

# Industrial noise policy in Brisbane

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## ABSTRACT

This paper will identify how the *Brisbane City Plan 2014* uses contemporary environmental noise policy to design out noise problems upfront in the strategic planning for the city and during the assessment of individual development applications. It will cover the policy approach and rationale behind the noise criteria and planning instruments used in the *Brisbane City Plan 2014* to protect noise-sensitive uses from industrial development and also to protect existing industrial activities from encroaching noise-sensitive development. The *Brisbane City Plan 2014* includes noise planning criteria that is separate from the regulatory criteria used for investigating noise complaints or licensing activities. It utilises planning instruments such as zoning and overlay maps to identify noise affected locations. It links noise planning criteria to the specific land use zones thereby recognising that not all parts of the city have the same quality of acoustic environment. The *Brisbane City Plan 2014* contains intrusive noise criteria, acoustic amenity criteria, night time (sleep disturbance) criteria and low frequency noise criteria for assessing the appropriateness of new development. New noise-sensitive uses encroaching on existing industry are required to incorporate building design and construction measures to achieve indoor noise criteria, but not outdoor criteria.

## 1. INTRODUCTION

Brisbane City Council (the Council) is the largest local government in Australia, covering the wider Brisbane metropolitan area and a population exceeding one million people. It includes major industrial areas of State significance such as the Australia Trade Coast and Port of Brisbane, in addition to regional and local scale industrial precincts.

The Council regulates noise from all industrial activities in Brisbane not licensed by the Queensland Government. In addition, all new industrial development or changes to existing industrial uses requires Council planning approval under the Brisbane planning scheme, called the *Brisbane City Plan 2014* (City Plan). Industrial development is assessed against the noise criteria in the City Plan, not against any State laws.

The drafting of the City Plan between 2008 and 2014 provided a rare opportunity for a major revision of industrial noise policy in Brisbane. In particular, it provided the opportunity to design out noise conflicts between incompatible land uses in the up-front strategic planning. This included addressing the impacts caused when residential and other sensitive uses encroach upon existing industry, often due to the transition of old inner-city industrial areas to residential neighbourhoods.

The drafting of the City Plan also enabled a complete review of the noise criteria and assessment methods used for new industrial and residential development. Considerable in-house research was undertaken of noise criteria, health effects, community annoyance theory, existing background and ambient noise levels across Brisbane and the approaches taken by other jurisdictions in Australia and internationally. This paper outlines the results of that research in regards to the policy approach and rationale behind the noise criteria and planning instruments used in the City Plan.

## 2. STRATEGIC PLANNING

Strategic outcomes for noise in the City Plan include protecting the health and wellbeing of occupants of sensitive uses by reducing their level of noise exposure and protecting existing lawful industrial uses from encroachment by incompatible sensitive uses.

A key policy decision made in the strategic planning was to recognise that not all areas of the city have the same quality of acoustic environment. Some parts of the city are inherently noisy, while some parts of the city have a high quality acoustic environment. The acoustic environment is one of the factors which define the amenity or quality of an area. This led to acoustic amenity expectations being articulated in the City Plan for the various land use zones. For example, a mixed use zone, which is intended to contain residential as well as vibrant late night commercial development, will be noisier in general than a low density residential zone. Development in the noisier

zones such as the mixed use zone is required to be designed, sited and constructed to minimise noise impacts on residents, however the City Plan also states that residents in these noisier zones cannot expect to enjoy the same level of noise amenity as would be expected in the low density residential zones.

In addition to building acoustic amenity expectations into the zones, a number of overlay maps are used in the City Plan to identify the areas of Brisbane potentially affected by transport, airport and industry noise. New sensitive development, such as residential development located within these overlay maps is required to be designed and constructed to enable indoor noise levels conducive to the health and well-being of future occupants. It has been shown that providing façade noise mitigation measures at the design stage generally has a positive benefit/cost ratio (Marchuk & Henry, 2010). A policy decision was made not to include outdoor noise criteria for sensitive development in these noisy areas. The primary reason for this is because large noise fences or barriers are often the only practical means of achieving outdoor noise criteria in these areas and the benefit does not outweigh the impact such fences and barriers can have on other City Plan outcomes including visual amenity, safety and surveillance, solar access, wind movement, maintenance and wildlife movement.

### 3. INDUSTRIAL DEVELOPMENT

All industrial development in Brisbane is assessed against the City Plan. The City Plan requires proposed industrial development to demonstrate that it can meet:

- Noise (planning) criteria
- Low frequency noise criteria
- Night time noise criteria.

The above criteria are used to predict the impact of proposed new industrial development on noise sensitive uses, to inform the Council's decision as to whether the development should be approved or not and if approved, under what conditions. The criteria (and the City Plan) are not used to assess or measure the operational compliance of industrial activities. Instead the conditions of the development approval and/or the Queensland *Environmental Protection Act 1994* are used to regulate operational compliance. Brisbane City Council is in the position whereby it is both the planning authority (under the City Plan) and the regulatory authority (under the *Environmental Protection Act 1994*) for most industrial activities. This enables the Council to take an integrated approach to the planning and regulatory laws that it administers.

The development approval conditions imposed by the Council for industrial development are based on the construction and design measures recommended during acoustical assessment of the proposal, such as mechanical plant enclosures, shielding and building and barrier specifications. Noise criteria are not generally stated in the development approval conditions imposed by the Council. Therefore the accuracy of the acoustic assessment report submitted with the development application is important. The development proponent must be confident that the noise attenuation performance and the mitigation measures stated in the acoustic assessment report are achievable and are consistent with the normal design, competent operation and maintenance of the proposed development. Post-commissioning testing may also be required as a condition of approval to verify the design and performance of the development complies with the statements made in the acoustic assessment report and with the City Plan noise criteria.

#### 3.1 Noise (planning) Criteria

The noise (planning) criteria are contained in the Industry code of the City Plan. It consists of two criteria – the intrusive noise criteria and the acoustic amenity criteria. The predicted noise from the proposed industrial development is not to exceed either criterion. This approach is based on the *New South Wales Industrial Noise Policy, 2000*.

The intent of the intrusive noise criteria is to ensure that predicted noise from the proposed industrial development generally mixes into the ambient noise environment and is not intrusive above the existing background noise at the sensitive receiver or zone boundary. A summary of the intrusive noise criteria is shown below in Table 1.

Table 1: Summary of intrusive noise criteria of the *Brisbane City Plan 2014*

Criteria location	Intrusive noise criteria ( $L_{Aeq,adj,T}$ )
Low density residential zone boundary	Not greater than RBL +3dB(A)
At a sensitive use in the mixed use zone	Not greater than RBL +5dB(A)
Conservation zone boundary	Not greater than RBL +0dB(A)

$L_{Aeq,adj,T}$  is the adjusted A-weighted equivalent continuous sound pressure level predicted for the relevant period, where T equals 11 hours for the day period (7am to 6pm), four hours for the evening period (6pm to 10pm) and nine hours for the night period (10pm to 7am).

The background noise is calculated as a rating background level (RBL) following a procedure contained in the Noise impact assessment planning scheme policy of the City Plan. The RBL is effectively the lowest 10th percentile  $L_{A90,1hr}$  background noise level during the day, evening or night period. A policy decision was made not to specify a minimum background noise level for the purpose of assessing the impact of proposed industrial development.

The intrusive noise criteria are based on the land use zones stated in the City Plan and assume the industrial development is in an industry zone or mixed use zone. A policy decision was made to use RBL plus 3dB(A) where the criteria location is a zone intended to have a high level of acoustic amenity, such as a low density residential zone, RBL plus 5dB(A) for the more vibrant zones such as a mixed use zone and RBL plus 0dB(A) for zones where the absence of industrial noise is an important feature of the zone, such as the conservation zone.

The A-weighted equivalent continuous sound pressure level ( $L_{Aeq}$ ) of the proposed development is predicted over the period being assessed (i.e. day, evening or night). Adjustments are made to the  $L_{Aeq}$  to account for likely annoying characteristics such as tonality or impulsiveness and the adjusted  $L_{Aeq}$  is then compared to the RBL.

A predicted 11 hour  $L_{Aeq}$  is used to assess the impact of proposed industrial noise for the day period. Noise predicted in the evening period is calculated as a four hour  $L_{Aeq}$  and noise for proposed night time industrial activities is calculated as a nine hour  $L_{Aeq}$ . A policy decision was made to predict the  $L_{Aeq}$  over the period rather than predicting a 15 minute  $L_{Aeq}$  (which is the procedure in other jurisdictions). While a 15 minute time period is convenient for field measurements for existing activities, most community health and annoyance research is based on the  $L_{Aeq}$  value over the day, evening or night period rather than a short term assessment (Miedema & Voss, 2004). Using the predicted noise level for the period is considered more appropriate for assessing possible annoyance associated with proposed development because the criteria is scientifically linked to published community response research. A primary goal in drafting the City Plan was to link criteria to contemporary community response research, rather than providing alignment with other jurisdictions.

Brisbane City Council still uses a short term noise descriptor (such as a 15 minute  $L_{Aeq}$ ) for field measurements for complaint investigations under the *Environmental Protection Act 1994*, for operating industrial activities. Using the *Environmental Protection Act 1994* for complaint investigations enables all the non-sound pressure level factors to be considered when assessing the reasonableness of the noise.

A wide range of industrial noise sources were reviewed during the drafting of the City Plan criteria, including a review of noise data contained in acoustic assessment reports submitted with development applications. It was observed that in many cases proposed industrial development could be unnecessarily limited by short term noise activities, such as deliveries, despite the amenity of the area being largely unaffected by the proposed development, typically due to existing industrial uses or other ambient noise.

The most crucial period in regards to short term elevated noise events was identified to be the night time period, where short term noise can impact negatively on sleep. The City Plan night time criteria discussed below manages the impact of short term industrial noise during the night period.

As illustrated in Table 1 above, the criteria location (receiver location) for the assessment is made based on the land use zones stated in the City Plan. This is to provide clarity and to avoid argument that may occur if the criteria location used a general description such as rural, suburban or urban. The assessment is made at the zone boundary to ensure future yet unbuilt noise sensitive uses are protected. The exception is the mixed use zones where low impacting industrial activities can occur in the same zone as sensitive uses. In these zones the assessment is made

at a sensitive use.

The intent of the acoustic amenity criteria is to prevent background and ambient noise levels increasing without limit (background creep) and to reflect reasonable expectations of acoustic amenity in the various City Plan land use zones. A summary of the intrusive noise criteria is shown below in Table 2.

Table 2: Summary of acoustic amenity criteria of the *Brisbane City Plan 2014*

Criteria location	Acoustic amenity criteria ( $L_{Aeq,adj,T}$ )		
	Day	Evening	Night
Low density residential zone boundary	55dB(A)	45dB(A)	40dB(A)
At a sensitive use in the mixed use zone	60dB(A)	55dB(A)	50dB(A)
Conservation zone boundary	40dB(A)	40dB(A)	40dB(A)

The acoustic amenity criteria provide an upper limit for the predicted  $L_{Aeq}$  noise levels for the industrial development during the relevant day, evening and night periods. The amenity criteria are informed by the dose response relationship data of Miedema & Voss, 2004 and also by in-house research undertaken by Brisbane City Council. A policy decision was made not to include an assessment of cumulative noise from existing industrial activities when assessing a proposed industrial development. A decision was made that while the consideration of cumulative and existing industrial noise is theoretically correct, in practice, including it in the planning assessment process does not provide significant benefit in the Brisbane context. A simple approach was preferred.

### 3.2 Low Frequency Noise Criteria

While most industrial noise sources can be reasonably assessed with an A-weighted sound pressure level, an A-weighted assessment can under-represent the impact of activities that produce significant low frequency noise. For this reason low frequency noise criteria has been included in the City Plan for assessing industrial development. Examples of the types of industrial noise sources that should have a low frequency noise assessment, in addition to an A-weighted noise assessment, include gas turbines, boilers, forced draft and induced draft fans, shakers on hoppers, vibratory screens, wind farms, power stations and generators.

A low-frequency noise assessment is not required where the industrial noise does not include a significant contribution from low frequencies.

A number of different approaches to assessing low frequency noise were considered during the development of the City Plan, including octave, one-third octave, A-weighted with penalty adjustment, zero-weighted and C-weighted assessment methods and criteria. Each has its strengths and weaknesses. While one-third octave analysis was considered the most accurate assessment method, it was decided to use C-weighted assessment because it provides a simple method of assessing low frequency noise from industrial activities, with sufficient accuracy for planning assessment. The predicted low-frequency C-weighted noise is to be adjusted in the same manner as the A-weighted level. That is, tonal, impulsive, modulating and fluctuating noise adjustments are to be applied.

A summary of the low frequency noise criteria in the City Plan is presented in Table 3 below. The low frequency noise ( $L_{Ceq,adj,T}$ ) of the industrial development is not to be greater than the values at the relevant criteria location for the day, evening and night time periods.

Table 3: Summary of low frequency noise criteria of the *Brisbane City Plan 2014*

Criteria location	Low frequency noise criteria ( $L_{Ceq,adj,T}$ )		
	Day	Evening	Night
Low density residential zone boundary	65dB(C)	65dB(C)	60dB(C)
At a sensitive use in the mixed use zone	75dB(C)	75dB(C)	70dB(C)
Conservation zone boundary	65dB(C)	65dB(C)	65dB(C)

The low frequency noise criteria used in the City Plan are largely based on Broner, 2011, however the published research by the United Kingdom Department for Environment, Food and Rural Affairs (DEFRA) (Moorhouse, Waddington & Adams, 2011) and in-house research undertaken by Brisbane City Council, also influenced the low frequency noise assessment approach.

### 3.3 Night Time Noise Criteria

The intent of the night time noise criteria is to reduce sleep disturbance for occupants of sensitive uses caused by industrial development. It only applies to short duration maximum noise events from industrial development during the night period (10pm to 7am).

There is considerable published research that shows a correlation between the A-weighted maximum sound pressure level ( $L_{Amax}$ ) and sleep disturbance from short duration or intermittent noise events (World Health Organization, 2009). However the number of variables that influence sleep disturbance from intermittent noise, such as the  $L_{Amax}$ , number of events and the emergence of the intrusive noise above the ambient or background, makes it difficult to draft a sleep disturbance criteria that is simple to use in practice. This is particularly the case for predicting the impact of proposed industrial development.

After considering the published research, in particular *Night Noise Guidelines for Europe* (World Health Organization, 2009) and the in-house research undertaken by Brisbane City Council, a decision was made to include a night time noise criteria based on the predicted night time  $L_{Amax}$  values and the night time ambient noise level at the sensitive use.

A summary of the night time noise criteria in the City Plan is presented in Table 4 below. The  $L_{Amax}$  criteria ranges from 50dB(A) to 65dB(A) and depends on the existing night time ambient noise level at the sensitive use. Generally, this results in night time  $L_{Amax}$  events from the industrial development that are mixed in with the existing ambient night time  $L_{Amax}$  events. The criteria include a limit for the average of the highest  $L_{Amax}$  events and a limit for the absolute highest single  $L_{Amax}$  event. As  $L_{Amax}$  levels from multiple events can be variable, both of these  $L_{Amax}$  criteria need to be achieved.

Although  $L_{Amax}$  is assessed for the night time period only, data for the proposed industrial development may be obtained at any time during the day, evening or night when predicting the forecast  $L_{Amax}$ . This is provided that the data obtained is equivalent to the forecast night time events to be used in the prediction.

Table 4: Summary of night time noise criteria of the *Brisbane City Plan 2014*

Criteria location	Where the existing $L_{Aeq,9hr\ night}$ at the criteria location is:	Average of the highest 15 single $L_{Amax}$ events	The absolute highest single $L_{Amax}$ event
	<45dB(A)	not greater than 50dB(A)	not greater than 55dB(A)
Low density residential zone boundary	45 to 60dB(A)	not greater than $L_{Aeq,9hr\ night} + 5dB(A)$	not greater than $L_{Aeq,9hr\ night} + 10dB(A)$
	>60dB(A)	not greater than 65dB(A)	not greater than 70dB(A)

## 4. RESIDENTIAL DEVELOPMENT ENCROACHING ON EXISTING INDUSTRY

The City Plan also seeks to manage the encroachment of residential and other sensitive development upon existing industry. This is to protect existing lawful industrial uses from encroachment by incompatible sensitive uses and to protect the health and wellbeing of the future occupants of the development. A map in the City Plan called the Industrial amenity overlay has been used to identify the potentially noisy areas around existing industry. Sensitive development within this overlay must be designed and constructed to achieve the noise criteria in Table 5 and Table 6 where low frequency noise assessment is relevant. The criteria apply inside a sensitive use and aim to protect sleep, relaxation and communication indoors.

The onus is on the new noise sensitive use to incorporate noise insulation in its construction. A policy decision was made not to include outdoor noise criteria for the proposed noise sensitive development. This is because it is

difficult to provide outdoor acoustic amenity in noisy areas adjacent to industry without the use of large noise barriers, which generally have marginal benefit compared to the negative impact on other City Plan outcomes.

The noise criteria in Table 5 and Table 6 are only used for designing the new development and are not used for monitoring ongoing or operational compliance.

The assessment is based on the predicted  $L_{Aeq,adj}$  for the day, evening and night periods and the predicted night time maximum internal  $L_{Amax}$  within a habitable room of the proposed development. Except for an assessment of low frequency noise which involves an assessment of  $L_{Ceq,adj}$  for the day, evening and night periods.

Table 5: Indoor noise (planning) criteria for sensitive uses

Location	Day $L_{Aeq,adj,11hr}$	Evening $L_{Aeq,adj,4hr}$	Night $L_{Aeq,adj,9hr}$	Night $L_{Amax}$
Sleeping areas	35dB(A)	35dB(A)	30dB(A)	45dB(A)
Other habitable rooms	35dB(A)	35dB(A)	35dB(A)	NA

Table 6: Indoor low frequency noise criteria for sensitive uses

Location	Day $L_{Ceq,adj,11hr}$	Evening $L_{Ceq,adj,4hr}$	Night $L_{Ceq,adj,9hr}$
Sleeping areas	60dB(C)	60dB(C)	55dB(C)
Other habitable rooms	60dB(C)	60dB(C)	60dB(C)

## 5. DEVELOPMENT THAT EXCEEDS THE CRITERIA

Noise is only one of the many factors that Brisbane City Council considers when assessing the appropriateness of a development. The City Plan requires an overall assessment of the economic, social and environmental benefits and impacts of a development.

There may be situations where even when best available noise mitigation measures are implemented by the development, it may not be economically feasible or technically practical to comply with the relevant noise criteria in the City Plan. In the situations where the noise criteria are forecast to be exceeded, the City Plan provides the opportunity for the development proponent to provide additional information that describes and quantifies the nature, scale and significance of the noise impact on the community. This helps the Brisbane City Council to assess the net benefit of the development in terms of economic, social and environmental outcomes.

In summary, the City Plan process requires a noise impact assessment report to be submitted with the development application that identifies the noise mitigation measures (e.g. design and construction measures) that are required for the development to achieve the City Plan noise criteria. If the proposed development is unable to achieve the noise criteria, the noise impact assessment report needs to identify what the best noise mitigation measures are, which can be practically implemented by the development and also what the nature, scale and significance of the impacts are from exceeding the criteria.

## 6. CONCLUSIONS

The *Brisbane City Plan 2014* includes noise criteria and assessment methods for industrial development and for sensitive development encroaching upon existing industry. The City Plan noise criteria for industrial development has been designed specifically for planning assessment purposes and is based on contemporary literature on community annoyance and sleep disturbance. It is not intended for measuring operational compliance, but rather, to guide design and construction solutions that can be implemented by a development to mitigate noise impacts. Noise impacts are assessed using the predicted  $L_{Aeq}$  for the relevant day, evening and night period and by using the predicted  $L_{Amax}$  relative to the existing ambient noise levels to assess potential impacts on sleep disturbance and  $L_{Ceq}$  for low frequency noise. The assessment is also linked to the land use zones in the City Plan, which articulate expectations for noise amenity.

In situations where the noise criteria are forecast to be exceeded, the nature, scale and significance of the noise impact on the community can be described and quantified to enable an assessment of the net benefit of a development.

Overlay maps are used to identify areas potentially affected by industry noise and where new noise-sensitive development encroaching on existing industry is required to incorporate building design and construction measures to achieve indoor noise criteria.

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