

Regulatory Strategies for Managing Noise from Outdoor Music Concerts

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ABSTRACT

Government authorities are faced with a number of challenges when attempting to regulate noise from outdoor concerts. A key difficulty is the ability of an authority to meaningfully influence the behaviour of a concert operator during the concert itself. In many jurisdictions, penalties for environmental noise nuisance are an insufficient deterrent – resulting in permit conditions and noise limits being routinely exceeded or ignored. Authorities can also face a regulatory burden where noise conditions are technically difficult to measure, difficult to determine compliance, and require specialised equipment and staff to be available outside standard business hours. Noise regulations need to be carefully determined with the aim of motivating good noise self-regulation without being prohibitively punitive or impractical. Noise limits need to consider the realistic sound levels that are needed to hold a successful concert, while still preventing unreasonable behaviour. This strategy has been implemented by setting noise measurement locations at the sound mixing desk. Mixing desk staff can then monitor their own levels with immediate feedback and corrections where required. Self-monitoring provides industry with the ability to clearly demonstrate responsible behaviour to authorities and the community and it provides certainty and security for future use of the venue.

1. INTRODUCTION

Outdoor music concert noise creates a unique regulatory challenge for authorities. Most noise regulation considers noise over long term periods with fixed and relatively predictable sources e.g. mechanical plant noise and traffic noise. In contrast, there are many variables other than the noise level that influence annoyance and complaint numbers in regards to outdoor concerts, including:

- The nature and scale of the event.
- The location and attitude of the local community.
- How often such concerts occur at the location, their duration and finish times.
- Meteorological conditions
- Whether or not the community has been consulted or notified prior to the concert.

Regulatory strategy therefore needs to go beyond a single noise level at the nearest sensitive receptor. A key constraint encountered when regulating outdoor concerts is that there is a minimum sound pressure level below which an outdoor concert cannot function in regards to audience enjoyment. Operational experience at Brisbane City Council is that the threshold for audience enjoyment is generally around 100dBA for a large concert and around 95dBA for smaller concerts. This means that outdoor concerts will cause a high level of noise in the surrounding community by their very nature. There is often limited scope to reduce the high noise levels produced by outdoor concerts, so best practice noise management techniques include restricting the location, frequency, duration, and finish time. Surrounding residents and businesses should also be notified prior to the event. Operational experience indicates that the majority of people accept high noise levels from outdoor concert events if they know they are infrequent in nature, if they were notified, and if they know the finish time.

Beyond setting management rules and noise criteria, the variable and infrequent nature of outdoor concerts also pose unique challenges for enforcement officers. The short duration of an event requires immediacy of feedback and corrective action. This can be more demanding on regulators in comparison to noise from other commercial, industrial or transport sources. In addition, regulatory penalties often do not provide a practical or significant deterrent. Case studies regarding Brisbane's Riverstage and Brisbane Showgrounds will be presented.

2. OUTDOOR MUSIC NOISE CRITERIA

Operational experience at Brisbane City Council is that every community has different expectations and tolerance levels for outdoor concert noise. It is therefore appropriate for noise limits, time limits, and other

restrictions to reflect the needs of the local community. This makes it difficult to prescribe a uniform receptor noise level across all jurisdictions.

In every population there are a percentage of people who react negatively to very low noise levels and those that are not disturbed by even very high noise levels. This variation in the population is very important when deciding appropriate noise limits for outdoor concerts. Attempting to protect all people against any negative impacts from noise would practically prohibit all outdoor concerts. The aim should be to balance the need to protect people from unreasonable impact, while still enabling an enjoyable concert experience.

Compared to other areas of noise research, community response data for outdoor music concerts is relatively limited. The numerous variables that influence noise complaints make it difficult to predict likely community reaction. The *Guidelines for concerts, events and organised gatherings* (Western Australia Department of Health, 2009) does provide some guidance, as shown in Table 1.

Table 1: Likely community response to outdoor music concerts

Noise level, for one-off events where the community has been notified	Likely Response
below 55dBA	Generally no complaints
55–65dBA	few complaints, increasing in sensitive areas and later hours
65–75dBA	considerable level of complaints, less in tolerant areas

A review of outdoor music event noise criteria shows that noise criteria tends to be set in the 65dBA to 70dBA range for outdoor noise at a sensitive receptor. While most other noise regulation focuses on long term community annoyance and sleep disturbance, outdoor music event criteria tends to be focused on minimising community complaint. A summary of outdoor music event criteria for sensitive receptors is given below in Table 2:

Table 2: Outdoor Music Event Noise Criteria

Policy document, Organisation	Outdoor at a sensitive receptor noise level
Guidelines for concerts, events and organised gatherings December 2009 (Western Australia Department of Health, 2009)	55dBA - 75dBA
State Environment Protection Policy, Control of Music Noise from Public Premises) No. N-2 (Environment Protection Authority Victoria, 1999)	65dBA
Queensland Environmental Protection Act (Queensland Government, 1994)	70dBA
Entertainment Venues and Events Local Law (Brisbane City Council, 1999)	70dBA
Noise Council code of practice on environmental noise at concerts (UK Chartered Institute of Environmental Health, 1995)	65dBA

Since 1999 Brisbane City Council has regulated outdoor concerts under its *Entertainment Venues and Events Local Law*. This local law includes criteria for sensitive receptors (see Table 2) but also enables event specific criteria to be set on permits issued under the local law. Between 2000 and 2002 Brisbane City Council set noise limits on permits at three locations for outdoor concerts. These included $L_{A10(15min)}102dBA$ at the mixing desk, $L_{A10(15min)}85dBA$ at the boundary of the event and $L_{A10(15min)}70dBA$ at the closest residence. It was found to be time consuming and difficult to monitor at a sensitive receptor and then communicate with the mixing desk to adjust the levels. It was often impractical to measure noise levels in the community due to meteorological conditions and road traffic noise.

Subsequently, in 2003 Brisbane City Council moved to setting noise limits only at the mixing desk of an outdoor concert. Between 2003 and 2007 Brisbane City Council generally set noise limits on permits for outdoor concerts as $L_{Aeq(5min)}$ 102dBA at the mixing desk (assumed to be 30 metres from the stage) and $L_{eq(5min)}$ 104dB in each one-third octave band between 31.5Hz and 125Hz, measured at the mixing desk. The 63Hz one-third octave band was found to be the limiting factor for outdoor concert noise levels in most cases. The one-third octave criteria were found to be not user friendly to apply in practice. In 2008 Brisbane City Council converted the one-third octave criteria to a dBC value for ease of use. While one-third octaves or full octaves were more precise, dBC was found to be more practical and easier to apply. From 2008 to the present Brisbane City Council sets noise limits on permits for outdoor concerts as $L_{Aeq(5min)}$ 100dBA and $L_{Ceq(5min)}$ 110dBC, measured at the mixing desk (assumed to be 30 metres from the stage). For smaller events $L_{Aeq(5min)}$ 95dBA, and $L_{Ceq(5min)}$ 105dBC measured at the mixing desk 30m from the stage are used. These levels were found to be a good balance between patron experience and protecting residents from unreasonable impact in the Brisbane context.

The Western Australian guidelines also advise that audience levels *'below 95dBA will be unlikely to provide satisfactory entertainment'* (Western Australia Department of Health, 2009). This is consistent with Brisbane City Council's experience of regulating events at Riverstage and the Brisbane Showgrounds. A mixing desk level of 95-100dBA/105-110dBC can therefore be used to model a proposed venue, providing a 'screening test' to see if a site is viable and capable of achieving 65-70dBA at sensitive receptors.

In summary we can conclude that noise regulation should focus on two aspects; providing a tolerable level at the receptor and providing a practical level at the concert itself. Brisbane City Council's experience has led toward a focus on controlling the concert level for the purpose of enforcement. There are several key reasons for this approach:

- Ease of self-regulation. The concert mixing desk operator can easily use a sound level meter to confirm compliance throughout the event, providing instant feedback and certainty for the operator.
- Ease of enforcement. Concert noise levels are dominant at the mixing desk, so measurements from the mixing desk location can be confidently attributed to music noise. In comparison, receptor measurements generally need to consider other ambient effects, creating delays where real-time feedback and action may be required.
- The concert level can be easily correlated with receptor level. Once a venue has been determined to be suitable for events, (through noise modelling or historical measurements), then the mixing desk level can be correlated to forecast receiver levels. Provided the mixing desk stays compliant, then receiver levels should be suitable.
- Event organisers can be required to submit their noise data from the mixing desk location. This can be used to confirm noise compliance post event. This is considerably more practical than taking spot measurements to confirm compliance at various receptor locations based on ad hoc complaints.

2.1 Frequency Weightings for outdoor music criteria

While the A-weighting is commonly used in environmental noise regulation, the C-weighting is well suited for concert music levels. The Association of Australian Acoustical Consultants states:

The 'C' frequency weighting approximates the 100 phon equal loudness contour. The human ear frequency response is more linear at high sound levels and the 100 phon equal loudness contour attempts to represent this at various frequencies at sound levels of approximately 100 dB.

Brisbane City Council has found that noise complaints often relate to the low frequency (bass) component of the music. Using an A-weighted concert level can often allow bass heavy music to comply with 100dBA at the mixer location and 70dBA at the receptor while still emitting particularly intrusive bass noise. This is a particular issue for music genres where the highest octave bands are 63Hz or 125Hz with decreasing amplitude at higher frequencies, such as Electronica, Hip Hop and Reggae (Hayne, Mee & Rumble 2005). A review of mixing desk noise measurement data in Brisbane found a typical difference between C-weighting and A-weighting of 10dB when measured at the mixing desk. Hence, a 110dBC criterion is applied by Brisbane City Council along with the 100dBA criterion.

3. CASE STUDY – BRISBANE RIVERSTAGE

Riverstage is a unique outdoor entertainment amphitheater located in the heart of the city bounded by the City Botanic Gardens and the Brisbane River. The venue is unique in that it is the only large outdoor venue in the central metropolitan area of Brisbane. Some large music festivals also extend from the Riverstage area into the City Botanic Gardens. Multiple unit and high rise residential buildings are also located in the vicinity of the Riverstage, both in the Brisbane Central Business District and across the river at Kangaroo Point. An aerial photograph of the site is shown below in Figure 1.

The venue is fortunate to benefit from a large separation distance, provided by the gardens themselves and the Brisbane River. The most significantly affected residential receptors are located over 400m away to the east of the river in Kangaroo point. This separation distance allows the concerts at the Riverstage to achieve levels below 70dBA at the nearest sensitive receptors while still allowing concert levels of 100dBA and 110dBC.

Riverstage currently holds approximately 24 large music events per year and residents are given notification through mail and email list subscription. Events run into the evening but are typically limited to a finish time of 10pm. The noise propagation for a typical event operating at 100dBA/110dBC is shown below in Figure 2 and the community response from three Riverstage music events are given below in Table 3:

Table 3: Community Response from River Stage

Description of Event	Exceedance of 110dBC front of house criterion	Community Response
Alternative rock concert 5 hours	No exceedances recorded	6 complaints
Alternative rock concert 6 hours	The event exceeded the criterion for 26% of the time. Worst exceedance 4dBC	11 complaints
Electronica concert 4 hours	The event exceeded the criterion for 42% of the time. Worst exceedance 6dBC	21 complaints. Several noted noise levels were louder than normal.

Noise modelling for figures 2, 3 and 4 were conducted using Sound Plan 7.0 using the CONCAWE propagation model with a 5m grid. Meteorological conditions were assumed to be neutral (Category 4). The source level was based on typical measured music levels that result in 100dBA and 110dBC at the mixing desk location. The mixing desk spectrum is given in Table 4:

Table 4: Spectrum for typical Riverstage event at mixing desk (30m)

Octave	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz
dB(lin)	110	96	92	94	95	95	89

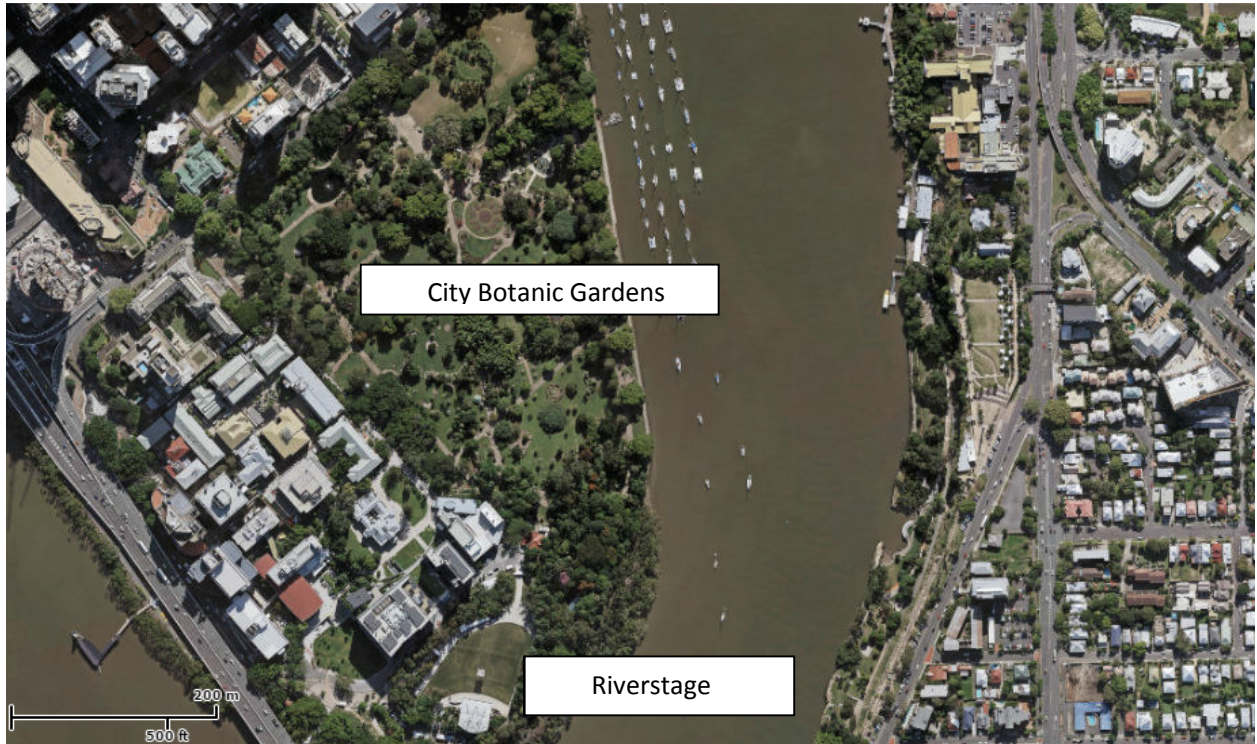


Figure 1: Riverstage and City Bontanic Gardens aerial photograph

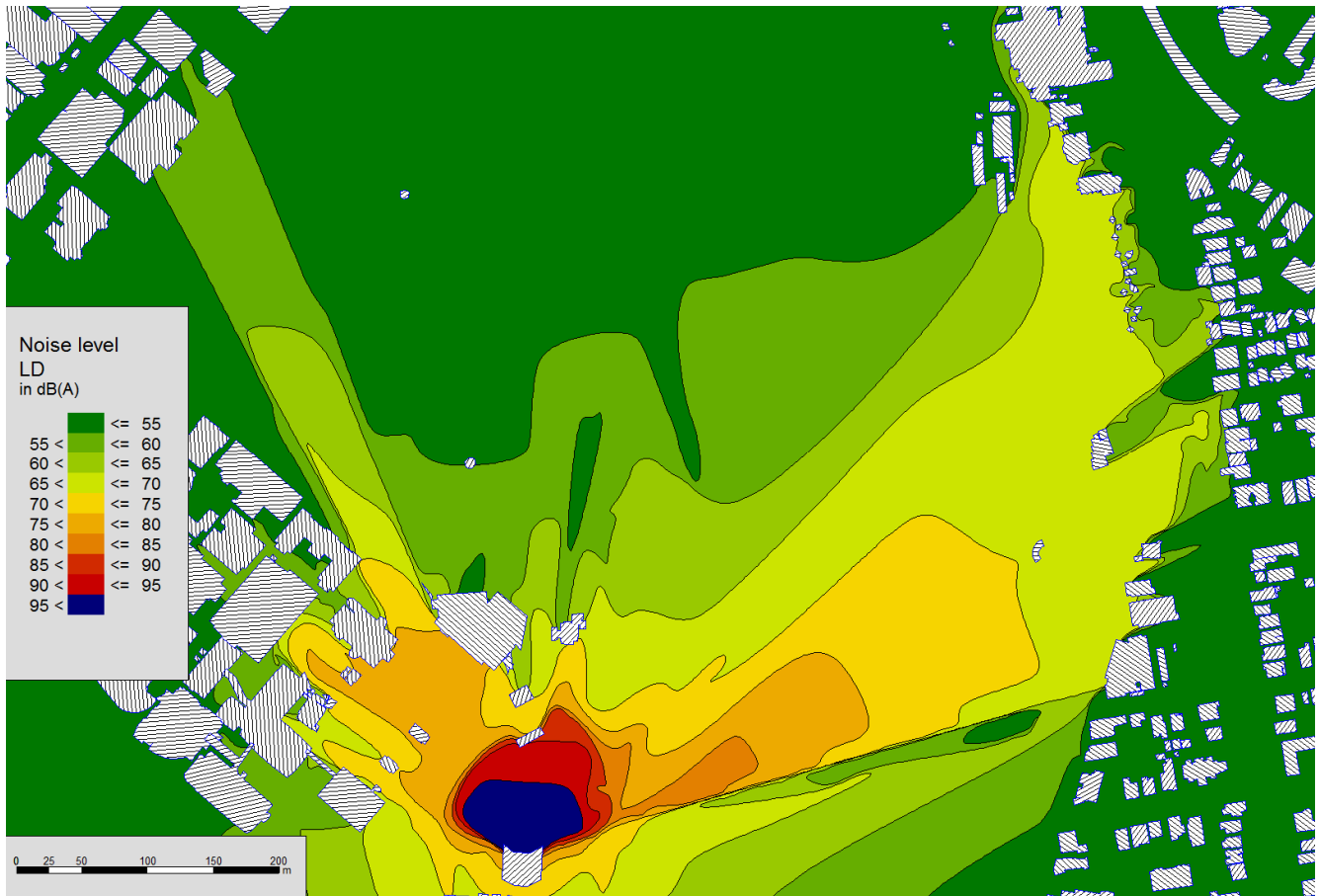


Figure 2: Noise propagation from Riverstage while achieving 100dBA at 30m

As seen above in Figure 2 the most exposed residents are located to the north east and north west of Riverstage. Provided that the Riverstage achieves its mixing desk criteria, then the closest residents will typically be exposed to levels of 60 to 70dBA. There is still a large area exposed to levels greater than 55dBA, particularly where high rise apartments have a direct line of sight to the venue (note that the noise map shows levels at 1.5m height). A small number of complaints can be expected in this scenario, for example Table 3 shows a five hour rock concert that recorded no exceedances but still received six complaints.

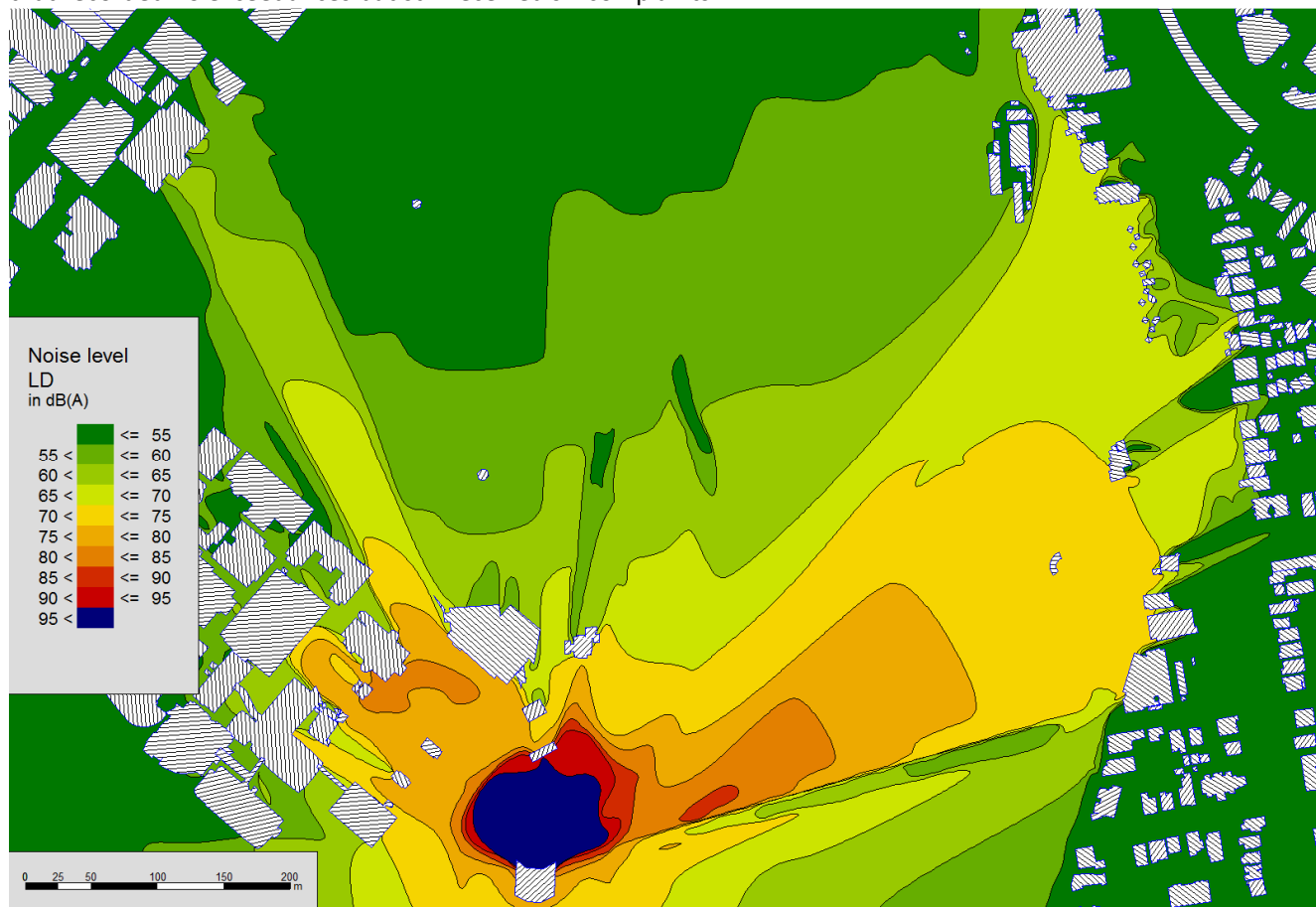


Figure 3: Noise propagation from Riverstage with 3dB exceedance

Figure 3 above shows the result of a small exceedance. The number of residents exposed to 70dBA is very small but note the large increase in area exposed to greater than 55dBA. Complaints can be expected to increase, for example Table 3 above shows a six hour rock concert with a significant proportion of minor exceedances that received 11 complaints.

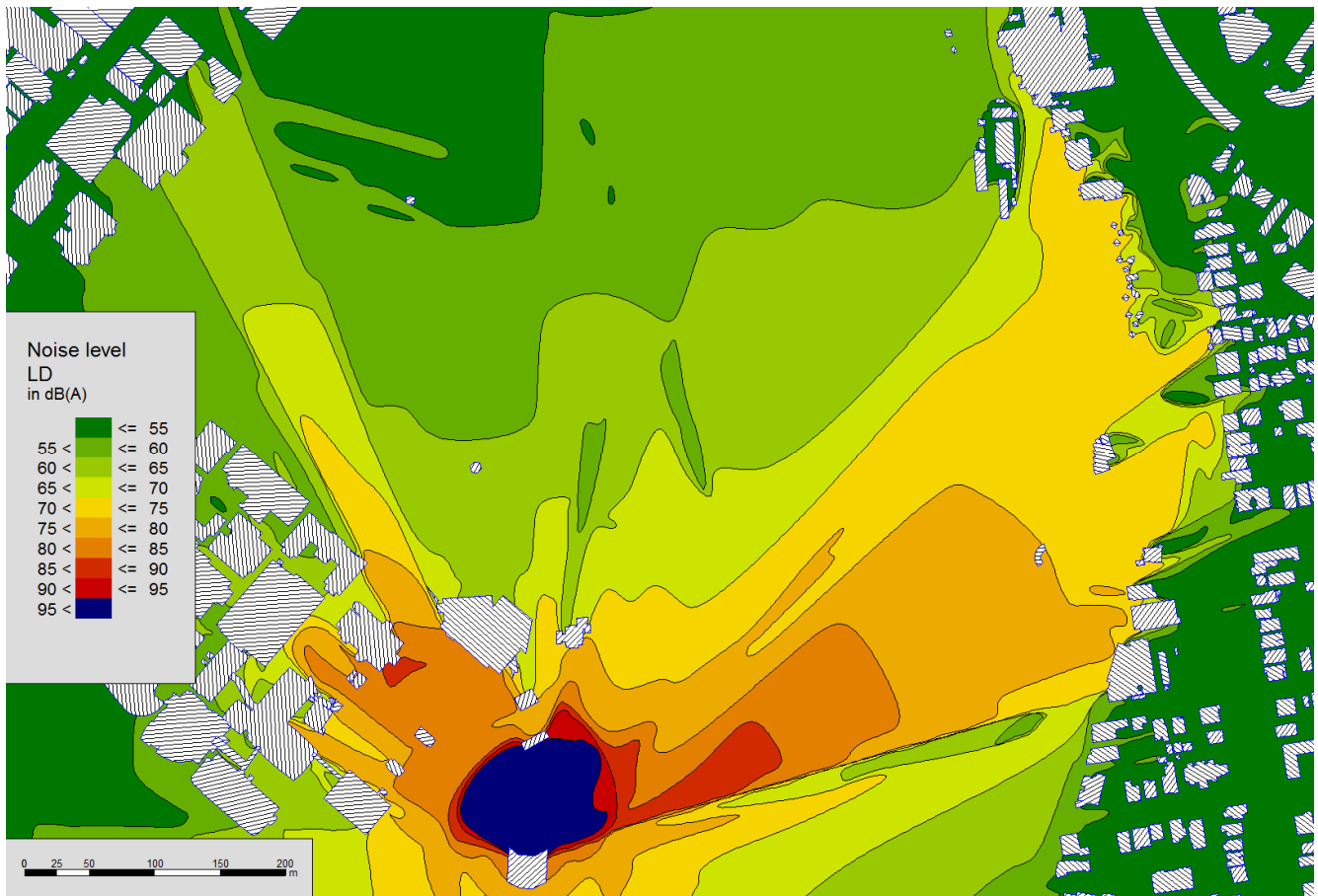


Figure 4: Noise propagation from Riverstage with 6dB exceedance

Figure 4 above shows the result of significantly exceeding the noise limit (6dB exceedance). Complaints can be expected to increase notably. For example Table 3 above shows a four hour electronica concert with significant exceedances that received 21 complaints. Note the very large area exposed to greater than 55dBA.

In summary the community response from Riverstage music noise is consistent with those described in the *Guidelines for concerts, events and organised gatherings*. Regulators should ensure that venues are appropriate for the scale and intensity of the event. Experience has shown that complaints can be minimised provided that only a small number of receptors are exposed to greater than 65dBA and provided low frequency noise levels are managed.

4. ENFORCEMENT OF NOISE CRITERIA

At present, under the Queensland *Environmental Protection Act 1994*, the maximum penalty for causing noise nuisance is \$1700 for an individual and \$8800 for a corporation. While this is generally a sufficient deterrent for small scale events, it is not sufficient for very large events (i.e. it may represent less than 1% of an event’s revenue).

For events over 2000 people, Brisbane City Council applies the *Entertainment Venues and Events Local Law 1999*. The local law provides Council with the ability to hold a performance bond that can be deducted (fully or partially) depending on how effectively an event complies with its noise criteria. The amount of bond is scaled depending on the size of the event and is shown below in Table 5.

Table 5: Noise compliance record for outdoor music festival

Size of Event	Performance Bond
2000-5000	\$0-5000
2001-20000	\$10000
20001-30000	\$25000
>30000	\$50000

Feedback from industry has indicated that the performance bond provides a suitable incentive for compliance, provided that any deductions are made in a reasonable manner. Regulators should take some consideration regarding the practicality of noise management at the event itself. Events can be long duration (e.g. 11 hour all day festivals) that involve many performers and a wide range of equipment. Noise levels vary throughout events and despite vigilant monitoring; short bursts of louder music can cause criteria to be exceeded at times. The regulatory goal should be to encourage event managers to take an active role in controlling their noise levels, rather than a strict punitive approach. The case study discussed below in 4.1 shows that allowing some leniency can actually result in better event cooperation and improved compliance.

4.1 Enforcement Case Study – Brisbane Showgrounds

The approach toward performance bond deduction in 2012 was:

- 2% deduction per exceedance of a noise condition by up to 3dB
- 4% deduction per exceedance of a noise condition by greater than 3dB.

For example, a 2012 event exceeded the 110dBC criterion for 32% of the measured 5 minute intervals. The majority of these intervals were only 1-3dB above the noise limit. There were enough small exceedances that it became known to the event operators that 100% of the bond had been lost well before the event was due to end. This can be particularly problematic where there are multiple stages with multiple small exceedances. As a result there was no clear incentive for further compliance. The final performances resulted in numerous and significant breaches of up to 9dB, this is illustrated in Figure 5.

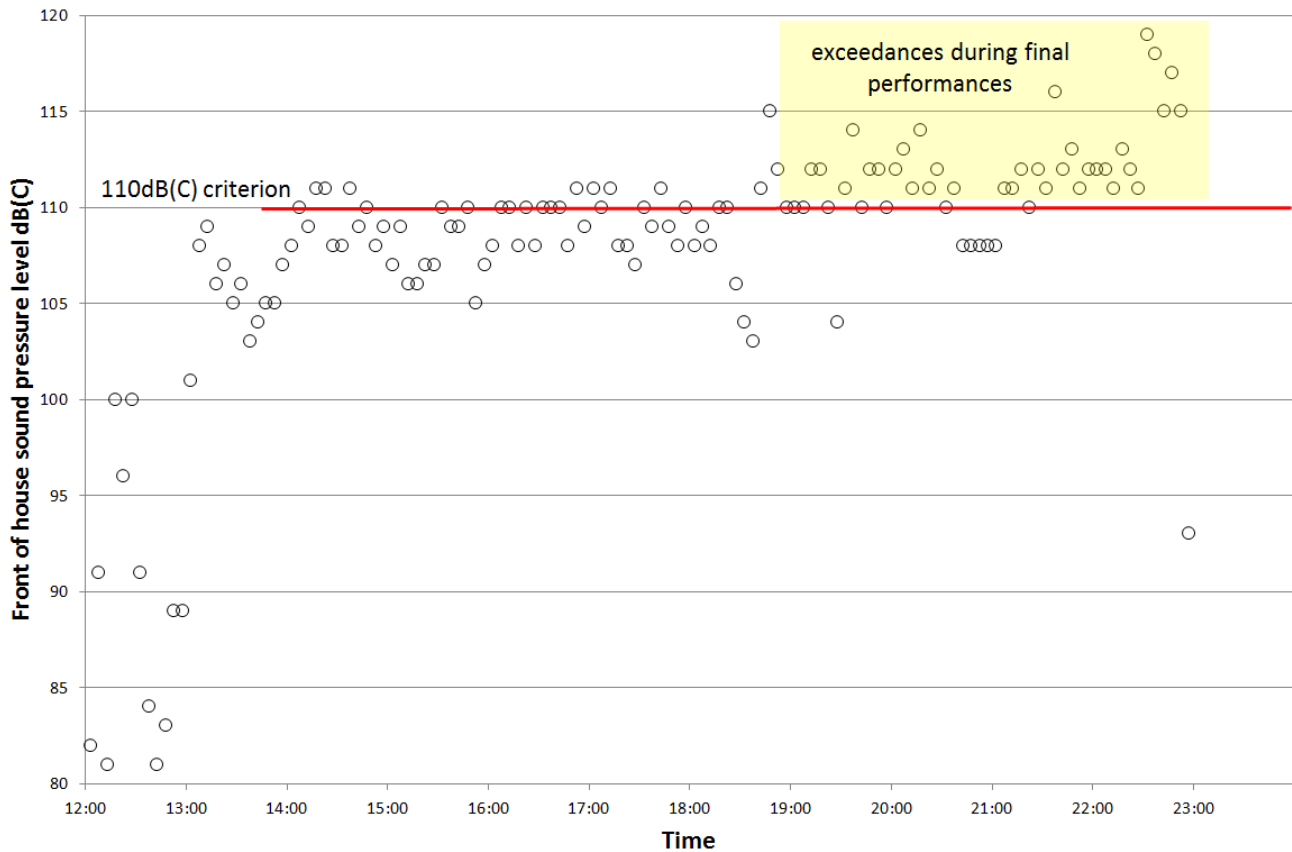


Figure 5: 2012 festival front of house, main stage mixing desk sound pressure

As a result, a more lenient approach was used for the next event. This approach recognised the practical aspects of allowing for small bursts of louder music, provided that any exceedance was immediately recognised and corrected. Small exceedances of criteria were not penalised provided they were immediately rectified. The approach to bond deduction in 2013 was as follows:

- 5% deduction for an exceedance of greater than 3dB for two consecutive 5 minute intervals

In this case the more lenient approach actually resulted in improved compliance. The event exceeded the 100dBC criterion for 19% of the time, with nearly all exceedances 3dB or less, and only four exceedances of 4dB were found. In this case the performance bond was fully refunded. This provides a clear incentive for taking reasonable and practical measures to control noise throughout the event. The comparative results for these two events are presented in Table 6:

Table 6: Summary of noise compliance for outdoor music festivals

Description of Event	Exceedance of 110dBC front of house criterion	Enforcement Measure
2012 festival event, 11 hours	The event exceeded the criterion for 32% of the time. Worst exceedance 9dB	100% loss of bond
2013 festival event, 11 hours	The event exceeded the criterion for 19% of the time. Worst exceedance 4dB	No loss of bond

We can see that even when setting noise limits with clear incentives for compliance, small exceedances are a common occurrence. Regulators should best address this by accounting for small exceedances when allowing

venues to be used for outdoor concerts and ensure that even with small exceedances, the receptor levels are still tolerable. We also see that if limits are too onerous there may be a threshold where an event ceases to self-regulate and begins to account for noise penalties as a cost of doing business – this obviously needs to be avoided.

5. CONCLUSIONS

Outdoor music concerts require a multifaceted approach to regulation because annoyance is dependent on many factors other than just the sound pressure level at a single point. Outdoor concert locations need to be selected with sufficient setback distance and shielding so that the high sound pressure levels needed to enable the concert to function does not result in unreasonable levels at sensitive receptors. Outdoor concert noise levels of $L_{Aeq(5min)} 100\text{dBA}$ and $L_{Ceq(5min)} 110\text{dBC}$, measured at the mixing desk (assumed to be 30 metres from the stage) were found to be a good balance between patron experience and protecting residents from unreasonable impact in the Brisbane context. Community complaint can be minimised provided there are sufficient limits on the number of events per year and hours of operation (particularly finishing time) and provided the community is notified prior to the event. It is important to provide incentives for compliance through measures such as performance bonds or infringement penalties. Best results have been achieved where the compliance measurement position is located at the concert mixing desk, allowing event staff to manage their own compliance without regulatory intervention during the event. Concerts for all genres of music have been successfully held with minimal complaints where these measures have been implemented.

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