Setting noise objectives for outdoor music festivals in rural locations

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ABSTRACT

Unwanted music from outdoor events is considered a form of noise pollution which presents a unique set of challenges for regulators when compared to other environmental noise sources. Unlike noise generated by sources such as transport or industry where lower levels are always desirable, there is a minimum level of music below which patron experience will be unacceptable. The challenge for regulators therefore lies in balancing the need for entertainment, against the impacts of outdoor music on the surrounding population. Regulators and organisers of outdoor music festivals in rural environments are generally required to comply with receiver-based noise limits in noise catchments which range from very low backgrounds to those which may have dominant natural or transportation noise. With this in mind, this paper describes the approach undertaken to develop a practical and realistic set of noise objectives for a music festival site on the north coast of NSW, Australia.

1 INTRODUCTION

An '*Outdoor Music Event*' is a term which can cover a wide range and combination of musical performances, however these events can generally be categorised as either:

- Urban Events – these tend to be single stage concerts held in stadia, parks or urban settings with city backdrops. Background noise levels will usually be high, and the nearest residents are generally in close proximity. Examples of these include the Sydney Cricket Ground, the Domain in Sydney, and Riverstage in Brisbane which hold events until around 11 pm; or
- Rural Events - these tend to be festivals that run over several days and may run until midnight or later. These events will usually have multiple stages, with a main stage for the headline acts, and smaller stages and bars that cater for lesser known artists or music genres. Background noise levels will generally be low, and the surrounding area sparsely populated. Glastonbury in the UK is the most well-known of these types of festivals, with Blues Fest and Splendour in the Grass examples of similar type festivals held in NSW.

In setting noise limits for outdoor music events, regulators must achieve an appropriate balance between the level of music required to provide satisfactory patron experience and protecting the amenity of surrounding residents. In doing this, it must be understood there is a minimum music level below which patron experience will be sub-standard. This matter is not typically considered in setting of noise objectives for other development types, but is critical to the success of outdoor music events. The following *'rules of thumb'* for music levels have been derived from the measurement of music from outdoor events:

- An L_{eq} level of 100 dB(A) represents a strong sound which is typical of rock concerts, but not as loud as that experienced in a night club or at a heavy metal concert;
- An L_{eq} level of 95 dB(A) represents a reasonably strong, full sound that is typical of Indie/alternative rock concerts. This level is likely to elicit a few complaints from the patrons, from being either too loud or too soft; and
- An L_{eq} level of less than 95 dB(A) is not considered to be sufficiently loud for most music genres, and is likely to elicit complaints from the event organisers and disgruntled patrons for being too low.

2 ASSESSMENT OF MUSIC EVENT IMPACTS

2.1 Assessment Metrics

Generally, noise is measured using the A-weighting curve. This curve is designed to approximate the response of the human ear and results in a single representative number for a noise exposure, rather than a level at multiple frequencies across the acoustic spectrum. In some cases where there are significant levels of low frequency noise, the C-weighting curve may be used to more appropriately assess music with a higher proportion of lower frequency bass.

In addition to the use of a frequency weighting, there is a range of metrics that can be used to assess noise. These can include the L_{max}, L_{10} and the L_{eq}. The L_{10} and particularly the L_{max} are prone to the influence of nearby extraneous noise and consequently the L_{eq} has gained favour as a more reliable assessment measure. However, the usefulness of metrics such as the L_{max} in certain circumstances such as measuring during gaps in traffic is recognised.

2.2 Duration of Measurement

Typically, environmental noise measurements are made over a period of 15 minutes or longer. For a music concert, this would typically represent 3 or more songs along with crowd applause. In order to allow a quick response (if required), it is preferable to have a shorter measurement period which also facilitates more locations or sampling to be undertaken. 5 or 10 minute periods are generally adequate for music assessment.

2.3 Low Frequency Content of Music

Not all music results in the same level of community complaints. Low frequency music with high levels of bass or dB(C) more commonly results in an adverse community reaction than does music with more mid frequencies including vocals and treble. The reason for this is twofold. Firstly, low frequency music is not attenuated as well by structures (barriers, windows, building walls) or air absorption when compared to high frequency music. Secondly, the resultant low frequency music heard indoors or at distance typically comprises distorted audio consisting only of the residual drum and bass guitar which is unpleasant to the ear and more intrusive.

There are several ways of identifying the low frequency content of music. Traditionally the use of the C–weighting scale has been used to provide a measure in dB(C). The C–weighting has a much flatter curve than the A–weighting scale and emphasises the low frequency content but can be influenced by acoustic energy in bands that are not audible or useful for the control of annoying characteristics.

From experience, when measured at large distances in dB(lin), most music is dominated by the 31.5, 63 and 125 Hz octave bands, particularly the 63 Hz octave. Whilst it is possible to mix music to avoid excessive levels in the 63 Hz band whilst maintaining excessive levels in the 31.5 and 125 Hz octaves, in practice this will not happen as the music would be significantly distorted and the spill from adjacent bands will still be evident in the 63 Hz band. Measurement of the 63 Hz band has an advantage over the 31.5 Hz octave in that it is generally the dominant frequency for most music genres including rock. For the same reasons, it is also preferred to the 125 Hz octave and has the added advantage that it is not as susceptible to contamination by extraneous noise as is the 125 Hz band, particularly road traffic noise. The use of the 63 Hz octave as a measure of excessive low frequency noise is supported by guidance provided by Brisbane City Council (BCC), Adelaide City Council and the UK Code of Practice (Noise Council, 1995). Whilst the use of 63 Hz has distinct advantages when measuring at distant receivers, these advantages are largely neutralised when the measurements are made in close proximity to the source, where dB(C) provides a satisfactory measure and is more widely used.

2.4 Relationship of dB(A) to lower frequencies

In this case study, a summary of historical data collected over the past 4 years of noise monitoring indicated the differential between the 63 $Hz_{(10\ minute)}$ and $L_{Aeq(10\ minute)}$ was an average of 12.9 dB with a standard deviation of 5.7 for the genres of music generally performed at the North Byron Parkland (NBP) venue. The authors had previously used a differential figure of 10 dB for outdoor events which is consistent with that used by BCC. Given the current level of understanding of music noise impacts, the authors were reluctant to completely abandon the use of an A-weighted noise descriptor and therefore, as a conservative approach, recommended the dB(A) be retained as an objective indicator to complement the 63 Hz criteria. Additionally, it was recommended to set a delta of 10 dB for the $L_{Aeq(10\ minute)}$ / $L_{63\ Hz(10\ minute)}$ relationship which closely mirrors the 10 dB delta adopted for the $L_{Aeq(5\ minute)}$ / $L_{Ceq(5\ minute)}$ relationship for outdoor events at the Sydney Opera House.

2.5 Assessment Location

Most environmental noise guidelines set levels which are to be met at the nearest residence. This is a logical location as it is where the most significant impact will typically occur and if required, allows for mitigation measures to be developed that will reduce the receiver impacts. Such performance-based criteria allow music event operators to determine how to best manage event impacts. However, in some cases, noise may be difficult to measure at the nearest receiver due to extraneous background noise contamination or issues gaining site access, and so alternate assessment practices may be required.

2.6 Front of House Levels

Music is, generally controlled by the sound engineer at the mixing desk which will be located in a position where a subjective assessment of the speaker performance and audience experience can be made. This position is known as Front of House (FoH) and is representative of the optimum listening location. It does not however represent the front row, nor the position where the most patrons would sit or stand to listen to the music. The majority of patrons will be generally located behind the FoH position.

Because the FoH is located in front of the stage, the sound heard can be considered '*source levels*', with noise levels reducing further away from the stage. For large events, delay speakers will often be deployed throughout the audience further from the stage to ensure that music levels do not drop too low. FoH levels of around 100 dB(A) and 110 dB(C) tend to represent levels that are acceptable to many patrons at a rock concert that has dominant bass levels.

Parnell and Hartcher (2017) have described how the control of FoH levels has been successfully implemented as a management tool for outdoor events at Sydney Opera House. This methodology is also employed by BCC to regulate events at Riverstage (Marchuk and Henry, 2016). Both of these events are held in their respective CBD fringes and utilise a single stage.

2.7 Multi – Stage Events and Rural Festivals

In a rural setting with low background noise levels, music may be audible over significant distances and consequently, potentially impacted receivers may be several km from the venue. Rural receivers are usually spread out and sparsely populated. In these circumstances, meteorology can play an important role in the propagation of music with positive or negative influences of 5 to 10 dB being common. In such cases, receiver-based assessment is generally the most appropriate way to quantify impact.

Whilst FoH levels have been shown to be an effective trigger for controlling music levels and impacts in urban areas where there is only one main stage, the methodology does not translate very successfully to control of multi-stage events in rural locations where cumulative impacts may be harder to analyse due to meteorological enhancement and directivity. Because meteorological enhancement has been observed to be upwards of 20 dB in some extreme circumstances the noise objectives may be exceeded at distances of greater than 2 km if not appropriately controlled. In such situations, FoH levels are still useful to understand patron experience near individual stage, however it will not consistently allow the prediction of impacts at remote receivers with various levels of intervening topography and micro-climates.

3 NOISE MANAGEMENT AT OUTDOOR MUSIC EVENTS

3.1 Options to Manage Festival Noise

Once all reasonable and feasible noise mitigation measures have been implemented (noise barriers, noise limiters, speaker positions, speaker type etc), there are three key ways in which the resultant / residual festival noise can be realistically managed, including:

- Control of Music Level – this is an obvious measure, but unlike the control of noise from an industrial premise where lower is always better, in the case of a music festival there is a minimum level below which the patron experience will be compromised;
- Event Duration – restricting the noise dose is a management tool that can be used to manage impacts. For example, a 1 day music event is unlikely to result in as many complaints as a 3 day event. Likewise, a 4 hour event at a certain level may be tolerated whilst a 12 hour event at the same level is likely to result in an adverse community reaction; and

- Finish Time – similar to control of duration, where louder music levels may be tolerated if the event finishes before most people would want to sleep.

In practice, regulators will consider combinations of all three of these management practices in developing noise conditions.

3.2 History of Festival Noise Management

Much of the initial management and regulation of outdoor music event impact comes from work undertaken in the UK, beginning in 1976 when the Noise Council Code of Practice was introduced which placed noise limits on outdoor music events in the L_{50} metric. Primarily music festivals at Knebworth were used as the test cases (Griffiths, 2004, 2010). Following improvements in sound level meters which allowed for integration, the L_{eq} noise descriptor began to gain favour as a more indicative tool for assessing annoyance. The Code of Practice evolved until the current version was released in 1995 (Noise Council, 1995).

The regulation of outdoor music events in Australia has occurred on an ad-hoc basis. As local councils are usually the appropriate regulatory authority, they generally develop site specific criteria based on what they believe is reasonable and acceptable to their local community. This is not to say these criteria are not appropriate, just they have not generally been developed regarding any established policy document.

3.3 Current Guidance on Levels for Outdoor Music Events in Australia

There is only limited guidance on the levels that are appropriate for outdoor music events in Australia. In some jurisdictions, there are non-mandatory guidelines set at a State level, however in most instances the regulation of music is deferred to the local authorities to take account of site and locality specific issues. A major deficiency is that there is no distinction between 1 day events and multi-day events.

3.3.1 Noise objectives in NSW

Guidance provided by the *Noise Guide for Local Government* (EPA, 2010) is the most directly applicable. It does not however provide regulatory limits, but rather advice for local environmental authorities when considering approvals for outdoor concerts, festivals and cinematic or theatrical events using sound amplification equipment. This document provides reference to the Royal Botanic Gardens, the Domain, Centennial Park, Moore Park, Parramatta Stadium, Sydney Cricket Ground, Sydney Football Stadium, Sydney Olympic Park, the Opera House and Darling Harbour. Criteria for these venues were developed separately and appear to have taken into account site specific factors, as well as the ability of the event to provide a reasonable patron experience. A summary of noise objectives for large music festivals and concerts at the major venues in Sydney is given in Table 1.

Table 1. Major NSW Event Locations

Location and Guiding Policy	Noise Objectives at Receivers (unless otherwise stated)
Centennial Park and Moore Park (Prevention Notice No.1)	8 events pa. of up to 4 days between 10 am and 10:30 pm L_{max} must not exceed 65 dB(A) / 85 dB(C)
Sydney Cricket Ground and Sydney Football Stadium (Prevention Notice No.2) 4 concerts pa. Up to 3 hrs between 10 am and 10:30 pm	For the SCG / SFS L_{max} must not exceed 70 dB(A) / 80 dB(A). L_{max} must not exceed 90 dB(C) / 100 dB(C)
Sydney Olympic Park (Sydney Olympic Park Authority Act 2001)	L_{10} 85 dB(A)

3.3.2 Noise objectives in other States

A summary of noise objectives for other States is given in Table 2 and as can be seen, a mix of noise indices such as L_{eq}, L_{10} and L_{max} have all been referenced. However, in general, these levels approximate to L_{eq} 55 – 70 dB(A), or an L_{max} of around 65 – 80 dB(A). In some cases, effort has been made to limit the low frequency content of music by suggesting limits on dB(C) and octave bands.

Table 2. Australian Major Event Policies

State	Guiding Policy	Event Times	Noise Objectives at Receivers (unless otherwise stated)
Queensland	Environmental Protection Act	7 am – 10 pm 10 pm – Midnight	70 dB(A) 50 dB(A) or background + 10 dB
Brisbane	BCC Local Law Policy (Entertainment Venues and Events)	On a case-by-case basis	L_{eq} 55 dB(A) / L_{10} 70 dB(A). FoH: 95 dB(A) to max of 100 dB(A) and 105 dB(A) @ 63 Hz.
Victoria	State Environment Protection Policy (Control of Music Noise from Public Premises) No. N-2	Til 11 pm 10 pm if > 5 hrs Other hours	65 dB(A) Council criteria applies
Western Australia	Environmental Protection (Noise) Regulations. (Not applicable to approved non-conforming events)	7 am – 7 pm 7 pm – 7 am	65 dB(A) 60 dB(A)
South Australia	Adelaide City Council. Event Noise Mitigation SoP.	7 am – 11 pm	60 dB(A) / 75 dB(A) L_{max} 70 dB(lin) in 31.5 / 63 / 125 Hz FoH 110 dB(C) (recommended)

From experience, it has been found that for a rock concert the difference between the L_{Aeq} and L_{Ceq} levels measured at FoH is often around 10 - 15 dB, whilst the difference between the L_{Ceq} and L_{63Hz} levels is often between 6 and 10 dB. It should be noted that these noise objectives generally apply to events scheduled to finish between 10:30 pm and 11:00 pm. There is very little guidance on the acceptability of music after midnight from open air events.

3.3.3 Urban noise objectives the UK and Ireland

Noise objectives at some major stadia and event locations in urban areas of the UK and Ireland are presented in Table 3. As can be seen, these are mostly an L_{eq} of 75 dB(A) at the receiver without any control on the low frequency component of music spectrum.

Table 3. Noise Objectives at UK and Ireland Stadia and Event Locations

Venue	Internal Criteria L_{eq}	External Criteria L_{eq}	Low Frequency Limit
Lancashire County Cricket Club	None	80 dB(A)	No
Heaton Park, Manchester	None	80 dB(A)	No
Hyde Park, London	None	75 dB(A)	No
Victoria Park	None	75 dB(A)	No
RDS Showground, Dublin	None	75 dB(A)	No
Twickenham Stadium	None	75 dB(A)	No
Hampden Park, Glasgow	None	75 dB(A)	No
Ricoh Stadium, Coventry	101 dB(A)	75 dB(A)	No
Don Valley, Sheffield	None	75 dB(A)	No
Portman Road, Ipswich	None	75 dB(A)	No
Madejski Stadium, Reading	None	75 dB(A)	No
St Marys, Southampton	None	75 dB(A)	No
Rosebowl, Southampton	None	75 dB(A)	No
Stadium of Light, Sunderland	None	75 dB(A)	No

4 NORTH BYRON PARKLANDS

The focus of this paper is a dedicated festival site to the north of Byron Bay on the NSW North Coast. The noise catchment around the North Byron Parklands site is variable. To the east is the Pacific Ocean (~ 3 km) which regularly dominates the background noise at nearby receivers including those on Jones Road some 1.5 km from the beach. To the west, lies both the old Pacific Highway (now known as the Tweed Valley Way which services the local coastal towns and developments), and the closely located M1 Motorway, specifically the section known as the Yelgun to Chinderah Bypass which carries the majority of Sydney – Brisbane freight and passenger road transport. Road traffic noise dominates the noise catchment for around 1 km each side of the road corridor. When festival noise is meteorologically enhanced in this direction, so is the road noise which tends to mask the music at receivers. To the south-east is the suburban developments of Ocean Shores and South Golden Beach. These areas experience high levels of insect and ocean noise. However, under noise enhancing meteorology festival music can be clearly audible, particularly in dry winter nights when insect noise may not be high.

4.1 North Byron Parkland Experience with Noise Criteria

Initially the site was assigned relative noise objectives based on the background levels. It is presumed that the rationale was based on the non-mandatory concept of the NSW Industrial Noise Policy (2000) of setting objectives of 'background + 5 dB', but in recognition that temporary impacts such as a festival can be more acceptable than permanent impacts (a concept of the NSW Interim Construction Noise Guideline, 2009) the noise objective was modified to 'background + 10 dB'.

However, there were fundamental flaws in this approach. Firstly, background levels vary widely in the noise catchment and according to seasonality, and can be very low in the winter when there is reduced insect activity. In such cases, levels of less than 30 dB(A) may be recorded which would result in levels as low as 38 dB(A) being applicable to some residences. These would mean that objectives on site would be unacceptably low, in the order of 70 dB(A) at the FoH which are neither reasonable nor achievable levels for a music festival. As a result, the event was in constant risk of non-compliance. Secondly, the criteria were only set in dB(A) which does not address the most problematic aspect of noise, which is the bass levels. Consequently, high numbers of complaints were received, and the community developed unreasonable expectations of what the festival impacts would be.

4.2 Improving Noise Management of the Site

To better manage noise impacts, three actions were implemented.

4.2.1 Development of an Acoustic Monitoring Program

This document describes the best practice methodology and procedures followed including:

- Attended and unattended monitoring requirements;
- Complaint management;
- Use of meteorological data and complaints to target areas and assign roving noise monitoring officers;
- Control room monitoring of real-time FoH feeds; and
- Provision of feedback to stage managers regarding changes required.

4.2.2 Assessment of Data and Observations

To identify potential improvements, a scientific and logical process was followed which is summarised below:

a) Measurements and observations were made at several locations outside of the event site under different meteorological conditions. These also covered a range of stage configurations and music genres.

b) Observations indicated that:

- In many cases the dB(A) value would be masked by extraneous noise, particularly frogs and crickets;
- All music contains strong 63 Hz and 125 Hz octave. 63 Hz is almost always the dominant octave band;
- Wind (aeolian noise), surf noise and road traffic can all affect the lower octave bands, however the 63 Hz octave is less influenced by traffic than the 125 Hz band; and
- When the signal-to-noise ratio is strong and music and vocals can be clearly heard, it is the 63 Hz noise objective that is the controlling criterion. Typically, if the 63 Hz objective is being approached, then the dB(A) weighted objective will be some 5 dB below the L_{Aeq} objective.

c) Analysis of the measurements indicates that:

At distances of greater than 1 km, atmospheric absorption along with other factors will differentially vary the frequency spectrum along the propagation path. This differential attenuation reduces higher frequencies (trebles - vocals) with the residual lower frequencies (bass – drums etc) being largely unattenuated.

4.2.3 Development of Alternate Noise Objectives

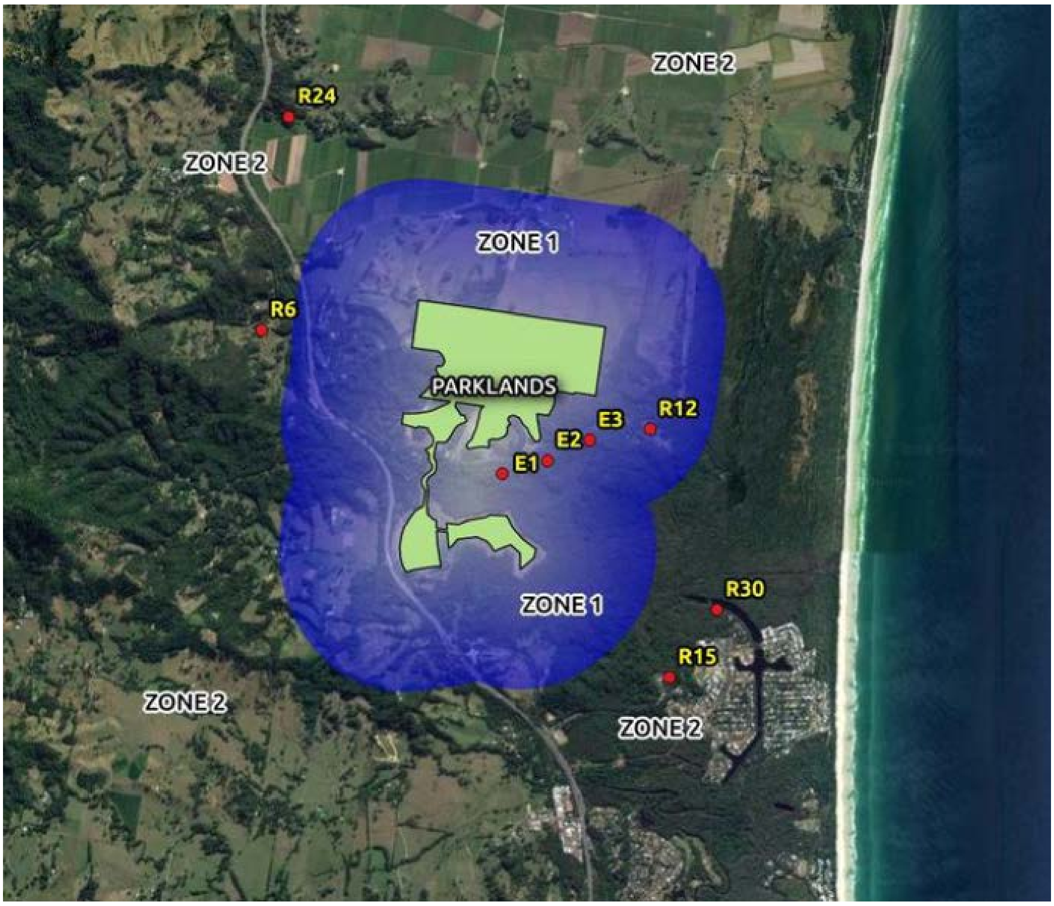
In order to develop a pragmatic set of noise objectives, three key aspects of the project were considered.

a) The noise impact that would be acceptable to residents for a festival of temporary nature;
b) The level of music required to ensure a satisfactory patron experience; and
c) The opportunities and constraints of the site, including location to isolated or clusters of residents.

In reviewing the three key aspects holistically, the following conclusions were formulated.

- Even if the festival operates at the lower end of acceptable patron experience, then there will be some isolated residences within 1 km of the festival site that may experience levels likely to cause annoyance;
- The music festival will be audible to the larger residential locations of South Golden Beach and Ocean Shores during calm and noise-enhancing meteorology, but levels can be managed to acceptable limits;
- Except for New Year's Eve, noise from the event should be further restricted after midnight;
- The event should be inaudible after 2am; and
- Whilst dB(A) levels are an important and well understood measure of annoyance, there also needs to be a low frequency noise objective.

To address the above conclusions, the Department firstly considered two zones of affectation as shown in Figure 1.



Source (North Byron Parklands, 2018)
Figure 1. Noise Management Zones

Secondly, the Department developed alternate noise conditions which it has now trialled since 2016. The salient aspects of these conditions are as follows:

1) During trial events, all stages may operate from 11am but must be shut down at midnight, excluding New Year's Eve, where stages may operate until 1am.

2) Between 11am and midnight, noise levels at sensitive receivers must not exceed the following noise criteria:

   a. For Zone 1:

      i. between 11am and midnight amplified entertainment noise from the event at sensitive receivers must not exceed 60dB(A) $L_{eq(10\ minute)}$; and
      70dB(lin) $L_{eq(10\ minute)}$ in the 63 hertz 1/1 octave band.

      ii. between midnight and 2am, amplified entertainment noise from the event at sensitive receivers must not exceed 45dB(A) $L_{eq(10\ minute)}$; and
      60dB(lin) $L_{eq(10\ minute)}$ in the 63 hertz 1/1 octave band.

   b. For Zone 2:

      i. between 11am and midnight amplified entertainment noise from the event at sensitive receivers must not exceed 55dB(A) $L_{eq(10\ minute)}$; and
      65dB(lin) $L_{eq(10\ minute)}$ in the 63 hertz 1/1 octave band.

      ii. between midnight and 2am, amplified entertainment noise from the event at sensitive receivers must not exceed 45dB(A) $L_{eq(10\ minute)}$; and
      55dB(lin) $L_{eq(10\ minute)}$ in the 63 hertz 1/1 octave band.

3) Amplified music from bars, cafes and the dance floor must cease at 2am.

5 TRIAL OF CONTEMPORARY NOISE OBJECTIVES

Figure 2 presents complaint data from the annual Splendour in The Grass (SITG) festival. This event is the largest event held at the site and occurs in winter when background levels are usually at their lowest (lack of insect noise) and noise-enhancing meteorology is more likely to occur (temperature inversions). Consequently, this event has traditionally attracted the largest number of complaints. As can be seen, following the trial of alternate noise objectives and other measures for the 2016 event, noise complaints were reduced by more than 80% compared to previous years. Of these residual complaints, investigations found some to have been clearly unsubstantiated or hoax complaints and it is therefore not expected that complaints numbers will ever be reduced to zero. Importantly, despite often struggling to meet noise objectives under adverse meteorological conditions, the event has been able to demonstrate compliance with the Noise Management Plan.

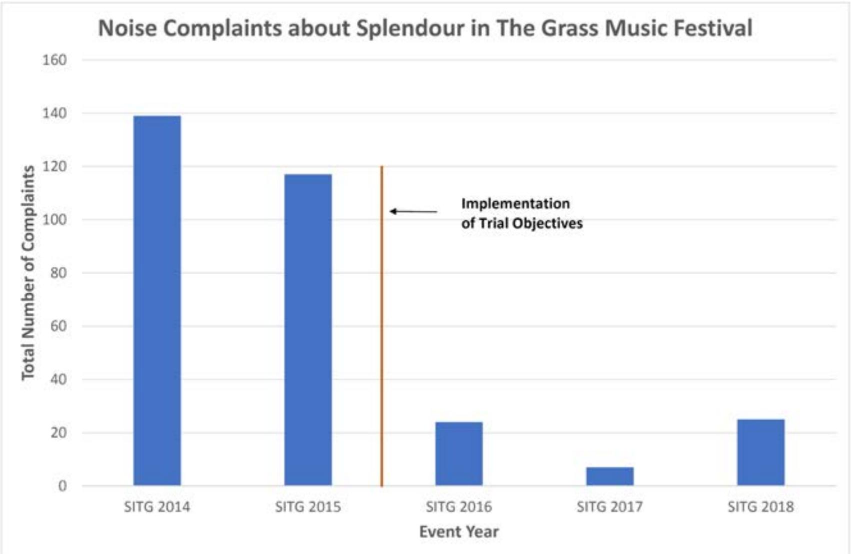


Figure 2. Summary of Noise Complaints 2014 – 18.

6 SUMMARY AND CONCLUSIONS

This paper supplements a previous paper by Parnell and Hartcher (2017) which examined best practice management of single stage outdoor music events in an urban location by considering a different scenario of multiple stages in a rural location.

For this case study, it has been concluded that while FoH management provides the ability to identify, anticipate and control problematic stages, ultimately compliance for multi-stage music festivals where the sensitive receivers are located at significant setbacks is most appropriately determined at representative receiver locations. This is primarily a consequence of the ability of meteorological conditions to vary music levels by more than 20 dB over these larger distances.

The Conditions of Approval developed for the project have been demonstrated to:

- Provide pragmatic noise objectives that can be realistically met;
- Significantly reduce noise complaints; and
- Provide the festival organisers the information and incentives to manage noise impacts by implementing innovative measures and continuously improve music spill from the site.

Further data analysis along with a targeted collection of music and extraneous acoustic spectrums may allow improvements in the screening of contaminated data. This would also further improve the knowledge of the propagation of music from the site, potentially leading to improved management measures. In particular, three areas have been identified for further examination:

a) Identify a distance at which a low pass filter can be applied to reduce false-positive dB(A) results caused by extraneous noise from frogs and crickets;
b) Further investigate the lower frequency music spectrum to assess whether a distinction between music and extraneous surf and wind noise can be confidently estimated; and
c) Examine whether a relationship between FoH levels at the main stages and field measurements could be established which would improve the confidence of field measurements.

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REFERENCES

Griffiths, J. Environmental Noise Guidelines and Sound Management for UK Concerts. *Proc. CFA/DAGA, Strasbourg* (2004).

Griffiths, J. *Witness Statement In relation to Noise Conditions for the National Bowl at Milton Keynes*. Vangardia Consulting, UK. (2010).

Marchuk, A. and Henry, F. Regulatory Strategies for Managing Noise from Outdoor Music Concerts. *Proc. Aust. Acoust. Soc. Conf. Brisbane, Australia*. (2016).

Noise Council (UK). *Code of Practice on Environmental Noise Control at Concerts*. London (1995).

NSW EPA. *Noise Guide for Local Government*. EPA, Sydney (2010).

NSW EPA. *Interim Construction Noise Guideline*. EPA, Sydney (2009).

Parnell, J. and Hartcher, A. Setting noise objectives for outdoor events at the Sydney Opera House. *Proc. Aust. Acoust. Soc. Conf. Perth, Australia*. (2017).