storing heat during the day.

5.4.2. Noise calculation algorithms for music noise

A validated engineering calculation method should be used. Factors that impact noise propagation should be considered in the calculation, as these can influence the noise level received at the noise sensitive area. These factors include source directivity, meteorological and ground effects, air attenuation, shielding and diffraction of sound by obstacles, multiple reflections of sound, and reflections on non-rigid surfaces.

The outdoor sound propagation procedures of international standard ISO 9613-2 are suitable for predicting music noise from outdoor entertainment venues and events, provided the frequency dependent directivity patterns of the loudspeaker systems are considered as an input to the calculations.

Other calculation algorithms can be used, provided:

- they can accurately predict noise levels for the specific situation under investigation
- their appropriateness has been validated and documented (together with the modelling uncertainty) in a verifiable reference.

Computer modelling should be used in complex situations, such as when there are many noise sources or noise sensitive areas, or when there is complicated topography. Computer modelling can be particularly useful to generate noise contour maps to provide a better understanding of the spatial distribution of noise levels. Several commercial software packages allow for calculations using recognised algorithms. The choice of program is dependent on whether it uses the appropriate noise prediction model for the specific circumstances under investigation. This must be established by the developer or the distributor of the program and documented in verifiable references.

5.5. Reporting requirements

5.5.1. Assessment report

The assessment report must clearly and accurately document the methodology used to ensure that:

- the noise assessment (measurements, calculations, analysis) can be replicated by another suitably qualified acoustic practitioner
- any deviation from the procedures of this guide found necessary during an assessment is justified
- all assumptions, uncertainties are documented, together with details on how they have been considered in drawing conclusions for the assessment.

Measurement results and input data for calculations must be from verifiable sources that are clearly referenced.

If deviation from the procedures of this guide was necessary during an assessment, this must be justified and documented. The report must also detail the risks and uncertainties associated with using a substitute methodology, and any effect it may have on the results of the assessment.

The information provided for each assessment location should include:

- details of noise source and the aim of the investigation
- details of operating conditions of the outdoor entertainment venue or event being assessed and all other relevant site-specific data

- details of assessment location, including the address of assessment location and/or GPS coordinates
- applicable noise limits
- results and interpretation, including relevant noise level data such as spectral data, where applicable
- a statement of whether (or not) the effective noise levels comply with the noise limit.

5.5.2. Reporting requirements for noise measurements

All noise measurements require the following to be reported:

- dates and times of noise measurements
- list of all equipment used – including brand, model, serial number and calibration status, as well as any specific settings used
- microphone position and orientation
- microphone height above ground level or floor level
- distance from sound reflecting surfaces
- date, time and measured levels for field calibration checks conducted
- atmospheric conditions at the time of measurement
- other relevant information – for example, field notes/observations, building facade, and photographs of microphone position demonstrating that it is in an appropriate location.

If an alternative assessment location has been used for music noise measurements, the assessment report must provide:

- justification for the selection of an alternative assessment location
- details of the calculation of the alternative assessment criterion, including the basis for the calculation method used, the underlying assumptions and the provisions used to factor in potential uncertainties.

If an indoor assessment has been conducted, the assessment report must provide:

- reason for an indoor assessment
- conditions of all windows or doors to the room (open or closed)
- room dimensions and description of the internal finishes and furniture, details on internal noise sources
- location(s) of the indoor measurement point(s) and justification for its (their) selection
- detailed specifications for the noise reduction of the building envelope, referred to a verifiable source, where relevant
- the spectrum of the music noise measurement if an assessment for indoor noise levels was conducted using an outdoor measurement.

5.5.3. Reporting requirements for music noise predictions

The assessment report for proposed outdoor entertainment venues and events (refer to section 5.4) should include details and justification of:

- the noise calculation algorithm used
- all inputs to the calculations including sound power, frequency spectrum and directivity of the noise sources
- and all assumptions made, including noise mitigation measures, topography, atmospheric and ground conditions.

The assessment report should also discuss the uncertainties associated with the calculations, the input data and the assumptions made. It should detail how these uncertainties have been taken into account in drawing conclusions for the assessment.

6. Music from indoor entertainment venues

6.1. Noise limits for indoor entertainment venues

The noise limits for music from indoor venues are set relative to the background levels. The assessment for such venues is different for the day and evening period, and the night period, for which more stringent limits apply to protect sleep (refer to section 4.3).

The noise limits for the day and evening period, and the night period, must be determined following Clauses 95 and 96 of the Noise Protocol, and the base noise limits provided in Regulation 125(2). Requirements for the measurement of background levels are given in Section 6.1.3.

The flow diagram in Figure 5 shows the step-by-step process to determine an appropriate measurement point for indoor venues.

6.1.1. Day and evening period

The noise limit for indoor venues for the day and evening period is based directly on the overall A-weighted background noise measured as an L_{A90}. In areas with very low background levels (below 27 dB(A)), the base noise limit set in Regulation 125(2)(a) is adopted as the noise limit.

Music noise from an indoor entertainment venue is **aggravated noise** if the effective noise level (L_{Aeq}) of the music noise exceeds the noise limit plus 15 dB during the day and evening period (Regulation 127).

6.1.2. Night period

The assessment of music from indoor venues for the night period takes into account the frequency spectrum of the noise assessed.

The noise limit in each octave band from 63 Hz to 4 kHz[1] is based on the background noise L_{OCT90} measured using the linear weighting.

In areas with very low background levels, the noise limit in a given octave band may take the value of the base noise limit specified in Regulation 125(2)(b) for the same octave band. This would occur when L_{OCT90} measured with linear weighting in the considered octave band is 8 dB below the value given for that octave band in the table of Regulation 125(2)(b).

Music noise from an indoor entertainment venue is **aggravated noise** if the effective noise level (L_{OCT10}) of the music noise exceeds the noise limit plus 20 dB during the night period (Regulation 127).

6.1.3. Background level

The background level must be measured in accordance with the Noise Protocol clauses 97 to 102. It must represent the noise level of the aggregate of background sounds within noise sensitive areas at the time of assessment. The background level must be absent of music from any entertainment venue or event.

[1] Octave bands between 63 Hz and 4 kHz are the octave bands with mid-band frequency 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz and 4 kHz.

Background measurement location

The background level must be measured outdoors, within a noise sensitive area, or at an alternative assessment location. The exception to this is when an indoor assessment is made as enabled in the Noise protocol (clause 106(a)), including when applying the *agent of change principle* for a noise sensitive residential use (refer to section 4).

When a measurement of the background noise is not possible within the noise sensitive area, for example, due to the presence of music from the venue investigated, or from other venues or events, the background noise measurement must be made at an alternative assessment location where the effective noise level is also assessed (Noise Protocol clause 99).

The background sounds at this alternative assessment location must represent the background level occurring within the noise sensitive area (Noise Protocol clause 99).

Time of background measurement

The measurement must represent the background at the time of assessment. As the assessment of music noise must be made at a time when the intrusion of music noise into the noise sensitive area is likely to be the greatest (refer to 6.2), the measurement of background must also represent these conditions.

When determining the time to measure the background level, consider the following factors that can influence the assessment:

- the operating days and hours of the entertainment venues affecting noise sensitive areas
- the sources of background noise and their potential fluctuations
- the atmospheric conditions, which may influence both the background and the music noise received within the noise sensitive area (levels measured downwind would be increased compared to the neutral situation with no wind. Conversely, levels measured upwind are lower).

As these factors may vary over time, at different hours and days, the background level measurement may need to be conducted on several occasions or across multiple days (refer to Appendix A).

Generally, targeted measurement of background level may be made:

- at a time as close as possible to the measurement time of the effective noise levels (for example, just before the music starts, or just after it stops, providing patron noise does not affect the measurement)
- at another time which represents the background during the assessment (for example, at the same time on another day)
- at an alternative assessment location that is representative of the background within the noise sensitive area at the time of impact (Noise Protocol clause 99).

The approach taken for selecting the time of background measurement must be justified in the assessment report.

Background level measurement

The background level must be based on the background noise measured for at least 15 minutes.

For the day and evening period, the background noise is measured as $L_{A90,15min}$ using the Fast time weighting and the A-frequency weighting network.

For the night period, the background noise is measured as L_{OCT90} using the Fast time weighting, and the linear weighting network.

The measurement can be attended or unattended (refer to Appendix A). An unattended measurement should be conducted for several days (typically seven days), to ensure enough valid data is collected. The measurement interval for logging should be 15 minutes.

To ensure the impact of music noise is adequately assessed, the background level must represent the conditions at the time of impact.

Therefore, it is essential that they reflect the variations in the background noise that occur normally:

- across the various periods of the day (for example, the background level at night would typically be lowest during 1 am and 4 am)
- between days (the background noise during weekends is typically quieter than it is during weekdays, except in busy entertainment areas that are vibrant at night).

Data that represents the background level at the time of noise impact must be selected. Any descriptive statistics, such as the average, median, minimum, or percentile value must not be adopted as the background without justification, considering whether the value chosen represents the background level at the time of noise impact. (Choosing the median value, or the arithmetic average, of L_{A90} measurements between these hours to set the noise limit can lead to substantial differences between the adopted criterion and the actual value that should apply at the time of impact, particularly during the quietest hours. For example, the background levels between the hours of 10 pm and 7 am can vary by up to about 10 dB in urbanised areas, and even more in rural settings).

The background sound level is to be measured at the same position that the music noise is measured with the noise source(s) not operating. Data collected just after the closure of the venue, or just after the music stopped, may be used as the background level for the final hours of operation of the venue.

Background level influenced by industry noise

When assessing music noise from an indoor entertainment venue, the background level is defined in the Noise Protocol as representing all background sounds, except for music noise. This means that the measurement of the background level must take account of noise from any industrial, commercial and trade premises, including the venue itself (which may include sources of industry noise such as cool-rooms and air conditioners).

If the regulatory limits for industry noise are exceeded, the background level will be elevated, which affects the value of the noise limit. A step-by-step approach must be followed to determine the background level that is relevant to the assessment of music noise:

1. Assess the industry noise impacting on the noise sensitive area considered following Part I of the Noise Protocol (refer to section 3 of this guide).
2. The background level informing the music noise limits is measured according to Noise Protocol Clauses 95 to 102 and this section.
3. If the industry noise exceeds regulatory requirements for any period, the limits applicable to music noise will need to be determined again, based on a re-measurement of the background level once the industry noise has been reduced (Noise protocol clause 101).

When the background level is influenced by industry noise that exceeds regulatory requirements, a pro-active approach to managing noise emissions from a venue consists of setting noise objectives based on the anticipated background level that will occur once the limits for industry noise are no longer exceeded. When applying this approach for the night period, the octave band spectrum for both the background and music noise must be considered.

6.2. Assessing music noise from indoor entertainment venues

The assessment must be made at a time when the greatest intrusion of music noise into the noise sensitive area considered is likely to occur (Noise Protocol clause 119). The chosen assessment time must be justified in the assessment report.

Since the music noise limits depend on the background level, which varies across the day and from day to day, the greatest intrusion does not necessarily occur at the time when the music is the loudest. When the background levels are lower, a given level of music noise would be more intrusive and have a greater impact on nearby residents and other sensitive uses than at other times when the background level is higher.

The time of greatest intrusion is typically when the venue is operating and when the background noise is lower, the music noise can then have the highest emergence over the background.

6.2.1. Noise sources assessed

Regulation 124 sets out the noise sources to be considered when assessing music noise from indoor entertainment venues.

For indoor entertainment venues that are places of worship, music noise that is not related to recognised religious observance must be assessed.

The assessment of music noise from indoor entertainment venues must consider noise from human voices and activities within the premises that are associated with the music sources. This includes, for example, patrons singing along with the music or clapping, noting that sustained applause after the music stopped is considered extraneous to the assessment.

The noise associated with the arrival and departure of people attending the indoor entertainment venue must be excluded from the assessment.

6.2.2. Assessment location

The assessment location must represent the greatest music noise intrusion within the noise sensitive areas affected, as relevant to the times the music is played at the venue (Section 4.3).

Other factors that determine the choice of the assessment location include the distribution of noise around the venue, variations in music noise levels over time, the noise reduction provided by the building within which the venue is located, the topography, and meteorological conditions that influence the noise spreading.

When assessing music noise impacting on classrooms or other rooms where learning occurs, such as in child care centres, kindergartens, primary schools or secondary schools, consideration should be given to the operating hours of the noise sensitive areas.

When the noise is to be assessed indoors, consideration should also be given to the building orientation and the transmission path of the noise into sensitive rooms.

When predicting music noise from an indoor entertainment venue, appropriate assumptions must be made about the configuration of the venue, the frequency spectrum of the music noise, and the directivity of the music noise sources, particularly when music is played in outdoor areas of the venue (refer to 6.4).

The assessment report must justify the chosen assessment location, particularly when it is not an outdoor location within the noise sensitive area.

6.2.3. Alternative assessment location and criteria for noise measurement

Alternative assessment location

A measurement closer to the music source may be necessary to facilitate the assessment, particularly when the noise sensitive area is affected by multiple venues (Noise Protocol clause 108), or when the music noise within the noise sensitive area is influenced by atmospheric conditions (Noise Protocol clause 109).

Measurement at an alternative assessment location is required when it is not possible to assess the noise at a location that represents the greatest intrusion (highest emergence of music noise over the background) within the noise sensitive area (Noise Protocol clause 110).

While an alternative assessment location may be either within or outside a noise sensitive area, the music noise received at the alternative assessment location must represent the noise intrusion within the sensitive area at the time of assessment.

Alternative assessment criteria

If an alternative assessment location is used, alternative assessment criteria need to be established for the time(s) of assessment. The effective noise level measured at the alternative assessment location is compared against the alternative assessment criteria to determine whether the noise limits are exceeded.

To set the alternative assessment criteria, regard must be given to:

- the respective sound paths to the noise sensitive area and to the alternative assessment location
- the distribution of noise around the venue, which depends on the configuration and construction of the building or structure within which the venue is located.

The assessment must also consider other factors which may affect the propagation of sound, such as separation distance, directivity of the music noise sources, ground cover, atmospheric conditions, barriers, and buildings or other structures that shield or reflect noise. Because most of these phenomena are frequency-dependent, the determination of the alternative assessment criteria should consider the frequency spectrum of the noise.

The alternative assessment criteria must be calculated using a suitable noise calculation algorithm.

The selected methodology to calculate the alternative assessment criteria must be substantiated by using:

- a recognised noise calculation algorithm that has been validated for the circumstances of the assessment (refer to section 6.4.2)
- robust assumptions that are justified and verifiable.

The alternative assessment criteria must also consider potential uncertainties introduced by the calculation or modelling. The choice of methodology, the assumptions made, and the uncertainty must be clearly documented and reported.

Box 9:
Assessing music noise when there are multiple indoor entertainment venues

The noise limits set by the Noise Protocol apply to the overall music noise from all indoor entertainment venues affecting the noise sensitive area considered. Sometimes it will be necessary to assess the individual contribution of each premises. Separating the contribution of one venue from the other contributions can be difficult, as the music noise from each venue will vary across the frequency spectrum over time. The following procedure should be followed:

1. Survey the noise sensitive area and listen to the music noise, paying specific attention to the contribution of the venue being assessed.
2. Identify an alternative assessment location at which the music noise is distinct from the venue being assessed, and for which the music noise levels represent the exposure within the noise sensitive area.
3. Determine the alternative assessment criteria based on the background level within the noise sensitive area. If the background level cannot be measured within the noise sensitive area, a measurement at the alternative assessment location nominated at step 2 can be used, provided it represents the background within the noise sensitive area.
4. Measure the effective noise levels, at the alternative assessment location and assess it against the alternative assessment criteria.

The chosen alternative assessment location needs to be justified. To support this justification, audio recordings of both the background noise and the music noise should be conducted in conjunction to the measurement. The volume of the recordings should be calibrated to the measured noise levels.

6.2.4. Indoor assessment

Assessment of music noise from indoor entertainment venues must only be made inside sensitive rooms when specified by the Noise Protocol (Clause 106.a).

The requirements for indoor measurements are further discussed in section 6.3.

6.2.5. Effective noise level

The effective noise level must represent 15 cumulative minutes of audible music within the noise sensitive areas. The assessment must represent the greatest intrusion of music noise into noise sensitive areas, as defined in section 6.2.

Extraneous noise and noise not directly associated with the music noise must be excluded from the assessment (refer to section 6.2.1).

Day and evening period

The effective noise level is measured as an L_{Aeq} of 15 cumulative minutes.

The only adjustment that may be applied is a reflection adjustment. A reflection adjustment must be made when the effective noise level is determined from measurements made near a sound reflecting surface.

Night period

The effective noise level is measured as an L_{OCT10}, determined using the linear weighting network.

The only adjustment that may be applied is a reflection adjustment. A reflection adjustment must be made when the effective noise level is determined from measurements made near a sound reflecting surface.

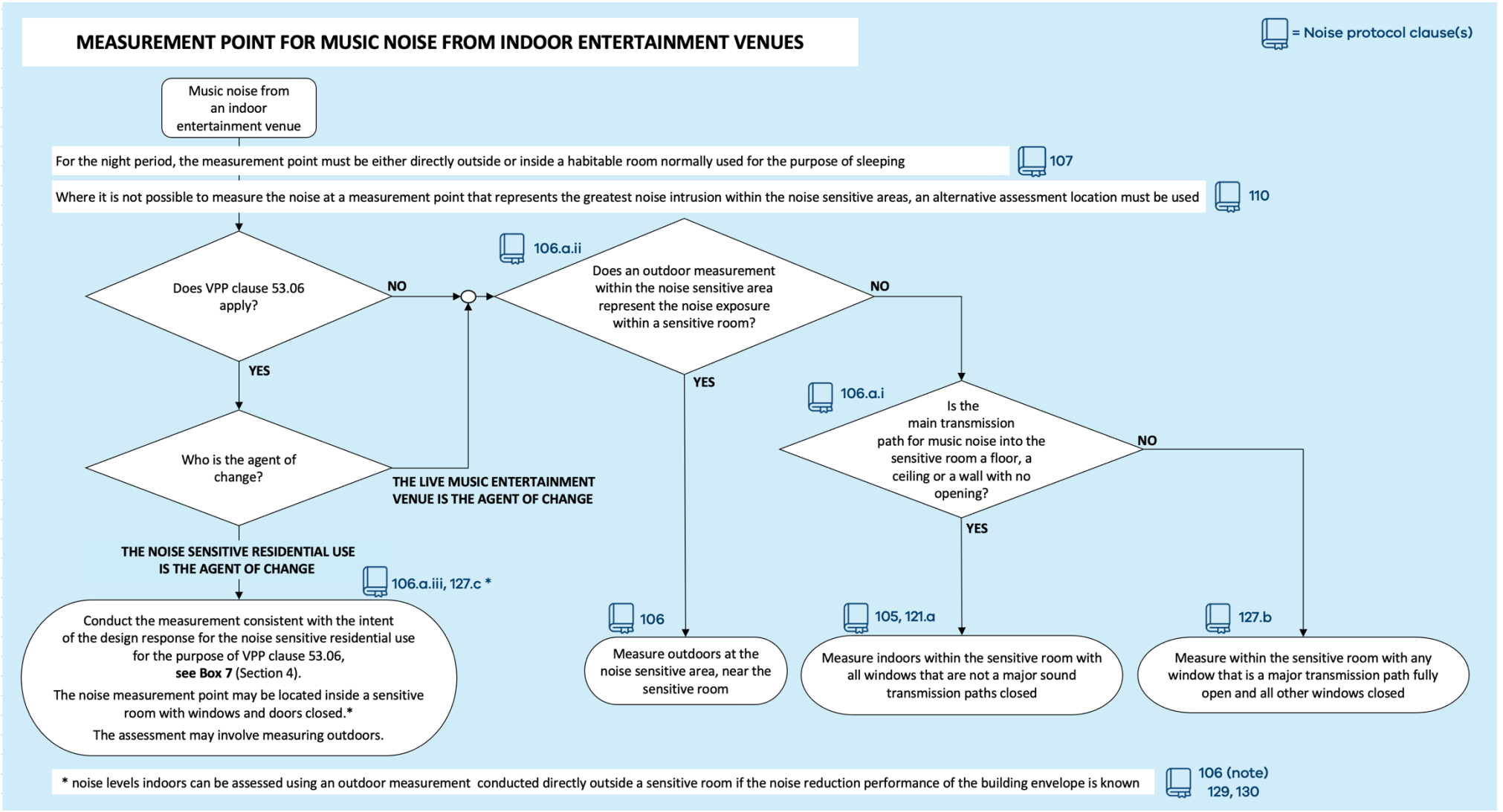

Figure 5: Measurement point for music noise from indoor entertainment venues

6.3. Measuring music noise from indoor venues

This section provides the general procedures that should be followed when measuring music noise from indoor entertainment venues. Detailed requirements for equipment and measurement methodology are provided in Appendix A.

This guide applies to measurement of effective noise levels to determine both unreasonable noise (Regulation 125) and aggravated noise (Regulation 127). The level for aggravated noise from indoor entertainment venues for the night period differs from that for the day and evening period because the acoustic descriptor used for the effective noise level is different for each period (refer to sections 6.1 and 6.2.5).

6.3.1. Measurement of effective noise level

The measurement period is 15 cumulative minutes of audible music at the measurement point. The measurement of music noise can include concurrent sounds associated with the music, such as from patrons singing along. Measurement of the effective noise level must exclude extraneous noise.

The removal of extraneous noise may involve pausing the measurement when the music stops or when extraneous noise occurs. Where audio recording is conducted, 15-minute samples can be obtained by combining several sequences of music during post-processing.

Measurements should be attended to ensure that observations by the operator can confirm the source of the music noise. It is useful to also conduct unattended measurement with audio recording that will provide information on the variation of the music noise over time, such as for different operating conditions or types of music.

Reflection adjustment

The only adjustment that applies to measurements of music noise from indoor entertainment venues is a reflection adjustment.

This adjustment applies when the measurement is conducted outdoors, at a measurement point between 1 and 2 metres from an acoustically reflective surface (Noise Protocol clause 126). This adjustment applies to measurements conducted both in the day and evening period, and in the night period.

6.3.2. Measurement point

The measurement point is the location of the microphone during a noise measurement. In some circumstances, more than one measurement point may be required (for example, when the noise emitted by the venue is not distributed evenly and affects several noise sensitive areas that are characterised by different background levels).

Unless the conditions for an indoor assessment apply (Noise protocol clause 106(a)), measurement must be conducted outdoors.

If an outdoor measurement within the noise sensitive area is not possible or does not represent the noise exposure experienced in a sensitive room, an alternative assessment should be used. This location can be away from the noise sensitive area, at a location that is demonstrated to represent the greatest intrusion of music noise (refer to section 6.2.3).

The flow diagram in Figure 5 provides the step-by-step process to determine an appropriate measurement point for indoor entertainment venues.

6.3.3. Indoor measurements

Indoor measurements are only conducted in specific circumstances (refer to Noise Protocol clause 106(a) and Section 6.2.4). In other circumstances, an alternative assessment location must be used.

Measuring indoors is not always practicable as it requires access to buildings and can disturb the occupants. If necessary, it is acceptable to deploy the microphone on a balcony or via a boom held inside and passed outside through an open window. A reflection adjustment must then be applied to the noise measurement.

Indoor measurements can only be made in an affected sensitive room. The requirements for the room condition under which the measurement is conducted vary with the circumstances that warrant an indoor measurement and are summarised in Table 5.

To accurately represent the exposure to the noise under investigation, the influence of internal noise sources such as appliances, ventilation and air conditioning systems and other building services must be minimised by turning them off, or by conducting measurements when they are not operating.

Table 5: Room conditions for indoor measurements of music noise from indoor entertainment venues

<table>
<tr><th>Circumstances</th><th>Sensitive room condition for indoor noise measurement</th><th>Noise Protocol clauses</th><th>Sections of this guide</th></tr>
<tr><td>1. The main transmission path of the music noise entering the sensitive room consists of a floor, ceiling or wall with no opening.</td><td rowspan="2">Any window that is a major sound transmission path fully open, and all windows that are not major transmission paths closed</td><td>106(a)(i)
127(a)</td><td rowspan="2">6.3.2 (Figure 5)</td></tr>
<tr><td>2. An outdoor measurement does not represent the noise exposure within a sensitive room and an external window is a major sound transmission path</td><td>106(a)(ii)
127(b)(i)</td></tr>
<tr><td>3. Application of the agent of change principle</td><td>Windows and doors closed</td><td>106(a)(iii)
127(c)</td><td>4</td></tr>
<tr><td>4. An outdoor measurement does not represent the noise exposure within a sensitive room and 1 and 2 do not apply</td><td>Windows and doors closed</td><td>106(a)(ii)
127(b)(ii)</td><td>6.3.2 (Figure 5)</td></tr>
</table>

The measurement point(s) should be at least 1 metre from the walls or other major reflecting surface, 1.2 to 1.5 metres above the floor and about 1.5 metres from windows. Measurement at the centre of the room should be avoided as far as possible.

When conducting an indoor measurement, the expected occupancy positions within the sensitive room should be considered.

The measurement point should be at the position where the greatest effective noise level occurs, or at a point representing the noise at this position. This may require investigating how

sound is distributed across the room when the noise has strong low frequency content (octave band 250 Hz and below), which may result in noise levels varying significantly between measurement points due to room effects.

6.3.4. Using an outdoor measurement to assess indoor noise levels

An outdoor measurement conducted directly outside a noise sensitive room can be used to assess the effective noise levels indoors under the circumstances specified in Noise Protocol Clause 129.

This approach is only possible when:

- The outdoor measurement of music noise is conducted in octave bands (or one-third octave bands); and
- The noise reduction provided by the building envelope is known, also in octave bands (or one-third octave bands); as may be the case when the building has been designed and constructed to achieve a particular acoustic performance, specified in verifiable documentation.

The indoor noise levels can then be calculated by subtracting the noise reduction performance of the building envelope from the external noise levels. The calculation generally involves a correction which is specific to the room as it considers its dimensions, configuration, internal finishes, and furniture.

6.4. Proposed indoor entertainment venues

6.4.1. Predicting music noise from indoor entertainment venues

To ensure that noise limits are met in noise sensitive areas, music noise from proposed indoor entertainment venues may need to be predicted to inform:

- design and construction of the building in which the venue is located
- stage location and orientation
- loudspeaker and sound system (public address) selection and configuration
- noise management measures such as devices to help maintain the music volume at a suitable level, including warning lights and noise limiters to restrict noise levels at source, and equalisers to control low frequency sound.

Noise calculation algorithms can be used to predict the noise level at the noise sensitive area, or to set alternative assessment criteria when an alternative assessment location will be used.

The noise limits and assessment methods of the Noise Protocol apply to proposed developments, which can be new indoor entertainment venues or the extension of existing premises.

Proposals for developments that present a risk of noise must be designed and constructed to incorporate measures to address noise emissions at the commencement of operation and must be consistent with the general environmental duty (GED) under section 25 of the Act.

This approach is crucial because remedial actions to address excessive noise, such as retrofitting soundproofing to the building envelope, can be more expensive to implement after installation than they would be during the design phase.

6.4.2. Noise calculation algorithms

A validated engineering calculation method should be used.

For noise sources confined within buildings, the noise reduction provided by the building should be predicted based on calculation methods of recognised standards, such as international standard ISO 12354-4. The calculation should consider the frequency spectrum of the music noise, and the frequency dependent noise reduction performance of the building.

Calculations based on material data for the sound insulation performance of the building envelope obtained from laboratory measurement must consider the risk of decrease in performance of field installations and the secondary sound transmission paths. Similar considerations apply to material data determined from mathematical modelling, the uncertainty of which should also be factored in the assessment.

For outdoor propagation of sound (music noise breaking out of buildings as well as potential external sources of music noise), the predictions should consider atmospheric conditions favourable to the propagation of sound. The procedures from international standard ISO 9613-2 are suitable, provided noise sources that are not point sources are adequately modelled (for example, area sources such as walls or windows, should be divided into small area sections, each represented by a point source at its centre). Other factors that impact noise propagation should be considered in the noise prediction model, as these can influence the noise level received at the noise sensitive area. These factors include source directivity, ground effect, air attenuation, shielding and diffraction of sound by obstacles, multiple reflections of sound, and reflections on non-rigid surfaces.

Other calculation procedures can be used, provided:

- they can accurately predict noise levels for the specific situation under investigation
- their suitability has been validated and documented (together with the modelling uncertainty) in a verifiable reference.

Computer modelling should be used in complex situations, such as when there are many noise sources or noise sensitive areas, or when there is complicated topography. Computer modelling can be particularly useful to generate noise contour maps to provide a better understanding of the spatial distribution of noise levels. Several commercial software packages allow for calculations using recognised noise prediction models. The choice of program is dependent on whether it uses the appropriate noise prediction model for the specific circumstances under investigation. This must be established by the developer or the distributor of the program and documented in verifiable references.

6.5. Reporting requirements

6.5.1. Assessment report

The assessment report must clearly and accurately document the methodology used to ensure that:

- the noise assessment (measurements, calculations, analysis) can be replicated by another suitably qualified acoustic practitioner
- any deviation from the procedures of this guide found necessary during an assessment is justified
- all assumptions, uncertainties are documented, together with details on how they have been taken into account in drawing conclusions for the assessment.

Measurement results and input data for calculations must be from verifiable sources that are clearly referenced.

If deviation from the procedures of the Noise Protocol or this guide was necessary during an assessment, this must be justified and documented. The report must also detail the risks and uncertainties associated with using a substitute methodology, and any effect it may have on the results of the assessment.

The information provided for each assessment location should include:

- details of noise source and the aim of the investigation
- details of operating conditions of the indoor entertainment venue all other relevant site-specific data
- details of assessment location, including the address of assessment location and/or GPS coordinates
- the determination of background levels for each of the day and evening period and the night period, detailing weekdays and weekends as relevant, and justification of the approach taken for selecting the background measurements (refer to section 6.1.3) applicable noise limits
- details of other noise sources contributing to the effective noise levels
- results and interpretation, including relevant noise level data such as spectral data, where applicable
- a statement of whether (or not) the effective noise levels comply with the noise limit.

6.5.2. Reporting requirements for noise measurements

All noise measurements require the following to be reported:

- dates and times of noise measurements
- list of all equipment used – including brand, model, serial number and calibration status, as well as any specific settings used
- microphone position and orientation
- microphone height above ground level or floor level
- distance from sound reflecting surfaces
- date, time and measured levels for field calibration checks conducted
- atmospheric conditions at the time of measurement
- other relevant information – for example, field notes/observations, building facade, and photographs of microphone position demonstrating that it is in an appropriate location.

If an alternative assessment location has been used for music noise measurements, the assessment report must provide:

- justification for the selection of an alternative assessment location
- details of the calculation of the alternative assessment criteria, including the basis for the calculation method used, the underlying assumptions and the provisions used to factor in potential uncertainties.

If an indoor assessment has been conducted, the assessment report must provide:

- reason for an indoor assessment
- room dimensions and description of the internal finishes and furniture, details on internal noise sources

- conditions of all windows or doors to the room (open or closed)
- location of the indoor measurement points
- detailed specifications for the noise reduction of the building envelope, referred to a verifiable source, if an assessment for indoor noise levels was conducted using an outdoor measurement
- the spectrum of the music noise measurement if an assessment for indoor noise levels was conducted using an outdoor measurement.

6.5.3. Reporting requirements for music noise predictions

The assessment report for proposed indoor entertainment venues (refer to section 6.4) should include details and justification of:

- the noise calculation algorithm used
- all inputs to the calculations including sound power, frequency spectrum and directivity of the noise sources
- and all assumptions made, including design and construction of the building in which the venue is located, noise mitigation measures, topography, atmospheric and ground conditions.

The assessment report should also discuss the uncertainties associated with the calculations, the input data and the assumptions made. It should detail how these uncertainties have been taken into account in drawing conclusions for the assessment.

7. References

7.1. Victorian government legislation and publications

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Victorian Government (2021) Environment Protection Regulations 2021, S.R. No 47/2021 https://www.legislation.vic.gov.au/as-made/statutory-rules/environment-protection-regulations-2021

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Planning schemes

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City of Melbourne (n.d.), Melbourne Planning Scheme, https://www.melbourne.vic.gov.au/building-and-development/urban-planning/melbourne-planning-scheme/Pages/melbourne-planning-scheme.aspx

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7.2. Australian and international standards

Standards Australia

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AS 1191-2002, Acoustics—Method for laboratory measurement of airborne sound insulation of building elements. Standards Australia, 2002, New South Wales, Australia

AS 2702-1984, Acoustics — Methods for the measurement of road traffic noise. Standards Australia, 1994, New South Wales, Australia

AS 1276.1:1999 (ISO 717-1:1996), Acoustics — Ratings of sound insulation in buildings and of building elements. Standards Australia, 1999, New South Wales, Australia

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Appendix A: Instrumentation and measurement requirements

A.1 Instrumentation

The measurement system for noise assessments is typically a sound level meter which consists of a microphone connected to a main unit via a pre-amplifier. A portable reference sound source (acoustic calibrator or pistonphone) is also required to check the performance of the measurement system during the field measurements.

Long-term noise monitoring requires noise loggers that measure continuously and provide integrated information at regular intervals. A noise logger typically comprises of a sound level meter in a weatherproof case. The microphone is commonly fitted to a small pole extending above the case. It may also be placed on a tripod or a boom and connected to the main unit via an extension cable.

The measurement system must:

- meet the Type 1 requirements set out in in Australian standard AS IEC 61672.1
- have intrinsic electronic noise sufficiently low so it doesn't affect the measurement
- have a dynamic range adequate for the sound measured
- have reliable data storage.

When the measurement requires spectral analysis in octave bands or one-third octave bands:

- the filters must comply with the relevant requirements specified in Australian standard ASIEC 61260.1.

When operating the measurement system:

- it must be set to measure sound using the ***Fast* ('F') time weighting** defined in Australian standard AS IEC 61672.1
- the microphone must be fitted with the windshield provided by the manufacturer.

If the audio signal is digitally recorded to allow for post-processing, the recording must be conducted:

- without distortion or saturation
- using a lossless compression format
- with automatic gain controls and limiters disabled.

Measurements must be fully traceable. To ensure this is the case, these steps must be followed:

- All instrumentation used for sound measurement and field calibration must hold a current calibration certificate issued by a calibration laboratory accredited with the National Australian Testing Association (NATA, 2019).
- Conduct regular field calibration checks with a portable reference sound source (acoustic calibrator or pistonphone) compliant with and calibrated to the requirements of AS IEC 60942. These calibration checks must be conducted with the complete measurement system used. For example, if an extension cable is used, it must set up for these calibration checks.
- Include a calibration tone in all recordings for the purpose of post-processing.
- Follow the reporting requirements listed in section 3.6, 5.5 and 6.5 as relevant.

Box 10: Field calibration checks

The field performance of the sound measurement system must be checked with a portable reference sound source (acoustic calibrator or piston phone) immediately before and after each measurement sequence, and at regular intervals during long-term measurements.

If the measurement system registers a calibration discrepancy equal to or greater than 1.0 dB between consecutive checks, any measurements in the interval between the two checks must be considered invalid.

The reference sound source must meet the Type 1 requirements set out in in Australian standard AS IEC 60942 and hold a current calibration certificate issued by a calibration laboratory accredited with NATA.

A.2 Measurement requirements

A.2.1 Measurement point

The microphone should be located at a point where the highest sound pressure level of the noise under investigation will be obtained. A preliminary survey of the assessment location, with spot measurements, can help in identifying a suitable measurement point.

The measurement should be taken outdoors. The microphone of the sound level meter should be located between a height of 1.2 and 1.5 metres above the ground.

The measurement point should be no less than 3.5 metres from any reflective surface, such as walls or buildings, other than the ground.

Where it is not possible to locate the measurement point 3.5 metres from reflective structures, such as outdoor measurements near buildings, the preferred measurement positions are 1 metre from the facade and 1.2 to 1.5 metres above each floor level of interest.

Where the sound is directly incident (being emitted from a location opposite) to that facade, an adjustment of –2.5 dB should be made to the measured sound pressure level.

Table A.1: Appropriate microphone position based on its assessment location

Assessment location	Microphone position
Outdoor measurement	The preferred microphone position is: at least 3.5 metres from a sound reflecting surface, and 1.2–1.5 metres above ground level. If this is not possible, a position close to the building facade can be selected but the noise level measured needs to be adjusted for reflection of sound. The microphone can be placed (by order of preference): 1 metre from the facade, and 1.2–1.5 metres above ground level or each floor level of interest on a balcony 1 metre from the facade, and 1.2–1.5 metres above each floor level of interest on a boom, out of a window 1 metre from the facade, and 1.2–1.5 metres above each floor level of interest.
Indoor measurement	The microphone must be placed: at least 1 metre from the walls or other major reflective surfaces 1.5 metres from windows and doors. Positions close to sound absorbing surfaces and close to the centre of the room should be avoided.

A.2.2 Measurement conditions

Measurements must be conducted to represent the greatest noise exposure that normally occurs in the noise sensitive area. A good understanding of the site is key to ensure the collection of robust data. A thorough review that considers all the variations of site conditions that may occur – seasonally, across different days of the week, or even across one period (day, evening, night) – will inform the appropriate time and duration for the measurement. Careful scheduling of the measurements will increase the likelihood that the measured levels represent the maximum effective noise levels in the noise sensitive area from industry operations or the greatest exposure to music noise from entertainment venues or events.

To prepare for the measurements, the following factors must be taken into account:

- operating times and conditions of the premises being assessed
- operating times and conditions of other premises that may also impact noise sensitive areas
- sources of background noise and their variations (for example, traffic distribution)
- potential sources of extraneous noise and their variations
- local topography
- presence of buildings or structures that may shield or reflect noise
- prevailing atmospheric conditions at the site, and the weather forecast
- any other factor that could influence the assessment.

Knowledge of the operating conditions can assist in validating data and should be documented. A register can be established in coordination with premises operators. It should detail which equipment operates at what time, and variation in operating conditions. It should also include observations such as the occurrence of a specific noise or noise feature. Similarly, the affected residents may be asked to keep a record of their observations of the noise.

A.2.3 Conducting measurements

Noise measurements can be attended or unattended. Audio recording may be conducted with both attended and unattended measurements to inform data validation and allow for post-processing. It is essential that the occupants of premises where measurements are conducted are informed when audio recording takes place and that their agreement is sought.

Attended measurements

Attended measurements are conducted by an operator in the field when a short period of time is sufficient to characterise the noise under investigation and to represent the greatest noise exposure.

The sound level meter is generally held at arm's length with the microphone pointing upwards, facing towards the direction of the noise source being investigated.

Unattended monitoring

Unattended measurements are used when the noise levels must be determined over an extended duration – such as an entire period (day, evening or night), or longer. Unattended monitoring is useful to capture variations in noise levels over time.

It is recommended that attended measurements are also conducted during the installation and decommissioning of noise loggers. Combined with site observations, it can assist in the analysis of the noise data collected.

It may also be useful to install noise loggers at the assessment location as well as near to the noise source, to correlate the noise levels at both locations and to assist with post-processing when identifying extraneous noise that needs to be excluded from the assessment.

Atmospheric conditions

Noise measurements must be conducted in dry conditions, with no or low wind (Beaufort Wind Scale 0, 1, 2 or 3, refer to Table A.1). Temperature, relative humidity, atmospheric pressure, wind direction and wind speed should be recorded. Meteorological data should be collected at the measurement site. However, if meteorological instrumentation is not available, the information below can be used to assess the validity of a noise measurement:

Attended measurements

Site observations of atmospheric conditions, including estimated wind speed and direction, temperature, and cloud cover. Wind speeds should be assessed using the Beaufort Wind Scale (refer to Table A.1).

Unattended monitoring

Half hourly reports from the Bureau of Meteorology's most relevant weather station. While this is generally the nearest station, there are circumstances when data from another station will provide a better representation of the conditions at the measurement point (for example at coastal locations, where dominant winds would differ from nearby inland locations).

Extraneous noise

Extraneous noise must be excluded from the measurements.

Extraneous noise refers to any noise which is not part of the industry or music noise being assessed and is not relevant to the typical background noise experienced within the noise sensitive area considered. Extraneous noise includes noise from aircraft, local traffic, construction works, insects, bird chirping, people talking, rustling leaves, and the effect of wind on the microphone diaphragm. The Regulations specifically define extraneous noise sources to consider when conducting an assessment.

Data validity must be confirmed by site observations or by listening to audio recordings, ensuring that the measurement was not affected by extraneous noise. Alternately, extraneous noise can be excluded by pausing the sound level meter during attended measurements, or by discarding it during post-processing of recorded attended and unattended measurements.

Box 11: Information to be recorded when conducting measurements

When conducting measurements, or during equipment set up for unattended monitoring, the operator should make notes of:

- the date, time and location (address or GPS coordinates) for the assessment location
- the name of the premises under investigation
- other premises that may contribute to the effective noise levels
- the location of the measurement point: height above ground or floor level, distance from sound reflecting surfaces, estimated distance between the noise source and the measurement point, and for indoor measurement, window location and whether it is fully open, partly open or closed
- the measurement position relative to the noise sensitive area and direction to noise sources
- the instrumentation brand, model, serial number and last calibration date
- the instrumentation settings: time and frequency weighting
- the field calibration levels immediately before and after measurement
- the atmospheric conditions: wind strength and direction, air temperature and cloud cover
- the observations relevant to the character of the noise: tonality, impulsiveness, intermittency and duration of operation
- the sources of extraneous noise
- all other observations that can affect the measurements and the interpretation of data.

For industry noise measurements less than 30 minutes, a statement of whether the noise measurement is representative of the 30-minute period.

Table A.2: Beaufort wind scale 0 to 5 (reproduced from AS 1055:2018)

Beaufort scale number	Description term	Units in km/h	Units in m/s	Units in knots	Description on land
0	Calm	< 1	< 0.3	< 1	Smoke rises vertically
1	Light air	1 to 5	0.3 to 1.5	1 to 3	Smoke drift indicates wind direction Leaves and wind vanes are stationary
2	Light breeze	6 to 11	1.6 to 3.3	4 to 6	Wind felt on exposed skin, leaves rustle, wind vanes begin to move
3	Gentle breeze	23 to 19	3.4 to 5.5	7 to 10	Leaves and small twigs constantly moving, light flags extended
4	Moderate winds	20 to 29	5.5 to 7.9	11 to 16	Raises dust and loose paper, small branches are moved
5	Fresh winds	30 to 39	8 to 10.7	17 to 21	Small trees in leaf begin to sway, crested wavelets on inland waters

Note: Above wind scale 5, it is unlikely that general environmental noise measurements would be made because of the effects of wind noise.

Appendix B: Example of duration adjustment for noise impulsive in nature

This appendix illustrates how the duration adjustment is determined for noise that consists of impulses only, without industry noise occurring between each impulse.

If 18 impulses separated by more than 10 seconds occur within the assessment period and are prominent:

1. determine the duration adjustment based on each impulse being deemed to be audible for 10 seconds. The total time for which the source is considered to be operating is three minutes (18×10 seconds). This corresponds to 10% on-time over the 30-minute period. The duration adjustment is −10 dB.
2. apply the relevant adjustments for noise character (refer to section 3.2.5):
    a. +5 dB adjustment for prominent impulsive character applies; and
    b. a tonal adjustment will apply if the impulsive noise has a tonal character.

If in this example, the impulses were only 5 seconds apart from each other, the total time the source is deemed to be operating would be 95 seconds, calculated as [(17×5) + 10] seconds. Each of the first 17 impulses is accounted for until the following occurrence five seconds later and the last impulse is deemed audible for 10 seconds.

Appendix C: Example objective assessment for tonal adjustment

This appendix illustrates how the tonal adjustment is determined from the one-third octave band frequency spectrum of the noise, using the objective method for tonal adjustment in Annex C of the Noise Protocol.

One-third octave band i	One-third octave band frequency (Hz)	A-weighted band sound level LA_i (dB)	Band exceedance BE_i (dB)	Tonal Factor TF_i (dB)	Band corrected level $L_{Ai}+TF_i$ (dB)
1	20	3.5	-	0	3.5
2	25	4.3*	-3.8**	0.0	4.3
3	31.5	12.6*	-2.3**	0.0	12.6
4	40	25.4*	-2.4**	0.0	25.4
5	50	43.0	16.9	7.0	50.0
6	63	26.8*	-14.0**	0.0	26.8
7	80	38.5	1.1**	0.0	38.5
8	100	48.0	9.3	5.1	53.1
9	125	38.9	-9.6**	0.0	38.9
10	160	49.0	8.5	4.9	53.9
11	200	42.1	-3.1**	0.0	42.1
12	250	41.4	-5.7**	0.0	41.4
13	315	52.0	9.2	5.1	57.1
14	400	44.2	-4.2**	0.0	44.2
15	500	44.8	0.6**	0.0	44.8
16	630	44.1	0.1**	0.0	44.1
17	800	43.2	-0.3**	0.0	43.2
18	1000	43.0	0.6**	0.0	43.0
19	1250	41.6	-2.9**	0.0	41.6
20	1600	46.0	5.6	6.4	52.4
21	2000	39.3	-3.4**	0.0	39.3
22	2500	39.3	0.0**	0.0	39.3
23	3150	39.2	0.5**	0.0	39.2
24	4000	38.2	0.6**	0.0	38.2

25	5000	36.0	0.1**	0.0	36.0
26	6300	33.5	0.0**	0.0	33.5
27	8000	30.9	-0.3**	0.0	30.9
28	10000	28.9	1.7**	0.0	28.9
29	12500	23.5*	-0.9**	0.0	23.5
30	16000	20.0*	2.3**	0.0	20.0
31	20000	12.0	-	0	12.0
Maximum band level (dB)		52.0			

Uncorrected Overall level LAeq, dB(A)			57.7
Overall corrected level LTC, dB(A)			61.6
Overall Tonal Factor OTF, dB			3.9
Tonal adjustment Atone, dB			+5
Adjusted LAeq, dB(A)			63

** Band level is 25 dB or more below the maximum band level*

*** Band exceedance is below 3 dB*

Appendix D: Urban area method for industry noise limits examples of application

D.1 Example 1: Procedure for determining the zoning level

Figure D.1 shows a map of an area containing land zoned as residential, business, industry and public use, main road and parkland, according to the local planning scheme (as can be obtained, for example, from the Zones layer in VicPlan (https://mapshare.vic.gov.au/vicplan/). The map shows the two concentric circles specified in clause 8 of the Noise Protocol. The outer circle's diameter is 400 metres and the smaller circle's diameter is 140 metres. Both are centred on the measurement point in the noise sensitive area, which in this instance is a residential allotment.

The different areas zoned on the map according to the planning scheme are categorised as type 1, type 2 or type 3, according to Annex A of the Noise Protocol (Designation of zones for urban area method for commercial, industrial and trade premises). The total area for each circle and the area of each type is determined for both the 140 metre and 400 metre circles using a GIS tool. Other methods of area measurement, such as a planimeter, may be used or the fraction of each circle occupied by type 2 and 3 zones and reservations may be used. The influencing factor (Noise Protocol clause 14) is not highly sensitive to errors in measurement.

The relevant areas of the inner circle and outer circle are as follows:

Area (square met)	Inner circle (140 metre diameter)	Outer circle (400 metre diameter)
Area of type 1	8699.4	63930.4
Area of type 2	5570.0	47287.9
Area of type 3	1095.3	14362.8
Total area	15364.7	125581

The influencing factor (IF) is calculated as follows (Noise Protocol clause 14(a)):

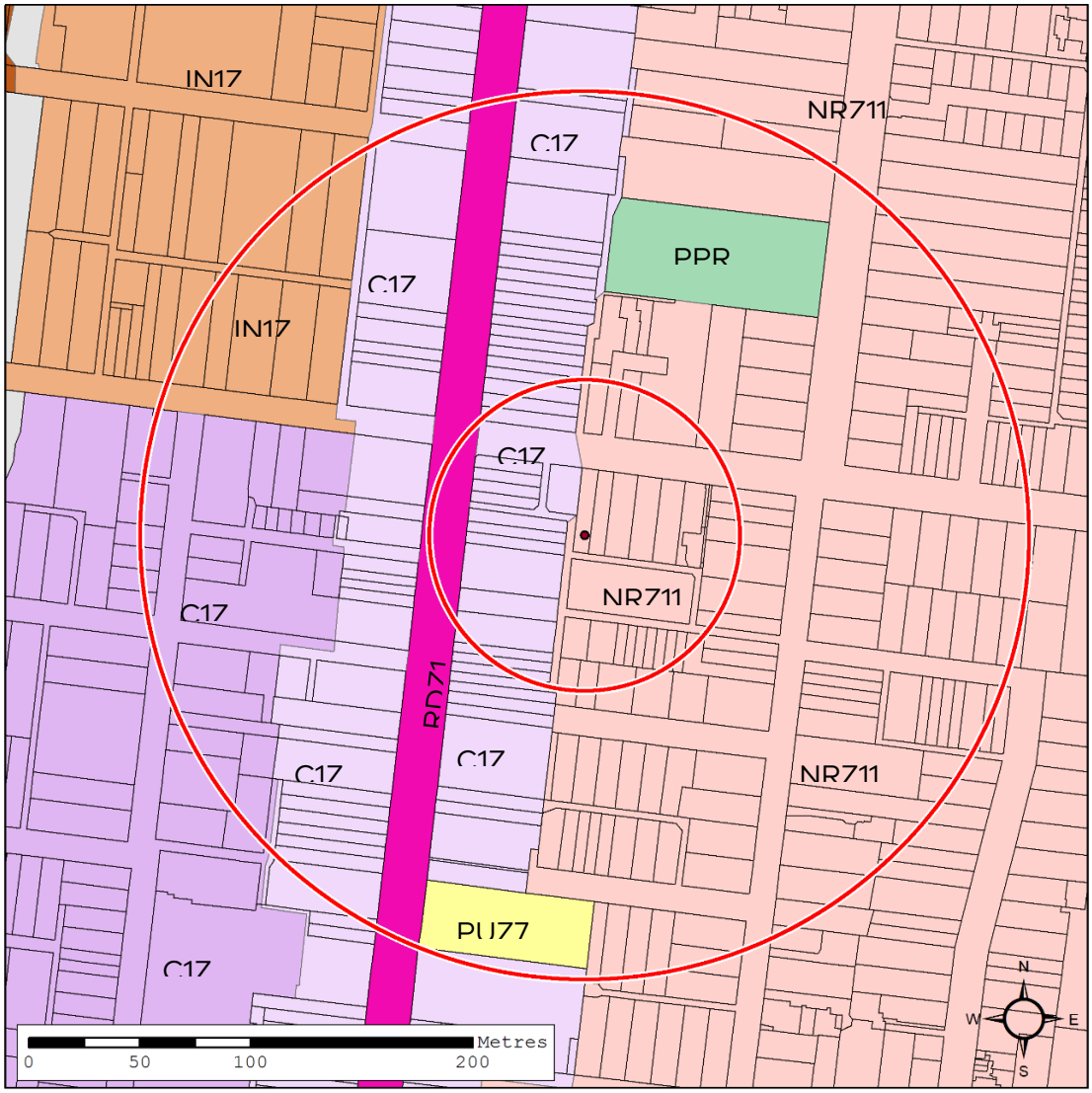
$$\text{IF} = {}^1\!/_2 \left(\frac{\text{area type 3} + {}^1\!/_2(\text{area type 2})}{\text{total area of circle}}\right)_{\text{140m circle}} + {}^1\!/_2 \left(\frac{\text{area type 3} + {}^1\!/_2(\text{area type 2})}{\text{total area of circle}}\right)_{\text{400m circle}}$$

$$\text{IF} = {}^1\!/_2 \left(\frac{\left(1095.3 + \frac{1}{2} \times 5570.0\right)}{15364.7}\right) + {}^1\!/_2 \left(\frac{\left(14362.8 + \frac{1}{2} \times 47287.9\right)}{125581.1}\right)$$

$$\text{IF} = 0.28$$

The influencing factor is used to determine the zoning level from Figure 1, clause 15 of the Noise Protocol. The zoning levels for an influencing factor of 0.28 are as follows:

Period	Zoning level
Day period (0700–1800 hours)	55 dB(A)
Evening period (1800–2200 hours)	49 dB(A)
Sunday (0700–2200 hours)	49 dB(A)
Night period (2200–0700 hours)	44 dB(A)



	Zone code	Shape area (m²)	Type		
Inner areas	C1Z	5570	2		**Calculations:**
	NRZ1	8699	1		
	RDZ1	1095	3		Influencing factor: IF = 0.278
	Zone code	Shape area (m²)	Type		Zoning level: Day period 55 dB(A) Evening period 49 dB(A) Night period 44 dB(A)
Outer areas	C1Z	44978	2		
	IN1Z	6735	3		
	PPRZ	4143	1		
	PUZ7	2321	2		
	NRZ1	59787	1		
	RDZ1	7628	3		

Figure D.1: Calculation of zoning levels based on land use planning zones

D.2 Example 2: Neutral background level procedure

In this example the background levels for the area were measured according to Part I:A.4 of the Noise Protocol (clauses 39 to 51) and compared with the zoning levels.

The Noise Protocol specifies that the background level is neutral when it is at least 6 dB, and no more than 12 dB, below the zoning level for the day period (clause 4(a)(i)). For the evening and night periods, the background level is neutral when it is at least 3 dB, and no more than 9 dB, below the zoning level (clause 4(b)(i)). In this example the background level is neutral, and the noise limit is the zoning level (clause 5).

The following results were obtained:

Period	Zoning levels	Background levels	Noise limits
Day period (0700-1800)	55 dB(A)	44 dB(A)	55 dB(A)
Evening period (1800-2200)	49 dB(A)	41 dB(A)	49 dB(A)
Sunday (0700–2200)	49 dB(A)	40 dB(A)	49 dB(A)
Night period (2200-0700)	44 dB(A)	36 dB(A)	44 dB(A)

D.3 Example 3: High background level procedure

In the previous example the noise limit was calculated for a measurement point in a noise sensitive area where the background level was neutral. If the background level for the noise sensitive area shown in Figure D.1: is not neutral, then the noise limit is determined from clause 4 and clause 6 of the Noise Protocol.

- During the day period, the background level is high when the background level plus 6 dB exceeds the zoning level (clause 4(a((ii)). In this case, the noise limit is the background level plus 6 dB (clause 6(a)(i)).
- For the evening period, the background level is high when the measured background level plus 3 dB exceeds the zoning level (clause 4(b)(ii)). In the case, the noise limit is the background level plus 3 dB (clause 6(b)(i)).
- For the night period, the background level is high when the background level plus 3 dB exceeds the zoning level (clause 4(b)(ii). The noise limit is the background level plus 3 dB, but not greater than 55 dB(A) (clause 6(c)(i)).

In this example, the background level was measured according to Part I:A.4 of the Noise Protocol and found to be high.

The background levels and zoning levels for the measurement point shown in Figure D.1: were as follows:

Period	Zoning levels	Background levels
Day period (0700-1800)	55 dB(A)	53 dB(A)
Evening period (1800-2200)	49 dB(A)	49 dB(A)
Sunday (0700-2200)	49 dB(A)	47 dB(A)
Night period (2200-0700)	44 dB(A)	43 dB(A)

According to the Noise Protocol, the background levels in this example are high. Therefore, the noise limits for the measurement point are based on the background level plus a margin above background for the day, evening, and night periods, as relevant. The background levels, margins above background and noise limits were:

Period	Background level	Margin above background	Noise limit
Day period (0700-1800)	53 dB(A)	+ 6 dB	59 dB(A)
Evening period (1800-2200)	49 dB(A)	+ 3 dB	52 dB(A)
Sunday (0700-2200)	47 dB(A)	+ 3 dB	50 dB(A)
Night period (2200-0700)	43 dB(A)	+ 3 dB*	46 dB(A)*

** Noise limit for the night period not greater than 55 dB(A)*

D.4 Example 4: Low background level procedure

The Noise Protocol states that the background is low when the background level is 13 dB or more below the zoning level for the day period (clause 4(a)(iii)) and 10 dB or more below the zoning level for the evening and night periods (clause 4(b)(iii)).

In this example the background level was found not to be neutral. The following results were obtained when the background levels were measured according to Part I:A.4 of the Noise Protocol and the zoning levels calculated:

Period	Zoning level	Background level
Day period (0700-1800)	55 dB(A)	41 dB(A)
Evening period (1800-2200)	49 dB(A)	40 dB(A)
Sunday (0700-2200)	49 dB(A)	35 dB(A)
Night period (2200-0700)	44 dB(A)	30 dB(A)

According to the Noise Protocol, the background level for the day and night periods and Sunday (0700–2200 hours) are low. The noise limits are calculated according to clause 6 of the Noise Protocol as follows.

D.4.1 Day period

The following equation is used to calculate the noise limit for the day period (Noise Protocol clause 6(a)(ii)):

Noise limit = ½ (zoning level + background level) + 4.5 dB(A)

= ½ (55 + 41) + 4.5 dB(A)

= 53 dB(A) (rounded to nearest decibel)

This value is above the base noise limit (45 dB(A), refer Regulation 118(2)(a)(i)), therefore the noise limit for the day period is 53 dB(A).

D.4.2 Evening period

The background level for the evening period is not low - it is neutral. The noise limit for this period is therefore the zoning level (clause 5).

Evening period (1800-2200)
Noise limit = 49 dB(A)

This value is above the base noise limit (40 dB(A), refer Regulation 118(2)(a)(ii)), therefore the noise limit for the evening period is 49 dB(A).

The background level for Sunday (0700-2200) is low. The noise limit is calculated as follows (Noise Protocol clause 6(b)(ii)):

Noise limit = ½ (zoning level + background level) + 3 dB(A)

Sunday (0700–2200),
noise limit = ½ (49 + 35) + 3 dB(A)

= 45 dB(A)

This value is above the base noise limit (40 dB(A), refer Regulation 118(2)(a)(ii)), therefore the noise limit for Sunday (0700-2200) is 45 dB(A).

D.4.3 Night period

The noise limit for the night period is calculated as follows (clause 6(c)(ii)):

Noise limit = ½ (zoning level + background level) + 3 dB(A)

Night period,
Noise limit = ½ (44 + 30) + 3 dB(A)

= 40 dB(A)

This value is above the base noise limit (35 dB(A), refer Regulation 118(2)(a)(iii)), therefore the noise limit for the night period is 40 dB(A).

Appendix E: Typical values for the industry noise limits in major urban areas

In major urban areas, the values of the noise limits for commercial, industrial and trade premises vary with the land use surrounding the noise sensitive area. The zoning level, based on land use planning zones, must be calculated for each measurement point in the noise sensitive area using the method in the Noise Protocol (Part I:A section 1.1, clauses 7 to 15).

Below are typical noise limits based on the land use zoning. These typical values are for information only and are not to be adopted as noise limits. Where the background level is much higher or lower than the zoning level, the noise limits will be outside these ranges. Regardless of the zoning and background level, the noise limit at night must not exceed 55 dB(A) at a noise sensitive area.

Land use mix surrounding the noise sensitive area	Common values for noise limit in major urban areas dB(A)		
	Day* 0700–1800 hours	Evening 1800–2200 hours	Night 2200–0700 hours
Mainly residential area	50–54	44–48	39–43
Area with some commerce or industry	54–59	48–52	43–47
Commercial district or bordering an industrial area	59–63	52–57	47–52
Predominantly industrial area	63–68	57–61	52–55

** The evening noise limit applies on Sundays and public holidays between 0700 and 1800 hours.*

Below are the base noise limits for major urban areas specified in Regulation 118(2)(a). These base noise limits are the lowest values the noise limits can take at noise sensitive areas located in major urban areas. They can be a useful conservative reference for assessing noise in very quiet locations (such as rural land within a major urban area) where there is no nearby industrial or commercial land.

The base noise limits are provided here as a reference to assist some investigations or to help industry avoid the need for background noise assessments when resolving issues. However, if a formal investigation or compliance action is required, the major urban area method of Part I:A.1 of the Noise Protocol must be followed for setting noise limits. This method includes a measurement of the background level to be conducted in accordance with Part I:A.4 of the Noise Protocol.

Period	Day* 0700–1800	Evening* 1800–2200	Night 2200–0700
Base noise limits	45	40	35

** The evening noise limit applies on Sundays and public holidays between 0700 and 1800 hours*

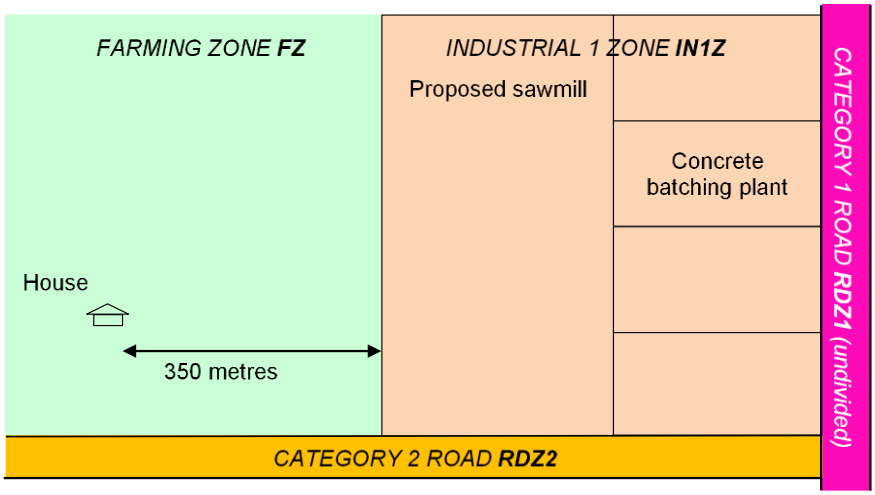
Appendix F: Rural area method for industry noise limits examples of application

This appendix provides examples for using the rural area method.

F.1 Example 1

A concrete batching plant in an Industrial 1 Zone (IN1Z) of a town with a population of 5000 generates noise that impinges on a dwelling in a large allotment in a Farming Zone abutting the industrial zone.

A sawmill is proposed on another industrial block in the IN1Z. Other blocks in the IN1Z are at present unoccupied or not significant noise contributors. Part I:A.2.1 of the Noise Protocol is followed,



In this example the noise limits are determined using the rural area method as the town's population is less than under 7000.

1. Zone levels (Noise Protocol clause 19): the generating zone is Industrial 1, and the receiving zone is Farming. The zone levels from Table B.1 in Annex B of the Noise Protocol are:
   Day 53 dB(A), Evening 48 dB(A) and Night 43 dB(A) (from Row 6, Column 3).
2. Distance-adjusted levels (clause 20): the receiver distance (350 metres) is greater than 300 metres but less than 400 metres, so the distance adjustment to the zone level is −3 dB.

   The distance-adjusted levels are:
   Day 50 dB(A), Evening 45 dB(A) and Night 40 dB(A).
3. Background level assessment (clauses 21 to 24): a background level assessment is not required because the receiving point is less than 600 metres from the generating zone boundary and not in a location where the background level is unusually elevated.
4. Base noise limit and night period noise limit check: the distance-adjusted levels from clause 20 are above the base noise limits specified in Regulation 118(2)(b) and the distance-adjusted level for the night period is less than 55 dB(A) (refer Regulation 118(3)).

The noise limits at the house in the farming zone are:

• Day:	Monday–Saturday (0700—1800)	50 dB(A)
• Evening:	Monday–Saturday (1800–2200)	45 dB(A)
	Sunday and Public Holidays (0700–2200)	45 dB(A)
• Night:	Monday–Sunday (2200–0700)	40 dB(A)

These limits apply to the total noise from commercial, industrial or trade noise sources at the measurement point. With other potential industrial noise contributors within the same zone, each industry premises needs to design or reduce noise to below the noise limits.

Section 3.3 of this guide provides relevant recommendations about multiple noise contributors. The council can, through the planning process, request the applicant from the sawmill to address its noise contribution considering the other existing and potential industry.

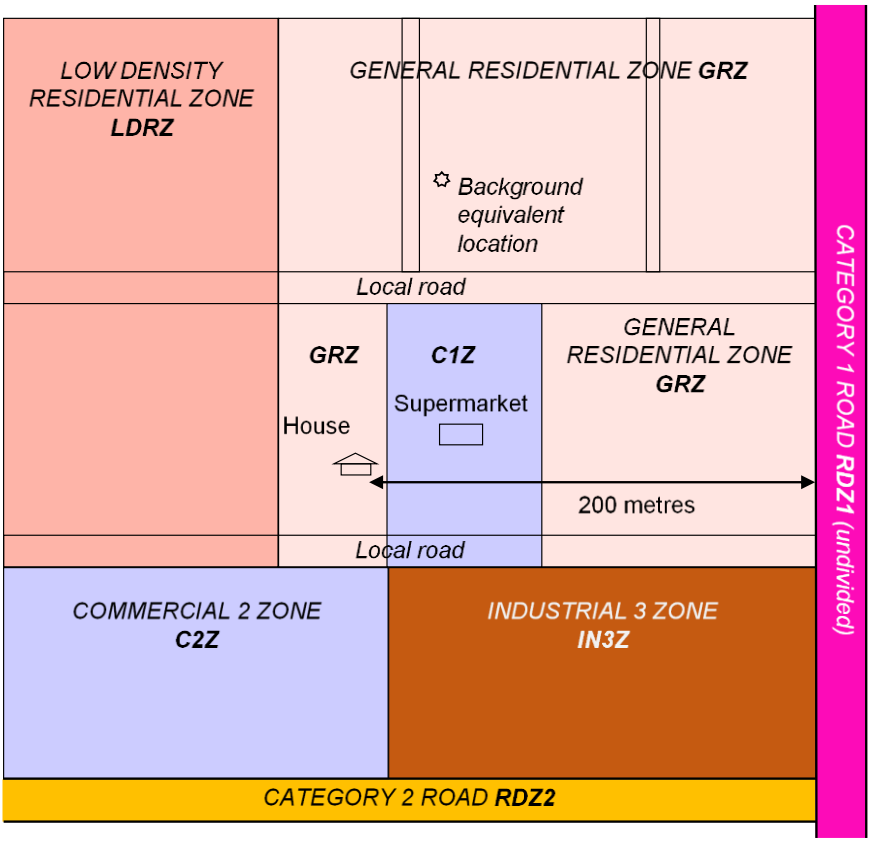
In this case the applicant and council agree that, as a new entrant into the industrial zone, the new operation should design noise emissions at the noise limits minus five decibels (45 dB(A) for the day period). This approach will help to contain 'noise creep' due to development growth. The sawmill operates in the daytime only, except for a wood kiln with exhaust fans. As future night-operating industrial premises might occupy other allotments in the zone, council seeks to ensure new developments are compatible with the ultimate development of the industrial zone. Council asks the applicant to demonstrate that night-time noise from the wood kiln will meet the noise limit for the night period minus 5 decibels. A reduction applies to the evening period as well, but the design for the night period is the critical one to ensure the noise limits are not exceeded.

The noise design criteria for the contribution to the noise emissions from the sawmill are:

• Day:	Monday–Saturday (0700–1800)	45 dB(A)
• Evening:	Monday–Saturday (1800–2200)	40 dB(A)
	Sunday and public holidays (0700–2200)	40 dB(A)
• Night:	Monday–Sunday (2200–0700)	35 dB(A)

F.2 Example 2

A supermarket refrigeration unit causes noise that affects a house on an adjacent residential zone in a city of population 6000. The measurement point is 200 metres from a main road and traffic noise is a feature of the local background noise. The receiving zone is adjacent to a developed commercial 2 zone (C2Z) and the supermarket's commercial 1 zone (C1Z) is adjacent to an undeveloped Industrial 3 zone (IN3Z).



Determining the noise limits requires considering the generating and receiving zones and considering background levels because of the presence of traffic noise from the main road.

The rural area method applies as the area is within a city of 6000 population. The city would have to have a population of 7000 or greater to use the urban area method to determine the noise limits.

1. Zone levels (Noise Protocol clause 19): the generating zone is a Commercial 1 zone (C1Z), and the receiving zone is a General Residential (GRZ). The zone levels (from Table B.1 in Annex B of the Noise Protocol) are Day 48 dB(A), Evening 43 dB(A) and Night 38 dB(A).
2. Distance-adjusted levels (clause 20): the distance between the receiver and the generator's zone boundary is less than 100 metres, so the distance-adjustment is zero under clause 20.

The distance-adjusted levels are:

• Day:	Monday–Saturday (0700—1800)	48 dB(A)
• Evening:	Monday–Saturday (1800—2200)	43 dB(A)
	Sunday and public holidays (0700—2200)	43 dB(A)
• Night:	Monday–Sunday (2200—0700)	38 dB(A)

3. Background level assessment (clauses 21 to 24): the receiving point is in a background-relevant area, as traffic is a significant audible background noise source.

The background level is measured using the procedures specified in section I.A.4 of the Noise Protocol (clauses 39 to 51). To avoid including industrial noise sources (the

refrigeration unit) — which are not background sound sources — the background levels were measured at a background equivalent location, another site with equivalent background level exposure, as marked on the diagram.

The measured representative background levels were:

• Day:	Monday–Saturday (0700—1800)	41 dB(A)
• Evening:	Monday–Sunday (1800—2200)	38 dB(A)
	Sunday and public holidays (0700—2200)	39 dB(A)
• Night:	Monday–Sunday (2200—0700)	30 dB(A)

The background levels are compared to the distance-adjusted levels from clause 20 (step 2 above) for each period, to see whether it will increase the noise limits. The noise limit becomes the greater of the distance-adjusted level or the base noise level and the background level, plus a margin as specified in clause 24 of the Noise Protocol.

The noise limits based on background level assessment are:

• Day:	Monday–Saturday (0700—1800)	49 dB(A) (Background level of 41 dB(A) +8 dB is 49 dB(A), which is greater than the 48 dB(A) distance-adjusted level and greater than the 45 dB(A) base noise limit)
• Evening:	Monday–Sunday (1800—2200)	43 dB(A) (Background level of 38 dB(A) +5 dB is 43 dB(A), which is equal to the 43 dB(A) distance-adjusted level and greater than the 37 dB(A) base noise limit)
• Evening:	Sunday and public holidays (0700—2200)	44 dB(A) (Background level of 39 dB(A) +5 dB is 44 dB(A), which is greater than the 43 dB(A) distance-adjusted level and greater than the 37 dB(A) base noise limit)
• Night:	Monday–Sunday (2200—0700)	38 dB(A) (Background level of 30 dB(A) + 5 dB is 35 dB(A), which is less than the 38 dB(A) distance-adjusted level. 38 dB(A) is greater than the 32 dB(A) base noise limit and less than 55 dB(A))

4. High traffic noise method (clauses 25 to 27): The supermarket is an existing industry; therefore the noise high traffic noise method does not apply.

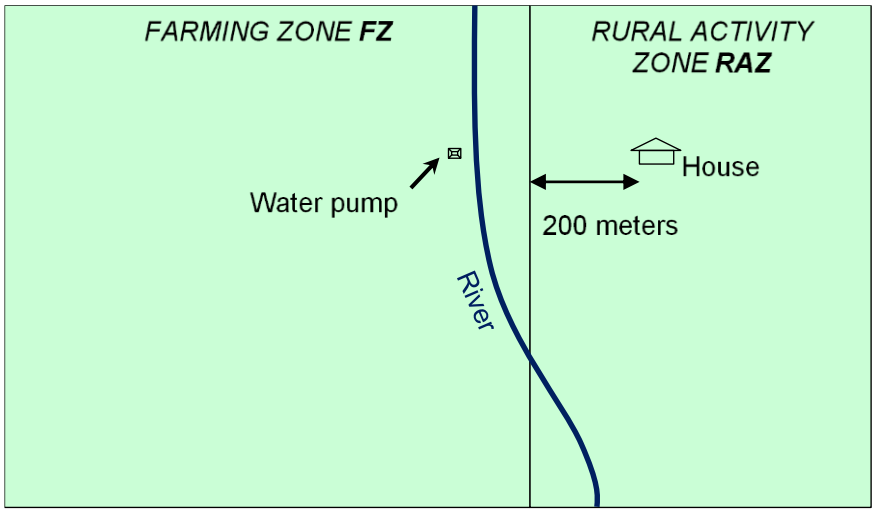
The noise limits are:

Day:	Monday–Saturday (0700—1800)	49 dB(A)
Evening:	Monday–Sunday (1800—2200)	43 dB(A)
	Sunday and public holidays (0700—2200)	44 dB(A)
Night:	Monday–Sunday (2200—0700)	38 dB(A)

As the supermarket refrigeration unit operates continuously during the day, evening and night periods, the crucial time is the night period. Checking of background level may only be needed during this period.

F.3 Example 3

A water pump is used to irrigate a market garden on a Farming Zone outside the Melbourne urban growth boundary, producing noise detectable at a dwelling on an abutting Rural Activity Zone. The pump is normally only operated during the daytime but may operate at night during summer.



The location is remote from any town or city, so the rural area method applies.

1. Zone levels (Noise Protocol clause 19): the zone levels are taken from Row 2, Column 3 of Table B.1 in Annex B of the Noise Protocol: Day 46 dB(A), Evening 41 dB(A), Night 36 dB(A).

Clauses 139 and 140 of the Noise Protocol detail special provisions relating to the Farming zone. In this case the land is used as a market garden. The agricultural activity is a more intensive one and on smaller allotments than broad-acre farming. It falls within the definition in the planning scheme of 'Horticulture' and clause 139 specifies a +3 dB adjustment to the zone level. The final zone levels are Day 49 dB(A), Evening 44 dB(A), Night 39 dB(A).

1. Distance-adjusted levels (clause 20): the house is in the Rural Activity Zone, 200 metres from the boundary of the Farming zone, so the distance adjustment is –2 dB. The distance-adjusted levels are Day 47dB(A), Evening 42 dB(A), Night 37 dB(A).
2. Background level assessment (clauses 21 to 24): there is no main road, highway or freeway nearby and traffic noise is not a characteristic of the local background noise. The receiver is within 600 m of the zone boundary and not within any other elevated-background area, so the location is not a background-relevant area. There is no need to conduct a background level assessment.

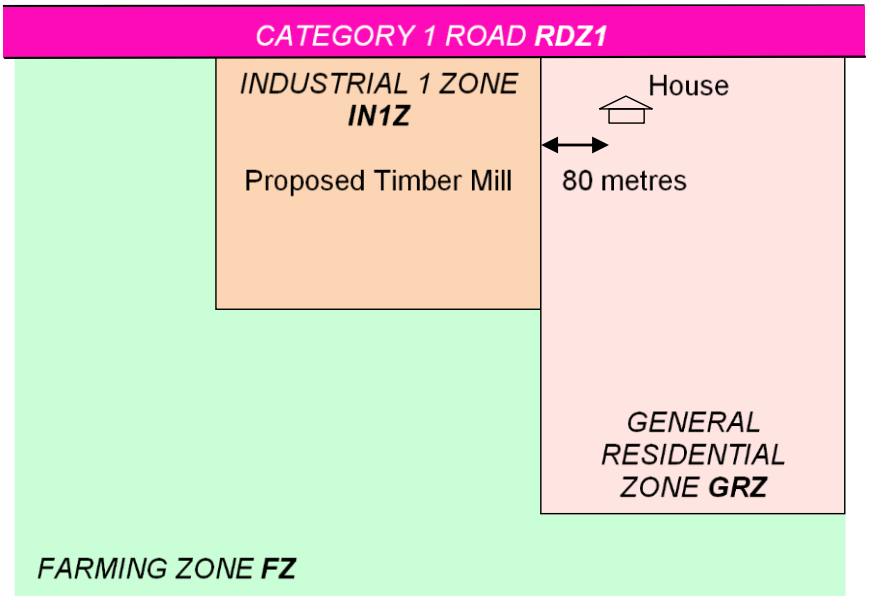
The noise limits outdoors at the house in the Rural Activity Zone become:

- Day: Monday–Saturday (0700—1800) 47 dB(A)
- Evening: Monday–Saturday (1800—2200) 42 dB(A)
  Sunday and public holidays (0700—2200) 42 dB(A)
- Night: Monday–Sunday (2200—0700) 37 dB(A)

Other noise from the farming area includes vehicle activity harvesting crops and tractor operations involved in ploughing and spraying. This operation of 'mobile farm machinery' is not included in the assessment against the noise limits (see Regulation 117(1)(c)(viii)). However, it is subject to the general environmental duty, and the noise must not be unreasonable having regard to the definition of unreasonable noise in section 3(1) of the Act.

F.4 Example 4

A new timber mill is proposed in an industrial zone on in a small town of population 2700. It is intended to operate 24 hours a day Monday to Friday. The noisier debarking operations are proposed for the day period only. The other activities will operate 24 hours. There are no other industries in the industrial zone. The industrial area and adjoining residential zone (the receiving zone) are located next to a busy highway.



Determining the noise limits requires considering the generating and receiving zones and considering background levels because of the presence of traffic noise from the highway.

The rural area method applies, as the area is within a town of 2700 population.

1. Zone levels (Noise Protocol clause 19): the generating zone is an Industrial 1 zone (IN1Z), and the receiving zone is a General Residential Zone. The zone levels (from Table B.1 in Annex B of the Noise Protocol) are Day 53 dB(A), Evening 48 dB(A) and Night 43 dB(A).
2. Distance-adjusted levels (clause 20): the distance between the receiver and the generator's zone boundary is less than 100 metres, so the distance-adjustment is zero. The distance-adjusted levels are Day 53 dB(A), Evening 48 dB(A) and Night 43 dB(A).

3. Background level assessment (clauses 21 to 24): the receiving point is in a background-relevant area, as traffic is a significant audible background noise source.
   The background level is measured using the procedures specified in Part I:A.4 of the Noise Protocol.

The measured representative background levels were:

• Day:	Monday–Saturday (0700–1800)	57 dB(A)
• Evening:	Monday–Sunday (1800–2200)	41 dB(A)
	Sunday and public holidays (0700–2200)	41 dB(A)
• Night:	Monday–Sunday (2200–0700)	29 dB(A)

The background levels are compared to the distance-adjusted levels and the base noise limits, for each period, to see whether it will increase the noise limits. The noise limits become the greater of the distance-adjusted level or the base noise limit, and the background level plus a margin as specified in clause 24 of the Noise Protocol.

In this case, only the Monday-Saturday day period background increases the value of this noise limit. For this period background of 57 dB(A) +8 dB is 65 dB(A), which is greater than the 53 dB(A) distance-adjusted level (and the 45 dB(A) base noise limit). For each of the other periods, the distance-adjusted level is adopted since it is greater than the background level plus 5 dB (and greater than the base noise limit).

The noise limit based on background level assessment (clause 24 values) are:

• Day:	Monday–Saturday (0700–1800)	65 dB(A)
• Evening:	Monday– Saturday (1800–2200)	48 dB(A)
	Sunday and public holidays (0700–2200)	48 dB(A)
• Night:	Monday–Sunday (2200–0700)	43 dB(A)

1. High traffic noise method (clauses 25 to 28): the background-relevant area is affected by high traffic-noise levels during the day period and the noise-sensitive area is in the General Residential Zone so the high traffic noise method for proposed developments in Noise Protocol section I.A.2.5 applies. All the clause 24 values are compared to the reference values for high traffic noise areas of table 1 in clause 26, as set out in table 2 in clause 27 for the day and the evening period, and in table 3 in clause 28 for the night period.

For the evening period and the night period, the clause 24 values are adopted as noise limits since they are lower than the respective reference values of table 1 in clause 26.

For the day period, the clause 24 value is greater than the 55 dB(A) reference value of table 1 in clause 26. The next step taken is to check the traffic noise L_{Aeq}, which is obtained from the background measurement data file. The day period traffic noise L_{Aeq} is 68 dB(A). As the traffic noise LA_{eq} is greater than the reference value +10 dB (65 dB(A)), the provision of row 3

of table 2 (clause 27) applies. The lower of the clause 24 value (65 dB(A)) and the traffic noise L_{Aeq} –10 dB(A) (58 dB(A)) becomes the noise limit.

The noise limits are:

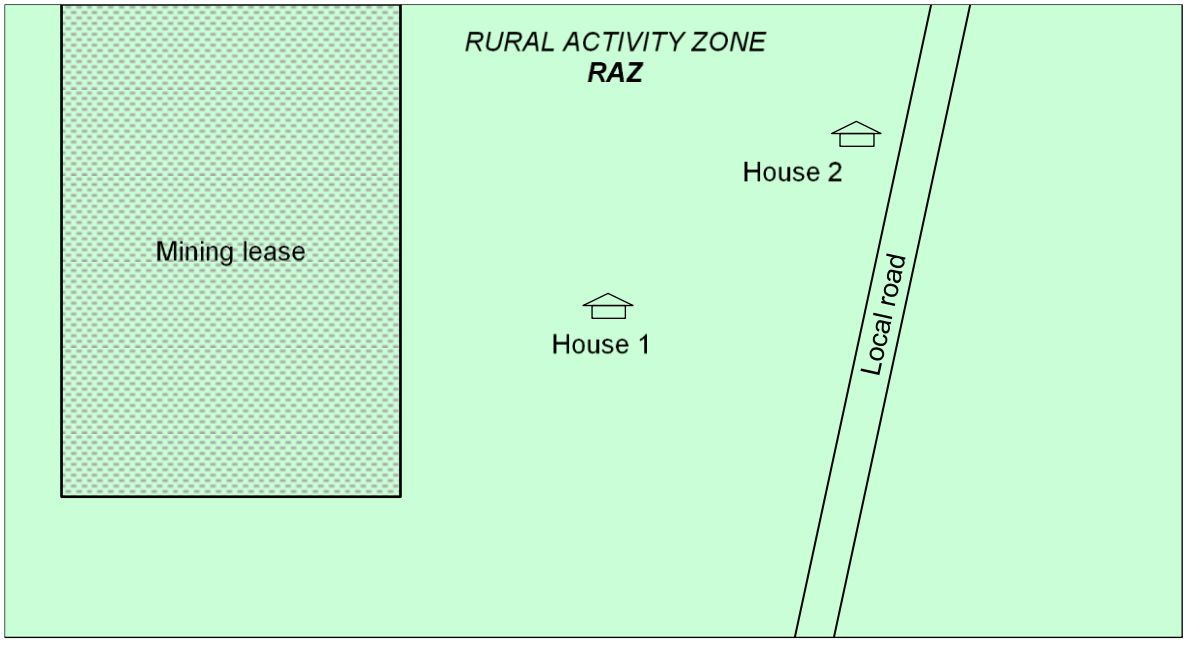
• Day:	Monday–Saturday (0700–1800)	58 dB(A)
• Evening:	Monday– Saturday (1800–2200)	48 dB(A)
	Sunday and public holidays (0700–2200)	48 dB(A)
• Night:	Monday–Sunday (2200–0700)	43 dB(A)

The noise limit for the day period is 58 dB(A). This is greater than the zone level, but the effect of the high traffic noise of the background levels is limited to provide a reasonable outcome for the nearby residents.

The timber mill operations other than debarking are to be designed to meet the night period noise limit of 43 dB(A). The debarking is to be designed to meet the noise limit for the day period of 58 dB(A).

F.5 Example 5

An open-cut goldmine is intended to operate in a Rural Activity Zone. The proposed hours of operation are 24 hours per day, Monday to Friday. There are several houses in the area, the two closest of which are shown in figure below.



The proposal is for an earth resources premises in a rural area, so the steps in Noise Protocol section I.A.2.7 (clauses 33 to 36) apply.

1. Earth resources levels (Noise Protocol clause 35): as the noise receiver is not in a GWAZ, RCZ, RLZ, IN3Z, SUZ, IN1Z, IN2Z or C2Z, the earth resources levels applied are: Day 46 dB(A), Evening 41 dB(A) and Night 36 dB(A).
2. There is no main road, highway or freeway nearby and traffic is not a significant audible background sound source. The receiver is not within any other elevated-background

area, so the location is not a background-relevant area. There is no need to measure background levels.

The noise limits that apply outside both houses become:

• Day:	Monday–Saturday (0700–1800)	46 dB(A)
• Evening:	Monday– Saturday (1800–2200)	41 dB(A)
	Sunday and public holidays (0700–2200)	41 dB(A)
• Night:	Monday–Sunday (2200–0700)	36 dB(A)

Because the use of the land is for mining purposes, the variations in Noise Protocol section I.A.5 (clauses 52 to 55 and table 4) with respect to mines, quarries and landfills apply in this case. There are special provisions for on-site construction works.

During necessary unshielded work to construct the tailings dam for the project (Noise Protocol Part I.A section 5 variations), as allowed in the approval, the permitted noise levels would be no greater than 56 dB(A) during the day period.

Appendix G: Alternative assessment location and criteria example of application

A livestock sales yard is located in a special use zone in a rural area surrounded by farming zone, and with a major highway to its south and another highway to its east. The nearest noise sensitive area is a residence located 700 metres away, in a farming zone to the north of the facility. The resident has reported noise from the sales yard. The noise is assessed by measurement.

On sales day, the facilities start operating at 5 am when cattle trucks start to arrive and finish at 9 pm when cleaning activities are completed.

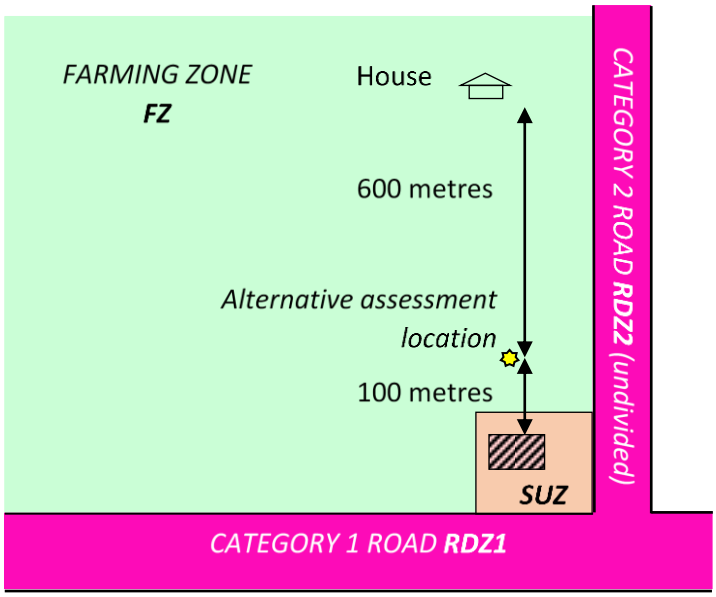


Figure G.1: Settings for the livestock sales yard

The noise limits, determined following the rural area method, including an assessment for background relevant area, are:

• Day:	Monday–Saturday (0700—1800)	46 dB(A)
• Evening:	Monday–Saturday (1800–2200)	41 dB(A)
	Sunday and Public Holidays (0700–2200)	41 dB(A)
• Night:	Monday–Sunday (2200–0700)	36 dB(A)

During a site inspection, it was observed that:

- The noise emitted by the sales yard has some impulsive character. Noise from livestock is not assessed under the Regulations, however noise from trucks within the boundary of the premises, from gates clanging and from cleaning activities is included in the assessment.
- The sounds heard within the noise sensitive area comprises not only noise from the premises being investigated which run continuously on sales day, but also significant local traffic noise, as well as noise from insects and leaves rustling.
- Although the sales yard was operating continuously, during the inspection its noise cannot be heard over the extraneous noise. It is difficult to measure the noise over 30 minutes.

In this situation, for which the noise within the noise sensitive area is affected by extraneous noise, an alternative assessment location should be specified.

Alternative assessment location

A measurement point located 100 metres away from the sales yard, in the same direction as the residence is selected for the alternative assessment. At this distance it was observed that the facilities investigated could be considered as a point source.

The noise is assessed at the alternative assessment location during the operation of the sales yard. An **overall noise level $L_{Aeq,30min}$ of 49 dB(A)** and the associated octave band frequency spectrum is measured. The frequency spectrum in octave bands, with linear weighting given in table G.1.

Table G.1: Octave band spectrum of the noise measured at the alternative assessment location

Octave band	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Measured $L_{eq,30min}$ (dB) (linear) (Alternative assessment location)	54.7	50.8	44.8	41.8	46.6	42.1	28.5	18.9

The difference in noise levels between the noise sensitive area and the alternative assessment location can be determined, in each octave band, using a suitable calculation algorithm.

Alternative assessment criteria

To determine the alternative assessment criteria that apply at the alternative assessment location, the difference in the sound path from the sales yard to this location and the sound path from the sales yard to the noise sensitive area is considered.

Factors that can affect propagation of sound include (refer section 3.2.2):

- directivity of the noise source
- separation distance
- atmospheric conditions
- ground cover
- buildings and structures that can shield or reflect noise.

Directivity of the noise source is not an issue in this case because, relative to the noise source, both the noise sensitive area and the alternative assessment location are in the same direction (north). There is no building or structure that shields or reflects noise.

Atmospheric and ground effects are frequency dependant, it is therefore necessary to consider the frequency spectrum of the noise to account for the difference in sound paths. The alternative assessment criteria are determined based on the procedures of ISO 9613-2, which assumes by default atmospheric conditions favourable to the propagation of sound.

The noise attenuation for separation distance, atmospheric absorption and ground effect is calculated for each octave band. The noise attenuation is shown in Table G.2 for the noise sensitive area and in Table G.3 for the alternative assessment location.

Table G.2: Noise attenuation in octave bands for propagation of sound from the sales yard to the noise sensitive area. Positive values mean a noise reduction, negative values represent an increase in noise level.

Octave band	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Separation distance (Geometrical attenuation, dB)	67.9	67.9	67.9	67.9	67.9	67.9	67.9	67.9
Atmospheric absorption (dB)	0.1	0.3	0.7	1.3	2.6	6.8	23.0	81.9
Ground attenuation (dB)	-5.1	2.3	4.2	-0.5	-2.6	-2.8	-2.8	-2.8
Total (dB)	62.9	70.5	72.8	68.7	67.9	71.9	88.1	147.0

Table G.3: Noise attenuation in octave bands during propagation of sound from the sales yard to the alternative assessment location. Positive values mean a noise reduction, negative values represent an increase in noise level.

Octave band	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Separation distance Geometrical attenuation (dB)	51.0	51.0	51.0	51.0	51.0	51.0	51.0	51.0
Atmospheric absorption (dB)	0.0	0.0	0.1	0.2	0.4	1.0	3.3	11.7
Ground attenuation (dB)	-3.0	2.4	9.4	4.5	0.6	0.0	0.0	0.0
Total (dB)	48.0	53.4	60.5	55.7	52.0	52.0	54.3	62.7

The noise attenuation due to the difference in sounds paths is calculated at each frequency octave band as shown in table G.4.

Table G.4: Difference in noise attenuation associated with the difference in sound path

Octave band	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Noise attenuation (dB) for the sound path to the noise sensitive area (table F.2)	62.9	70.5	72.8	68.7	67.9	71.9	88.1	147.0
Noise attenuation (dB) for the sound path to the alternative assessment location (table F.3)	48.0	53.4	60.5	55.7	52.0	52.0	54.3	62.7
Difference in noise attenuation (dB) between the two sound paths	14.9	17.1	12.3	13	15.9	19.9	33.8	84.3

The values in table G.4 are used to calculate the overall noise level, in dB(A) at the receiver in the noise sensitive area. The difference in noise attenuation is applied to the linear noise level measured in each octave band (table G.1), together with the relevant A-weighting factor.

The overall noise level at the receiver within the noise sensitive area is calculated to be 33 dB(A), after combining the A-weighted sound energy across all the octave bands.

This means that for the operating conditions for which the measurement was conducted, **the noise level at the alternative assessment location is 16 dB(A) higher than the level at the receiver in the noise sensitive area**.

The alternative assessment criterion at the alternative assessment location, for each period, is then calculated by adding the difference in overall noise level to the noise limits that apply to the noise sensitive area.

• Day:	Monday–Saturday (0700—1800)	46 + 16 = 62 dB(A)
• Evening:	Monday–Saturday (1800–2200)	41 + 16 = 57 dB(A)
	Sunday and Public Holidays (0700–2200)	41 + 16 = 57 dB(A)
• Night:	Monday–Sunday (2200–0700)	36 + 16 = 52 dB(A)

Assessment

A noise level of $L_{Aeq,30min}$ 49 dB was measured at the alternative assessment location. The only character adjustment to apply is a +2 dB for impulsiveness. No duration adjustment applies as the noise emissions from the sales yard occur continuously during operating hours.

The effective noise level to compare to the alternative assessment criteria is 51 dB(A). The effective noise level is below the alterative assessment criteria for all periods. The criterion for the night period, as relevant to the operations of the sales yard (5am to 7am), is met with a 1 dB margin.

To assess whether the noise limits are exceeded or not, the uncertainty introduced using alternative assessment location and criteria needs to be considered. In this situation, the calculation algorithm (ISO 9613-2) assumes atmospheric conditions that are favourable to the propagation of sound.

Provided other assumptions made to determine the alternative assessment criteria and the conditions under which the measurement was undertaken are consistent with a conservative assessment (such as maximum operation of the premises and atmospheric conditions favourable to the propagation of sound), it can be concluded, with a reasonable degree of confidence that, for all periods, the noise limits will not be exceeded.