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NOISE FROM OUTDOOR MUSIC ACTIVITIES: SELECTED RECOMMENDATIONS DEDICATED TO QUEBEC MUNICIPALITIES

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ABSTRACT

Through a governmental health prevention policy, the Quebec government decided to take actions in order to reduce the effects of environmental noise on the health and quality of life of the population. According to a recent interdepartmental action plan, a priority action was to give recommendations to municipalities and event promoters for the outdoor music activities. The two kinds of population of interest were the attendees potentially exposed to high sound levels and the residents living close to the venues. Based on a literature review from worldwide documents (e.g. regulations, recommendations, scientific papers and reports), this paper presents the noise and sound limit values recommended for Quebec municipalities.

1. INTRODUCTION

Environmental noise is defined by World Health Organization (WHO) as the noise from all sources except occupational noise. It is an important public health issue, featuring among the top environmental risks to health [1]. Environmental noise includes noise produced by transport traffic, industrial activities, neighborhood but also leisure activities such as outdoor music activities.

In 2016, through a governmental health prevention policy, the Quebec government decided to take actions in order to reduce the effects of environmental noise on the health and quality of life of the population [2]. However, the population's exposure to noise is poorly documented in Quebec particularly that related to outdoor leisure activities. According to a recent interdepartmental action plan, one of the priority actions is to give recommendations, in the short term, to municipalities and promoters of major events for the prevention and management of noise issues associated to outdoor music activities. The population of interest are (i) the attendees potentially exposed to high sound levels that could lead to hearing disorders and (ii) the residents living close to the venues (referred to as "noise-sensitive areas" or "noise-sensitive premises" in this paper) who are exposed to "lower" noise level than that exposed to the attendees, but which can nevertheless have an impact on their health and quality of life.

The purpose of the research project founded by the Health Ministry of Quebec (MSSS) is to define some recommendations for Quebec municipalities to help them with planning and managing noisy outdoor music activities. Based on a literature review from worldwide documents [3], this study focuses on the noise and sound limit values, dedicated respectively to noise-sensitive

areas and to attendees. The limit values for outdoor music activities recommended to Quebec municipalities are presented and discussed in this paper.

2. METHODS

A systematic review based on worldwide documents (academic and grey literature) has been performed in order to identify and evaluate the identified limit values in regulations, recommendations, scientific papers and reports. Some interesting examples have been chosen for this paper coming from; Australia, Austria, Belgium, China, France, Germany, Netherland, Norway, Sweden, Switzerland and United Kingdom (UK).

3. RESULTS AND ANALYSIS

3.1 Worldwide regulations and recommendations dedicated to attendees

The most common noisy leisure activity in Canada is amplified music such as concert, nightclubs, etc. [4]. However, there is no regulatory limit value in Canada at the federal level and in Quebec at the provincial level. Since 1999, the WHO [5] [6] recommends the following sound limit values $L_{Aeq,4h} = 100$ dB(A) and $L_{AFmax} = 110$ dB(A) (as shown by the **Table 1**), without hearing protection and for less than five events per year.

Countries and Organization	Common descriptors dB(A)	Additional descriptors dB(A) or dB(C)
Event organized for adult attendees		
Austria [7]	$L_{Aeq,1min} = 100$	
Belgium [8] [9]	$L_{Aeq,60min} = 100$	$L_{Ceq,60min} = 115$
Belgium [10]	$L_{Aeq,60min} = 100$	$L_{AFmax} = 102$
France [11]	$L_{Aeq,15min} = 102$	$L_{Ceq,15min} = 118$
Netherland [7]	$L_{Aeq,15min} = 103$	
Norway [12]	$L_{Aeq,30min} = 99$	$L_{Cpeak} = 130$
Sweden [7]	$L_{Aeq,T} = 100$	$L_{AFmax} = 115$
Switzerland [13]	$L_{Aeq,60min} = 100$	$L_{AFmax} = 125$
UK [14]	$L_{Aeq,event} = 107$	$L_{Cpeak} = 140$
WOH [6]	$L_{Aeq,4h} = 100$	$L_{AFmax} = 110$
Event organized for young attendees		
France [11]	$L_{Aeq,15min} = 94$	$L_{Ceq,15min} = 104$
Sweden [7]	$L_{Aeq,T} = 97$	$L_{AFmax} = 110$
Switzerland [13]	$L_{Aeq,60min} = 93$	$L_{AFmax} = 93$

Table 1. Regulated and recommended sound limit values dedicated to attendees.

For the selected regulations presented in **Table 1**, the most commonly used limit value is $L_{Aeq,T} = 100$ dB(A). Additional sound limit values are also given with L_{AFmax} , $L_{Ceq,T}$ and L_{Cpeak} descriptors, as shown in **Table 1**. Moreover, the sound limit values for events organized for young attendees are lower. The ages associated with these reduced limit values are 7, 13 and 16 years old in France [11], Sweden [7] and Switzerland [13], respectively.

The sound limit values presented in the **Table 1** apply generally (i) to all over the event where there may be attendees (e.g. France [11], Belgium [8] [9] [10]) or (ii) at the “front of house” (FoH) position, which is usually at the mixing desk (e.g. United Kingdom [14], Switzerland [13], Norway [12]). The most used stated time intervals of duration are 60 and 15 minutes. However, time intervals of duration may vary between 1 minute and 4 hours (or event duration).

3.2 Worldwide regulations and recommendations dedicated to noise-sensitive areas

Since 2009, the WHO [15] recommends to use the *night noise guideline* $L_{night, outside} = 40$ dB(A) (or the *interim target* $L_{night, outside} = 55$ dB(A)) for long-term health effects of noise during nighttime, such as cardiovascular disorders. The L_{Amax} descriptor is also recommended to prevent the instantaneous health effects of noise during nighttime, such as sleep disturbances.

For the specific regulations for outdoor music activities presented in **Table 2**, the most used noise limit value outdoors is $L_{Aeq,T} = 65$ dB(A) during daytime. The noise limit value $L_{Aeq,T} = 70$ dB(A) is also used when the number of event per calendar year is less than 6 to 10 (e.g. Austria [16], Germany [16], Norway [12]). However, noise limit values based on the $L_{Aeq,T}$ descriptor may vary between 55 dB(A) and 80 dB(A) during daytime and between 45 dB(A) and 60 dB(A) during nighttime. The noise limit values are also given by the L_{AFmax} descriptor during nighttime (e.g. 55 dB(A) in Norway [12] and 65 dB(A) in Germany [16]).

Countries, states and cities	Daytime and Evening (dB(A))	Nighttime (dB(A))
Adelaide [17]	$L_{Aeq,5min} = 45 - 65$ $L_{AXmax} = 75$	$L_{Aeq,5min} = 45$
Austria [16]	$L_{Aeq,T} = 60 - 80$	$L_{Aeq,T} = 50 - 60$
Brisbane [18]	$L_{Aeq,15min} = 55$	Inaudible
Germany [16]	$L_{Aeq,T} = 65 - 70$ $L_{AFmax} = 85 - 90$	$L_{Aeq,T} = 55$ $L_{AFmax} = 65$
Hong Kong [19]	$L_{Aeq,15min} = L_{Aeq,5min}^1 + 10$	Inaudible
Norway [12]	$L_{Aeq,30min} = 70 - 80$	$L_{Aeq,8h} = 45$ $L_{AFmax} = 55$
UK [20]	$L_{Aeq,15min} = 65 - 75$ $L_{Aeq,15min} = L_{A90} + 15$	Inaudible
Victoria [21]	$L_{Aeq,30min} = 65$	Inaudible
WHO [15]		$L_{night} = 40 - 55$

¹ background noise level

Table 2. Regulated and recommended outside noise limit values dedicated to noise sensitive areas.

The noise limit values presented in **Table 2** may vary from event duration (e.g. Norway [12]), weekdays (e.g. Adelaide (Australia) [17]), number of events per calendar year (e.g. Austria [16], United Kingdom [20]) and event venue (e.g. United Kingdom [20]). Moreover, some noise limit values are also defined related to background noise without events (e.g. Hong-Kong [19], United Kingdom [20]).

The noise limit values presented in **Table 2** apply outside at the façade of noise-sensitive premises. The stated time intervals of duration may vary between 5 to 30 minutes.

In addition to “overall” noise limit values presented in **Table 2**, some cities propose low-frequency noise limit values on the 31.5, 63 and 125 Hz octave bands. **Table 3** presents these values.

Cities	Low-frequency	Octave band (Hz)
Adelaide [17]	$L_{Zeq,T} = 70$ dB(Z)	31.5, 63 and 125
Brisbane [18]	$L_{A10,5min} = 105$ dB(A)	63
Manchester [22]	$L_{Zeq,T} = 75$ dB(Z)	63 and 125

Table 3. Regulated and recommended outside low-frequency noise limit values dedicated to noise-sensitive areas.

The noise limits apply outside at the façade of noise-sensitive premises for Adelaide [17] and Manchester [22] and at the FoH position for Brisbane [18].

4. DISCUSSION

The following recommendations, dedicated to the Quebec municipalities, are based on the results and analysis of the previous section.

4.1 Recommendations dedicated to attendees

The recommended sound limit values for attendees are presented in **Table 4**. The sound limit values could possibly be regulated at the provincial level (Quebec) or at the federal level (Canada).

According to section 3.1, the most used sound limit value is $L_{Aeq,T} = 100$ dB(A) for different time intervals of duration. However, this sound limit value do not exclude the risk of hearing loss. Indeed, the values recommended by the WHO are only given for less than five events per year [6]. Moreover, the sound exposure of an attendee during an event is combined with his occupational daily noise exposure at the workplace [23]. If the sound levels are close to these regulatory limits, it is necessary to encourage the wearing of hearing protection (especially the youngest attendees).

Sound descriptors	Attendees	
	Adults	Young (< 10 years old)
$L_{Aeq,15min}$ dB(A)	100	94
$L_{Ceq,15min}$ dB(C)	115	104
L_{AFmax} dB(A)	110	100

Table 4. Recommended sound limit values dedicated to attendees.

Moreover, the A-weighting linked to a high sound level do not take into account the ear response and low-frequencies. C-weighting values shown in **Table 4** are therefore proposed to the municipalities.

The recommended sound limit values, shown in **Table 4**, apply at the FoH position. To represent several songs and the applauses of the crowd during a concert, a 15 minutes time interval of duration was chosen. This time interval of duration allows an immediate correction of the level unlike a longer time interval of duration (e.g. the 4 hours' time interval duration recommended by the WHO [6]).

4.2 Recommendations dedicated to noise-sensitive areas

According to sec. 3.2, the most commonly used noise limit value during daytime is $L_{Aeq,T} \leq 65$ dB(A) and, for a number of event per calendar year less than 6 and 10, $L_{Aeq,T} \leq 70$ dB(A). These values are also recommended for the municipalities of the province of Québec as shown in **Table 6**. Moreover, the nighttime noise limit values complies with the WHO recommendations (e.g. $L_{night,outside} = 55$ dB(A) ; use of the L_{Amax} descriptor at nighttime) [15].

However, the recommended noise limit values may vary more or less than 5 dB(A) in order to adapt them to the municipalities context (e.g. proximity of noise-sensitive areas). Moreover, if the background noise exceeds the noise limit value shown in **Table 5** (e.g. induced by the traffic noise), emergence values based on background noise should be defined.

The frequencies perceived inside residential buildings are predominant in the octave bands 31.5, 63 and 125 Hz [24]. Some regulations and recommendations (see **Table 3**) set values on these octave bands [25] [26] [27]. However, the 63 Hz octave band should be preferred to the 31.5 Hz and 125 Hz because it is generally the dominant frequency for most music genres. Moreover, the 125 Hz octave band is likely to be contaminated by road traffic noise [28]. The recommended low-frequency noise limit value are therefore proposed at the 63 Hz octave band as shown in **Table 6**.

The noise limit values presented in Table 6 apply outside at the façade of noise-sensitive premises. A 15 minutes time interval of duration has also been chosen for the reasons already mentioned for the recommended sound limit values dedicated to attendees.

Noise descriptors	Time of day		
	Daytime	Evening and Sunday	Nighttime
$L_{Zeq,15min}$ @ 63 Hz	70 dB(Z)		
Events per calendar year (< 6)			
$L_{Aeq,15min}$	70 dB(A)	65 dB(A)	50 dB(A)
L_{AFmax}	90 dB(A)	85 dB(A)	55 dB(A)
Events per calendar year (≥ 6)			
$L_{Aeq,15min}$	65 dB(A)	60 dB(A)	50 dB(A)
L_{AFmax}	85 dB(A)	80 dB(A)	55 dB(A)

Table 6. Recommended outside noise limit values dedicated to noise-sensitive areas.

5. CONCLUSION

For the application of the recommended limit values presented in the sections 4.1 and 4.2, the measurement methodology should be specified. In addition to recommended limit values, a set of good practices in terms of management and planning should be given for outdoor music activities and for other leisure activities such as car racing, fireworks and shooting ranges.

6. ACKNOWLEDGMENTS

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