

Acoustics Vibration Structural Dynamics

THE STAR SYDNEY, PYRMONT

Key Sites Masterplan

13 September 2021

The Star Sydney

TK614-08D01 The Star Key Sites Masterplan (r4)





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Executive summary

The Star Key Site Master Plan involves a proposal to rezone 20-80 Pyrmont Street and 37-69 Union Street, Pyrmont and to establish new planning controls.

The site will potentially also accommodate a new Metro Station and alterations to existing Light Rail infrastructure.

The purpose of this report is to:

- Identify planning controls (both typically applied and any new/innovative controls that may be applicable to the site).
- Demonstrate that this rezoning and proposed new use is feasible from an acoustic viewpoint.

The report identifies key considerations with respect to:

- Operational noise (outdoor dining/gaming/retail), plant and equipment noise, special events).
- Construction noise.
- Road traffic noise.
- The potential impact of Metro and Light Rail infrastructure.

In our opinion the site is capable of supporting the proposed uses envisaged as part of the rezoning application envisaged in the Master Plan.

There are a number of acoustic planning controls that have been identified that should be considered either in addition to or as an alternative to commonly adopted noise emission guidelines. These relate primarily to noise associated with special event use of the site, noise from retail/outdoor dining/entertainment areas and increases in road traffic noise as a result of the intensification of use of the site. These alternative criteria are proposed with a view to maximising the utilisation of the site, inclusive of public realm spaces. This is consistent with the intention of DPIE/City of Sydney with respect to redevelopment of the Pyrmont Peninsula, to our understanding.

These alternative controls should be encapsulated in the site specific DCP to enable them to be considered in a merit assessment of any Development Application lodged for the site.

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1 Introduction

This report has been prepared on behalf of The Star Entertainment Group (The Star) in support of its Key Site Master Plan under the Pyrmont Peninsula Place Strategy.

The Star Key Site Master Plan involves a proposal to rezone 20-80 Pyrmont Street and 37-69 Union Street, Pyrmont and to establish new planning controls to be included in a site specific Development Control Plan. This rezoning will enable redevelopment of the site with an expanded number of permissible uses. Proposed uses include new residential development and an intensification of some uses already permitted on the site (retail, commercial uses and hotel).

The purpose of this report is to:

- Identify planning controls (both typically applied and any new/innovative controls that may be applicable to the site).
- Demonstrate that this rezoning and proposed new use is feasible from an acoustic viewpoint.

In addition to the rezoning commentary, this report also considers:

- How a future potential Metro station would impact the viability of the development (specifically, its impact on the proposed residential tower).
- A reconfiguration of the entry to a light rail station (within the Star building).
- Regulations relating to outdoor special events.

The Master Plan is developed under the framework established under the Pyrmont Peninsula Place Strategy (PPPS), where The Star has been identified as one of four 'key sites'. The PPPS creates a 20year vision and planning framework to support the NSW Government's vision to transform the Pyrmont Peninsula to "*be an innovative, creative and cultural precinct and an engine room of the Eastern Harbour CBD*" while meeting the aspirations of the business, industry, visitors, local and future residents.

The Master Plan ultimately seeks to inform updated planning controls related to 20-80 Pyrmont Street and 37-69 Union Street, Pyrmont to facilitate redevelopment of both sites and enable the Star's contribution to the Precinct as "a renowned and treasured cultural and entertainment precinct".

It should be acknowledged this report has been prepared based on the provided information in the Pyrmont Peninsula Placement Strategy (PPPS, December 2020) and the technical consultant reports that accompany the document. Assumptions have had to be made in order to make a reasonable assessment of the precinct-wide matters related to external noise impacts, issues of natural ventilation and the rail vibration guidelines.

1.1 Pyrmont Peninsula Place Strategy

The PPPS provides a 20-year framework that identifies areas that can accommodate growth in Darling Island, Blackwattle Bay, Tumbalong Park and Ultimo sub-precincts, while enabling more growth in the Pyrmont Village and Wentworth Park sub-precincts. The PPPS is implemented in the statutory planning system by a Ministerial Direction that requires all land use and planning proposals to be consistent with the Place Strategy.

The first phase in implementing the PPPS is the preparation of master plans for each of the seven subprecincts that make up the Peninsula (Figure 1). As a 'Key Site' located in the Darling Island subprecinct, The Star has been identified to progress its own Master Plan for its 'Key Site' alongside the broader Precinct-wide master planning being undertaken by the Department, in consultation with the City of Sydney.



Figure 1: Pyrmont Peninsula Sub-Precincts

Figure 2: The Star Key Site



1.2 The Star

The Star is an ASX 100 listed company that owns and operates The Star Sydney, Treasury Brisbane and The Star Gold Coast.

The Star Sydney is Sydney's leading entertainment, dining and tourism destination. More than 11 million people, including locals, domestic visitors and international tourists visit The Star annually, facilitated by a workforce of approximately 4,500 people (pre-COVID). As Sydney's only integrated resort, The Star Sydney focuses on the development of tourism and entertainment products across four key segments - accommodation, Food & Beverage (F&B), gaming and entertainment.

1.3 The Proposal

The Star Key Site Master Plan is proposing to rezone 20-80 Pyrmont Street and 37-69 Union Street, Pyrmont and to establish new planning controls to enable redevelopment on the site to accommodate future mixed uses including retail, commercial uses, hotel and residential. The site is outlined in Figure 3.

Figure 3: Site Aerial



Source: Nearmap/Ethos Urban

The rezoning and proposed planning controls have been informed by detailed site planning considerations as well as existing and future local context analysis. The proposed new controls that comprise amendments to the Sydney Local Environmental Plan 2012 (Sydney LEP 2012) and a Design Guide, respond to the objectives for The Star site Master Plan as listed in the PPPS as well as the Strategy's directions, big moves and place priorities.

It should be noted that subsequent development applications will be required in line with the relevant provisions of the *Environmental Planning & Assessment Act 1979* to deliver the proposed developments.

The key development outcomes sought to be achieved for The Star site from the proposed Master Plan include:

Northern Site (20-80 Pyrmont Street)

- A new 27 storey six star hotel (capped at RL 110) on Pirrama Road (North Tower) comprising;
 - 6 storey podium that retains the existing ground level setback on The Star site

- 21 storey tower with 1.5m street setback from podium and increased minimum 7m street setback to the north in line with wind advice and view sharing principles
- Total gross floor area of 26,000m² (excluding through-site link)
- New porte-cochere drop off servicing hotel
- Additional built form to Level 5 rooftop of the main Star site comprising:
 - A collection of indoor and outdoor spaces with complementary functions such as indoor/outdoor dining opportunities, recreational spaces, wellness spaces and hotel amenities, including an existing hotel pool
 - Total of approximately 3,000m² (additional to existing)
- Opening up of Pirrama Road frontage to reveal light rail and to provide improved connectivity to public realm and waterfront including:
 - Active uses such as retail, food and beverage and wellness uses at street level; and
 - Total GFA of approximately 200m² (additional to existing).
- New through-site link connecting Jones Bay Road and Pirrama Road
- Re-configured and expanded entry to the Lyric Theatre
- Façade upgrades to existing Astral Towers

Southern Site (37-69 Union Street)

- A new 37 storey mixed use building (capped at RL 140) on Union Street (South Tower) comprising:
 - 5 storey podium mixed use podium with a 3m ground level setback along the Pyrmont Bridge Road boundary to increase footpath width, comprising uses such as retail, residential and hotel amenities and/or dedicated hotel levels
 - 32 storey tower generally setback 5-7m from the podium, comprising uses such as retail, residential and hotel amenities and/or dedicated hotel levels and 2 plant levels
 - Total GFA of approximately 32,000m²

Public Realm

- Upgrades to corner of Edward Street and Union Street
- Upgrades to corner of Union Street and Pyrmont Street
- Improvements to public domain along Edward Street
- Improvements to public domain along Pirrama Road
- Upgrades to Union Street with potential for shared zone, including upgrades to walkway and cycleway

Once new planning controls are adopted, The Star will progress with the detailed design and planning of the future development on the site, including progressing with a design competition and securing development approval for the winning design.

1.4 General Requirements

This report has been prepared with reference to the *General Requirements for Preparing Key Site Master Plans under the Pyrmont Peninsula Place Strategy* and the alignment review prepared by the Department of Planning, Industry and Environment (DPIE) dated 26 April 2021.

2 Site Description

The Star Sydney site is bounded by Pyrmont Street to the west, Union Street to the south, Edward Street and Pirrama Road to the east, and Jones Bay Road to the north. The South Tower site is bounded by Union Street, Edward Street and Pyrmont Bridge Road.

The nearest residential receivers are identified to the east along Pirrama Road (Sydney Wharf Apartments), to the north along Jones Bay Road (2 Jones Bay Road), to the west along Pyrmont Street (91 and 93 Pyrmont Street) and to the south along Pyrmont and Edward Streets with predominately commercial premises in the vicinity. Additional residential receivers are identified further to the west along Harris Street and further to the south along Pyrmont Bridge Road.

The site is located in the City of Sydney Council Local Government Area and is currently zoned B3 Commercial Core with the new southern portion zoned B4 Mixed Use under Sydney Local Environment Plan (LEP) 2012.



Figure 4: Aerial view of the existing site

From our site investigation through aerial maps and review of available relevant planning documentation for the site and surrounds, the following key acoustic issues are relevant to the site and the proposed rezoning application:

- Incorporation of a residential use in an entertainment precinct
- Intensification of Hotel use
- Podium/outdoor dining area noise and impact on existing residences (outside of Star site) and future residences (within Star site)
- Implications with respect to noise and vibration associated with the light rail and future Metro station
- Outdoor areas to be used for special events
- Gaming area noise

The noise generating activities from the proposal that have the potential to affect development surrounding the site are identified as follows:

- New porte-cochere drop off serving hotel
- Opening up of Pirrama Road frontage to reveal light rail, ie. additional light rail noise that is previously acoustically shielded / contained within the site
- Additional built form to Level 5 to facilitate indoor / outdoor dining and events
- Plant and equipment servicing the two proposed towers and any other new works.
- New commercial / retail uses within the lower floors of the Southern mixed used tower
- Noise as a result of additional road traffic due to increase in overall Gross Floor Area (GFA)

With respect to noise impacts on the site:

- The sources of noise affecting the site are the local roads surrounding the site and Western Distributor to the far south-west (the proposed towers with potential line-of-sight), and the L1 Dulwich Hill Line Sydney Light Rail.
- In addition, there is a Sydney Metro West station proposed to be located within the basement level of the proposed new residential tower (South Tower) on Union Street.
- The site sits outside the Aircraft Noise Exposure Forecast (ANEF) of Sydney Airport (<u>https://aircraftnoise.sydneyairport.com.au/wp-content/uploads/2018/07/180824-ANEF-A1-Map-ENDORSED.pdf</u>) and therefore, no aircraft noise assessment is deemed necessary.
- There are no identified industrial premises in the vicinity of the site beside the White Bay Cruise Terminal (WBCT) to the north-west (approximately 800m away).

The Star Precinct and the proposed development is shown in Figures 5 to 7 below.

Figure 5: Precinct Overview



Potential other redevelopment sites (shown greyed/translucent)

New podium level outdoor dining/retail

Casino Precinct outlined in blue

New entry to Light Rail Station

Figure 6: Masterplan Proposed Key Elements



Figure 7: Masterplan Elevations



Outcomes of the Masterplan Density and Building Uses

3 Planning Objectives of Pyrmont Peninsula Precinct Redevelopment

Relevant Department DPIE and City of Sydney objective/strategy documents outlined below.

3.1 DPIE Objectives

3.1.1 Pyrmont Peninsula Placement Strategy (December 2020)

The Star site at Darling Island was identified as one of the key sites in the Pyrmont Peninsula Place Strategy.

The relevant sections of the PPPS with regard to the Darling Island place priorities are summarised below:

- 12. Address potential impacts of **24-hour economy activities** on amenity including **noise**, safety, traffic and transport, amongst others.
- 13. Promote activities under the **24 Hour Economy Strategy** in a way that recognises and addresses potential impacts to residential amenity, including **noise**, safety, traffic and transport in planning and other regulatory processes.

3.1.2 Night Time Economy

DPIE is supporting nightlife as one of the most important parts of a city's culture [ref: <u>https://www.planning.nsw.gov.au/Policy-and-Legislation/Night-Time-Economy</u>] by publishing a Guide for Establishing and Managing Night Time Economy Uses.

It found that ambient noise can contribute to the vibrancy and activation of a nigh life activities and is integral to a city's night-time economy. It is important to analyse the site to understand its relationship to neighbouring properties and the surrounding area.

As an example, Wollongong City Council has pre-approved sites within the city centre for applicants to host events and The Star Sydney can be one of the designated sites within the City of Sydney Council LGA/Pyrmont. It has also implemented planning certificates, which clearly identify the area's capacity for evening trading to alert recipients/future residences of the certificate to potential noise and longer trading hours impacts which are a part of living near a commercial centre.

A new part has been inserted into Chapter 8 of the Local Government Act 1993 (LG Act) allowing councils to establish a special entertainment precinct within their local government areas (LGA), by amending its local environmental plan (LEP) to identify the special entertainment precinct.

Council will then need to prepare a plan for regulating noise from amplified music from premises in the special entertainment precinct and publish it on the council's website.

Consent authorities will be unable to refuse consent based on noise caused by the playing or performance of music if they are satisfied the noise can be managed and minimised to an acceptable level.

This will enable greater flexibility and provide certainties to operator in considering the type of venues that can be accommodated/considered within the Masterplan.

3.1.3 Greater Sydney's 24-hour economy

As set out in the Global NSW's Sydney 24-hour Economy Strategy [ref:

https://www.investment.nsw.gov.au/greater-sydneys-24-hour-economy/], it is not possible to create successful night-time hubs without partnering with local communities, ensuring local residents and business owners feel connected to their area and empowered to shape its offering. With an increasing number of people living in close proximity to commercial hubs that trade in the evening and night, it is essential to balance residential amenity and non-residential activities that can create land use conflicts (eg. increased noise).

Live entertainment, such as live music and performance, is an integral part of a vibrant 24-hour economy. The regulatory environment for live music and 24-hour economy sound needs to strike a balance between protecting the rights and needs of residents and supporting thriving 24-hour economy hubs where live entertainment is accepted and celebrated.

As a part of its action plan, the 24-hour Economy Coordinator General will work with the EPA and other relevant NSW Government departments to explore ways of further streamlining noise regulation, including by considering relevant legislation and regulations.

3.2 City of Sydney Council Objectives

3.2.1 A 24-hour city centre

Allowing 24-hour trading across the entire city centre may reduce issues such as crowding, queuing and **noise** at existing hotspots.

These businesses will also be able to take advantage of **the future Sydney metro**, which will operate 21 hours a day and include 4 stops in the new zone, and the city centre light rail.

Within the Guide for Establishing and Managing Night Time Economy Uses, the different distinct time periods of assessment were identified, being early evening (6-9pm), evening (9-11pm), night (11pm-2am) and late night (2am-6am). These are certainly different to the time periods under the NPfl but nevertheless provided a more meaningful breakdown as the amenity levels change in an area where night-time economy is targeted. Referring to these periods as lower impact activities (early/evening) and higher impact activities (night/late night) may also be useful to describe the potential noise impacts to the local community.

3.2.2 Draft Sydney Development Control Plan: Late Night Trading 2018

In order to support the vision of the night-time economy, the area surrounding The Star Sydney can be considered as a Local Centre, similar to those approved for Chippendale Local Centre.

This will allow low impact premises to be able to extend hours to 2:00am if the premises has entry and egress onto a main street. This will then allow smaller venues/tenancies along the Pirrama Road frontage to be assessed as Category B (low impact) premises instead of being assessed cumulatively with the gaming business of The Star Sydney.

The noise emission goals set out in section 6 (specifically section 6.2) will be critical in order to encourage activation of commercial/retail areas while balancing the need to provide acoustic protection to future residents.

4 Identification of key acoustic issues and site constraints

4.1 Incorporation of a residential use in an entertainment precinct

Outdoor areas, in particular the podium level of the Casino building, will become overlooked by future residential development in the South Tower and potential residential towers adjacent to the south Tower (even closer to the Casino Podium level).

The noise impact of outdoor dining/podium use and outdoor special events will need to be considered carefully.

A "background noise level + 5dB octave band" at property boundary/facade assessment (as is typically adopted in Office of Liquor and Gaming acoustic criteria) will almost certainly hinder utilisation of outdoor entertainment spaces.

Noise emission controls focusing on internal noise levels rather than at boundary/facade noise levels should be considered. This creates an opportunity to use facade and balcony design of future residential development to protect the residences while getting better utility of the rooftop/podium spaces. This approach was adopted in the *South Barangaroo Noise Masterplan* and is also proposed in the Surry Hills Shopping Village redevelopment and the Harbourside Redevelopment project. This is discussed in section 6.

Redevelopment of this nature also requires careful consideration of noise from new mechanical plant and its impact on nearby development. This will be a particular consideration with respect to:

- The new Hotel building (North Tower) given hotels are typically plant intensive.
- Plant and equipment associated with a potential Metro Station in the basement of the south tower (which are extremely noise and space intensive).

However it would not be expected that acoustic criteria different to these typically imposed by the EPA Noise Policy for Industry would be required for the assessment of plant noise (particularly as the NPfI has provisions for how to regulate noise in areas proposed to be rezoned). This is discussed in section 7.

4.2 Gaming area noise

Noise from the operation of outdoor gaming areas will typically be subject to the same noise emission requirements as licenced areas, as discussed above.

These spaces will typically be required to be operated after midnight at which time the inaudibility requirements of the Liquor & Gaming NSW becomes applicable.

4.3 Apartment natural ventilation

Being an urban area with existing entertainment noise and traffic noise (Pyrmont Bridge Road, the Western Distributor), the site is moderately impacted by external noise.

The residential tower (South Tower) will be exposed to entertainment noise from the Casino (proposed podium outdoor areas and outdoor special events) and Pyrmont Bridge Road. Upper levels of the towers in particular will be exposed to roof top plant noise from neighbouring buildings and become increasing exposed to distant noise sources (Western Distributor and Darling Harbour entertainment precinct).

In noisy areas a typical design approach is to provide a building façade of good acoustic performance to protect the occupants from external noise and ensure that suitable internal noise levels are achieved. However, by relying on a closed ©, provision of fresh air to apartments can then require a supplementary fresh air source (fan assisted or otherwise).

Consideration of natural/passive provision of fresh air while still maintaining good acoustic amenity will be a key consideration at the site, as this is an Apartment Design Guide requirement. This can involve consideration of apartment balcony design, window opening design, cross ventilation and specialist acoustic treatments such as plenums or trickle vents.

This is relevant with respect to protection from road traffic noise and also for protection from Star operational noise from the podium retail/outdoor dining space (as discussed in section 4.1).

Discussion regarding protection from outdoor noise and natural ventilation of apartments is presented in section 9.

4.4 Intensification of hotel use and increased road traffic noise generation

The rezoning application will intensify the use of The Star Sydney with new additions and alterations to its existing development.

Primary noise associated with hotel use will be from use of guest outdoor areas (pool, etc.), function rooms and mechanical plant. Use of guest outdoor common areas and function rooms/entertainment would be recommended to be addressed in the same as any other entertainment/outdoor area noise (see Sections 4.1 and 6.1).

The intensification of use is also likely to increase the traffic volumes on local roads. This will require detailed analysis of existing and future traffic conditions (and the noise associated with them) and assessment with reference to EPA Road Noise Policy Guidelines. This is discussed in section 11

4.5 Implications with respect to noise and vibration associated with the light rail and potential Metro station

Noise impacts from the light rail currently acoustically shielded by the existing building envelope. However it is proposed to provide an opening for the entrance to the existing light rail station, opening directly to Pirrama Road.

This will assist with the visibility of the public transport infrastructure and assist with the permeability of the site. However, the opening will also create a new noise path from the operation of the light rail towards the residential receivers to the east of The Star Sydney (Sydney Wharf Apartments).

With respect to the potential Metro station within the South Tower, this would consist of an underground in a station box, with over station development above. This is similar to other Metro Sites (Pitt Street, Martin Place, Waterloo Metro Stations and also Northwest Rapid Transit (NRT) such as Macquarie Park Metro Station, Norwest Metro Station, etc.

Design of Metro Stations in this scenario is not uncommon, and requires consideration of:

- Vibration isolation of the track.
- Extensive acoustic treatment of the tunnel and station fans.

Design of rail noise and vibration treatments to enable residential over station development is already adopted in other Metro station development. It would be incumbent on the proponent (Station Box developer) to address noise and vibration such that nearby land users (both in the Over Station component, and outside the development) are not adversely impacted. Typically the acoustic controls in EPA documents *Noise Policy for Industry* and *Assessing Vibration: A Technical Guideline* are required to be adopted in the design of the station box. This also typically involves "budgeting" of allowable noise emissions among the different parts of the development (rail ventilation, station box plant, HV systems, etc.) to ensure that cumulative noise emissions are compliant with the overall noise emission goal for the Station.

The incorporation of the Metro station would not necessitate consideration of acoustic criteria different to those already adopted in the design of Metro Stations – the Noise Policy for Industry and Assessing Vibration: A Technical Guideline.

The design of the station box would need to be cognisant of the residential land use above and elsewhere in the vicinity.

This is discussed in section 10.

4.6 Outdoor areas to be used for special events

With respect to the use of the Pirrama Road frontage for special events, this has been previously demonstrated to operate successfully with the adoption of special event noise criteria for events such as the ARIA Awards, etc.

Adoption of a "Background+5dB(A)" criteria for occasional outdoor events is inappropriate and will excessively restrict the use of the spaces/events.

Use of outdoor spaces for special events is regulated by the *Protection of the Environment Operations Act* and guided by the Noise Guide for Local Government. It will typically require the creation of a Noise Management Plan. The management plan will typically address:

- Number of events per year, types of events and noise levels associated with each type of event in order to create an event schedule.
- Procedures regarding noise monitoring of events, and refinement of management practices to ensure ongoing noise impacts are reasonable.

Commonly, guidance will be taken from approvals for similar sites, where a hierarchy of number of events per year and permissible noise generation is considered (see for example Centennial Park and Moore Park Trust Noise Management Plan). Alternatively, a point-based system can be created (noisier events assigned a larger number of points out of an annual budget) to provide a greater level of flexibility in event scheduling.

This is discussed in section 8.

5 Existing Approval

The current operational noise control for the site is presented below.

5.1 Modification of Minister's Approval

The Minister for Planning approved Modification (MOD) 14 for Application No. MP 08_0098 on 16 February 2015.

A set of post construction & ongoing operational conditions were set in Part F, in particular Condition F5 *Noise* requiring cumulative noise caused by the approved use including music and other activities must comply with the following criteria:

F5 Noise

<u>Cumulative</u> noise caused by the approved use including music and other activities must comply with the following criteria:

- The use must not result in the transmission of "offensive noise" as defined in the Protection of the Environment Operations Act 1997 to any place of different occupancy <u>outside the</u> <u>boundary;</u>
- 2. The L10 noise level emitted from the use must not exceed 5dB above the background (L90) noise level in any Octave Band Centre Frequency (31.5 Hz to 8kHz inclusive) between the hours of 7.00am and 12.00 midnight when assessed at the boundary of the nearest affected property. The background noise level must be measured in the absence of noise emitted from the use.
- 3. The L10 noise level emitted from the use must not exceed the background (L90) noise level in any Octave Band Centre Frequency (31.5 Hz to 8kHz inclusive) between the hours of 12.00 midnight and 7.00am when assessed at the boundary of the nearest affected property. The background noise level must be measured in the absence of noise emitted from the use.
- Notwithstanding compliance with (1) and (2) above, the noise from the use must not be audible within any habitable room in any residential property between the hours of 12.00 midnight and 7.00am.
- The L10 noise level emitted from the use must not exceed the background noise level (L90) in any Octave Band Centre Frequency (31.5 Hz to 8kHz inclusive) by more than 3dB when assessed indoors at any affected commercial premises.

This condition is consistent with the standard noise requirement of the Liquor & Gaming NSW (L&GNSW) for licensed premises with the addition of the standard noise requirement of City of Sydney Council's *–oise - Entertainment* for any affected commercial premises.

However, these conditions focus on noise levels at external locations (property boundaries). Application of noise limits based on external noise limits in mixed use/high density areas can excessively curtail potential commercial uses (particularly retail and outdoor dining given the close proximity of the noise source and noise receiver). They are also not well suited to assessment of noise emissions in an area with significant rezoning and intensification of use proposed (as the case within the Pyrmont Peninsula).

In order to encourage continued development of the precinct (while still providing reasonable acoustic protection), alternative criteria are appropriate. Alternative criteria to the above should take into account:

• The fact that background noise levels potentially change as a result of rezoning, changes in use and density. Noise emission controls should be appropriate for a changing environment.

In some circumstances (such as in the assessment of outdoor area noise emissions) a criteria that is focussed on an internal noise level within an apartment, as opposed to an external noise level at property boundary, will most likely permit more flexibility in use of the outdoor ar

• eas.

The following sections address noise associated with key components of the site, being:

- Entertainment noise.
- Plant and equipment noise.
- Special event noise.
- External noise impacts on the site.
- Noise from additional traffic generated by the site.
- Light Rail and Metro station noise and vibration.

In each of these sections, we will present:

- Typical acoustic guidelines adopted for those noise sources.
- Additional/alternative guidelines, where relevant.
- Commentary about the key acoustic issues and ability of the site to comply with the guidelines.

6 Operational Noise Emission Asses-ment -Entertainment Noise

Noise from entertainment venues is typically regulated by local council (in this case the City of Sydney) and the Liquor & Gaming NSW. These authorities (similar to the existing approval as detailed in Section 5 of this report) set noise limits with reference to background noise levels and are applied at property boundaries.

In development of mixed use areas in urban environments, this can be overly restrictive and hinder utilisation of the precinct and as such, alternative noise goals may be considered.

6.1 Typical Acoustic Guidelines

6.1.1 City of Sydney Council Development Control Plan (DCP) 2012

Standard entertainment precinct noise emission criteria adopted by the City of Sydney are presented below:

NOISE

- (a) The L_{A10, 15} minute noise level emitted from the use must not exceed the background noise level (L_{A90, 15minute}) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 5dB between the hours of 7.00am and 12.00 midnight when assessed at the boundary of any affected residence.
- (b) The L_{A10, 15} minute noise level emitted from the use must not exceed the background noise level (L_{A30, 15} minute) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) between the hours of 12.00 midnight and 7.00am when assessed at the boundary of any affected residence.
- (c) Notwithstanding compliance with (a) and (b) above, noise from the use when assessed as an L_{A10, 15 minute} enters any residential use through an internal to internal transmission path is not to exceed the existing internal L_{AB0, 15 minute} (from external sources excluding the use) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) when assessed within a habitable room at any affected residential use between the hours of 7am and 12midnight. Where the L_{A10, 15 minute} noise level is below the threshold of hearing, Tf at any Octave Band Centre Frequency as defined in Table 1 of International Standard ISO 226 : 2003- Normal Equal-Loudness-Level Contours then the value of Tf corresponding to that Octave Band Centre Frequency shall be used instead.
- (d) Notwithstanding compliance with (a), (b) and (c) above, the noise from the use must not be audible within any habitable room in any residential use between the hours of 12.00 midnight and 7.00am.
- (e) The L_{A10, 15} minute noise level emitted from the use must not exceed the background noise level (L_{A30, 15} minute) in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 3dB when assessed indoors at any affected commercial premises.

Note: The L_{A10, 10 minute} noise level emitted from the use is as per the definition in the Australian Standard AS1055-1997 Acoustics – Description and measurement of environmental noise. The background noise level L_{A90, 15 minute} is to be determined in the absence of noise emitted by the use and be representative of the noise sensitive receiver. It is to be determined from the assessment L_{A90} / rating L_{A90} methodology in complete accordance with the process listed in the NSW EPA Industrial Noise Policy and relevant requirements of AS1055.1997.

6.1.2 Liquor & Gaming NSW (L&GNSW)

Noise emissions from licensed premises in NSW, such as restaurants, bars, and clubs, should aim to comply with the standard noise criteria set by the L&GNSW. The L&GNSW, through the Liquor Act 2007, is the regulatory authority that deals with noise pollution issues pertaining to licensed premises. The L&GNSW criteria apply to noise emission associated with activities from the licensed area of the premises, including music and patron noise but excludes mechanical plant. Noise emissions are assessed in terms of the noise limits set out in the L&GNSW's 'Standard Noise Condition' which states as follows:

"The LA10* noise level emitted from the licensed premises shall not exceed the background noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) by more than 5dB between 7:00am and 12:00 midnight at the boundary of any affected residence.

The LA10* noise level emitted from the licensed premises shall not exceed the background noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) between 12:00 midnight and 7:00am at the boundary of any affected residence.

Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00 midnight and 7:00am.

Interior noise levels which still exceed safe hearing levels are in no way supported or condoned by the Liquor Administration Board.

This is a minimum standard. In some instances, the Board may specify a time earlier than midnight in respect of the above condition.

*For the purposes of this condition, the LA10 can be taken as the average maximum deflection of the noise emission from the licensed premises."

6.2 Alternative Noise Cri–eria - Barangaroo –outh - Master Plan Noise Assessment

The *Barangaroo South Master Plan Noise Assessment* (Wilkinson Murray Report No.: 10232-BN-1; Version: G), was created to develop acoustic criteria suitable for a mixed use–zone - residential in close proximity to entertainment/retail uses.

The *Barangaroo South Master Plan* set noise emission goals for internal spaces within the *future* residential development (as opposed to an external "at boundary"/"at balcony" noise target). This gave the developer of the mixed use buildings the opportunity to improve acoustic performance of the apartment building shell (protecting the resident) while enabling greater flexibility of use of the retail outdoor space (being numbers of people, times of use, etc.).

In respect of *existing* residential receivers, the *Barangaroo South Master Plan* noted that patron and music noise emissions should be assessed and managed in accordance with typical Council/L&GNSW criteria focussing on "at boundary" noise levels. However, given that each existing residential receiver could be impacted by multiple tenancies, as a further control to protect the amenity of the receivers from cumulative noise impacts.

In respect of impacts on the new residences in the mixed use component of the site, the *Barangaroo South Master Plan Noise Assessment* drew on case studies from New York and San Francisco to set project internal noise goals for patron and music noise with windows closed. The proposed limits were as follows:

- Day/Evening (7am to 10pm):
 - Living Areas: 43dB(A) L_{eq(15min)}
 - Bedroom: 38dB(A) L_{eq(15min)}
- Night (10pm to midnight):
 - Living Areas: 40dB(A) L_{eq(15min)}
 - Bedroom: 35dB(A) L_{eq(15min)}

It is proposed to apply a similar approach here in order to get the best utilisation of retail and outdoor dining spaces.

It is recommended the Site Specific DCP address the following:

- It should permit an internal noise level criteria assessment to be adopted when assessing entertainment noise impacts on new residential apartments within the Star precinct.
- The DCP should also require that future residential development (outside of the Star site but within the PPPS area) is acoustically treated such that precinct noise (inclusive of Star retail podium noise) is attenuated by their building façade such that the internal noise goals above are met. In effect, the future development building shell should be designed to treat precinct entertainment noise as an external noise source (similar to road traffic), as opposed to curtailing the noise from the entertainment precinct.
- Noise from the site to *existing* residences (which are not acoustically treated) should still be required to comply with Office of Liquor and Gaming acoustic criteria, as is typical practice. Given these residences are typical below podium level and therefore screened from podium noise, this would not excessively restrict outdoor retail/dining areas at podium level.

6.3 Commentary

A primary noise emission source from the site will be from the retail/outdoor dining use of the large podium area. This is a key feature of the proposed redevelopment.

However, the podium area is likely to be overlooked by future residential development, both South Tower and future residential towers on Edward Street. If adopting a simple "background+5dB octave band assessment" for noise form the Star podium to these residences, it is likely that patron numbers and times of use of the podium will be significantly restricted.

Through adoption of the alternative noise goals outlined in Section 6.2, the amenity of future residents of these apartments can be protected while still promoting the activation of the entertainment areas of the precinct. The building façades will potentially require glazing systems of moderate acoustic performance (say, 10.38mm laminated glass) and also consideration of natural ventilation design (see section 9).

With respect to outdoor gaming areas:

- Noise from these spaces typically consists of patron noise, background music and gaming machine noise.
- Background music noise can be easily controlled by disabling all speakers between the sensitive hours of 12:00am midnight to 7:00am in the morning as per the condition that is already currently imposed on The Star Sydney.
- Gaming machine noise can also be physically controlled by reducing the set levels to a minimum or completely disabled as well if identified to be in the vicinity of residential receivers.
- In the event that the gaming areas are located in close proximity to residences, use of acoustic louvres or similar will potentially be required at ventilation openings.

7 Operational –oise - Plant and Equipment Noise

This section addresses noise associated with plant and equipment, use of port-cocheres and loading docks.

7.1 Typical Acoustic Requirements

7.1.1 EPA Noise Policy for Industry

Noise Policy for Industry has two primary sets of noise emission criteria, both of which must typically be complied with:

- Intrusive Noise Criteria
- Project Amenity Criteria

In addition, the NPfI has sleep disturbance criteria for intermittent late night noise events.

7.1.1.1 Intrusive Noise Criteria

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq,15min} descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

L_{Aeq,15minute} Intrusiveness noise level = Rating Background Level (RBL) plus 5dB(A)

However, for sites where land uses are expected to change as a result of rezoning, and existing noise environments also expected to change, the Intrusive criteria is not always applied. This is clearly relevant to the subject development.

7.1.1.2 Project amenity noise levels

The project amenity noise levels for different time periods of day are determined in accordance with Section 2.4 of the NPfI. The NPfI recommends amenity noise levels (L_{Aeq, period}) for various receivers including residential, commercial, industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches, and parks. These "recommended amenity noise levels" represent the objective for total industrial noise experienced at receiver location. However, when assessing a single industrial development and its impact on an area, "project amenity noise levels" apply.

The recommended *amenity* noise levels applicable for the subject area are reproduced in **Error! Reference source not found.** below.

Type of Receiver	Noise Amenity Area	Time of Day	Recommended amenity noise level, L _{Aeq} , dB(A)
Residential	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers'	Urban	Day	65
quarters, holiday accommodation, permanent		Evening	55
resident caravan parks		Night	50
Place of wo-ship - internal	All	When in use	40
Area specifically reserved for passive recreation (eg. national park)	All	When in use	50
Commercial premises	All	When in use	65

Table 1: Recommended amenity noise levels

Notes:

1. Daytime 7.00am to 6.00pm; Evening 6.00pm to 10.00pm; Night-time 10.00pm to 7.00am.

2. On Sundays and Public Holidays, Daytime 8–00am - 6.00pm; Evening 6–00pm - 10.00pm; Night-time 10–00pm - 8.00am.

3. The L_{Aeq} index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

4. The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration.

To ensure that the total industrial noise level (existing plus new) remain within the recommended amenity noise levels for an area, the *project amenity* noise level that applies for each new industrial noise source is determined as follows:

L_{Aeq,period} Project amenity noise level = L_{Aeq,period} Recommended amenity noise level – 5dB(A)

Furthermore, given that the intrusiveness noise level is based on a 15-minute assessment period and the project amenity noise level is based on day, evening, and night assessment periods, the NPfl provides the following guidance on adjusting the $L_{Aeq, period}$ level to a representative $L_{Aeq, 15minute}$ level in order to standardise the time periods.

 $L_{Aeq,15minute} = L_{Aeq, period} + 3dB(A)$

7.1.1.3 Sleep disturbance noise levels

The potential for sleep disturbance from maximum noise level events from premises during the nighttime period needs to be considered. In accordance with NPfI, a detailed maximum noise level event assessment should be undertaken where the subject development night-time noise levels at a residential location exceed:

- LAeq,15min 40dB(A) or the prevailing RBL plus 5dB, whichever is the greater, and/or
- L_{AFmax} 52dB(A) or the prevailing RBL plus 15dB, whichever is the greater.

Where there are noise events found to exceed the initial screening level, further analysis is undertaken to identify:

- The likely number of events that might occur during the night assessment period,
- The extent to which the maximum noise level exceeds the rating background noise level.

7.1.2 City of Sydney Requirements

Although not the consent authority, typical Council planning controls are as follows:

NOISE – COMMERCIAL PLANT / INDUSTRIAL DEVELOPMENT

- (a) Noise from commercial plant and industrial development must not exceed a project amenity/intrusiveness noise level or maximum noise level in accordance with relevant requirements of the NSW EPA Noise Policy for Industry 2017 (NPfI) unless agreed to by the City's Area Planning Manager. Further:
 - (i) Background noise monitoring must be carried out in accordance with the long-term methodology in *Fact Sheet B* of the NPfl unless otherwise agreed by the City's Area Planning Manager.
 - Commercial plant is limited to heating, ventilation, air conditioning, refrigeration and energy generation equipment.
- (b) An L_{Add,15 minute} (noise level) emitted from the development must not exceed the L_{Add, 15 minute} (background noise level) by more than 3dB when assessed inside any habitable room of any affected residence or noise sensitive commercial premises at any time. Further:
 - (i) The noise level and the background noise level shall both be measured with all external doors and windows of the affected residence closed.
 - Background noise measurements must not include noise from the development but may include noise from necessary ventilation at the affected premise.
- (c) Corrections in Fact Sheet C of the NPfI are applicable to relevant noise from the development measured in accordance with this condition, however duration corrections are excluded from commercial noise.

7.2 Alternative Criteria and Commentary

City of Sydney DCP recommends implementation of EPA NPfI (clause (a)) and a secondary noise control relating to noise to internal areas (clause (b)).

City of Sydney internal noise goals (clause (b)) will potentially create overly stringent criteria with respect to the assessment of plant/equipment noise.

For plant and equipment noise, it is standard practice that noise emitted from one site to another has to comply with the EPA Noise Policy for Industry when measured at the property boundary of the site (as per City of Sydney standard clause (a)).

The City of Sydney "Background+3dB" internal noise criteria (clause (b)), however, are potentially excessively stringent:

- The criteria do not differentiate between noise transmitted from one site to another (external to external noise transfer), or noise transfer within the same development (internal to internal noise transfer between internal walls and floors).
- It is the external to external application of the "Background+3dB(A)" requirement that is more stringent than typical acoustic requirements. This occurs for two reasons:
 - Obviously, a background+3dB(A) criteria is more stringent than the typical EPA Intrusiveness Criteria of "Background+5dB(A)".
 - Secondly, the City of Sydney requirement does not include a means to take into account how ambient noise levels may change as a result of a future re-zoning. Noise emission limits are set with reference purely to background noise levels. Background levels are required to be measured prior to development of the site.
- This is not appropriate for a site with significant future changes in density and rezoning. Background noise levels will change.
- The Noise Policy for Industry has provisions to address this situation (changing land use), whereas the City of Sydney criteria do not. Given significant development and zoning changes proposed, adoption of the City of Sydney Clause (b) will create overly stringent noise emission requirements and unnecessarily curtail development.
- Plant noise emission requirements should be set using the Noise Policy for Industry, but not the typical City of Sydney "background+3dB(A)" for the assessment of *external noise emissions*.

7.3 Commentary

Acoustic design of mechanical plant is routinely conducted after development approval (as equipment selections are not typically made at this stage). Ensuring that appropriate protection is provided from plant and equipment noise is done by implementing appropriate conditions of consent. Compliance with noise emission goals can always be achieved with sufficient acoustic treatment (noise screens/duct lining, etc.). However, by *not* including City of Sydney standard condition (b) with respect to external noise emissions, this avoids the cost of unnecessary levels of acoustic treatment, that could be an impediment to development. This should be reflected in the Site Specific DCP.

It is recommended, however, that Clause (b) remains but is limited to the assessment of noise through internal walls/floors from one part of a development to another as this is a particular concern for mixed uses within the same building shell.

8 Operational Noise – Special Events

8.1 Typical Criteria

Noise emitted from entertainment venues is typically assessed with reference to the criteria adopted by the L&GNSW which requires that the following noise levels are achieved at nearby residential development:

- Between 7am and–12am Entertainment noise is not to exceed background noise levels by more than 5dB when measured in octave bands between 31.5Hz and 8kHz.
- Between 12am an– 7am Entertainment noise is not to exceed background noise levels by more than 0dB when measured in octave bands between 31.5Hz and 8kHz.
- Between 12am an– 7am Entertainment noise is not to be audible inside a habitable room of a nearby residential development.

Similar acoustic criteria are routinely adopted by the City of Sydney Council, although not published on their website.

The above criteria are typically adopted for indoor venues, or venues with an outdoor component (such as a bar with outdoor beer garden or similar). However, in the case of outdoor public venues used for special events, the above guidelines are not typically used as they are overly restrictive for special events,

8.2 Recommended Criteria

The Appropriate Regulating Authority (ARA) for the development will be either the EPA or the City of Sydney Council.

In either case, a Noise Management Plan for the site must be developed for outdoor special event use. For the purpose of creating a Noise Management Plan for the special events for The Star Sydney, the following should be taken into account:

- Part 3 of the *Noise Guide for Local Government*, specifically Section 3.6 Case Studies 1 and 2 (Open-air concerts and public address systems, and Special Event noise "budgeting").
- Approvals granted for other special event venues.

Case Studies 1 and 2 from Section 3.6 of the *Noise Guide for Local Government* provides assistance in developing appropriate acoustic criteria for special events. These case studies illustrate two different methods by which noise from special events can be managed:

 Method 1 (Case Study 1) sets numerical noise goals at nearby residences and assigns a number of permissible events per year. Method 2 (Case Study 2) creates a "budget" system. The special event site is allocated a budget of "equivalent events" per year. For louder events (event predicted to exceed background noise levels by more than 5dB(A)), that event will take more than just the one "equivalent event". The further above background noise level the special event is predicted to be, the more "equivalent events" are taken up by that particular event. This effectively allows event organisers some flexibility in use of the–site - they can have more relatively quiet events per year, of fewer but louder events per year.

8.2.1 Comparison With Other Special Event Site Approvals

On review of similar approvals, noise limits that were set were as follows:

- The Cutting, Barangaroo Headland:
 - Four events of 65dB(A)L_{eq(10min)}/75dB(C)L_{eq(10min)} per year.
 - Six multi-day events of 55dB(A)L_{eq(10min)}/65dB(C)L_{eq(10min)}.
 - 15 single day events of 55dB(A)L_{eq(10min)}/65dB(C)L_{eq(10min)}.
- Centennial Park/Moore Park Trust
 - Eight concert events of 65dB(A)L_{max}/85dB(C)L_{max}
 - Cinematic events/performances (26 weeks, up to 6 events per -eek) 55dB(A)L_{max}.
- Sydney Cricket and Sports Ground Trust
 - Eight concert events of 65dB(A)L_{max}/85dB(C)L_{max}
 - Four events per year in total, with the following noise limits to apply:
 - If the Cricket ground is-used 70dB(A)L_{max}/90dB(A)L_{max}.
 - If the football stadium is-used 80dB(A)L_{max}/100dB(A)L_{max}.

8.2.2 Proposed Noise Management Str-tegy - The Star Sydney

As an alternative to the above, an "equivalent events" based management strategy can be considered (similar to Case Study 2 from Section 3.6 of the Noise Guide for Local Government). The noise management strategy is developed as follows:

- Examine the background noise level and conditions of approval for a similar site.
- Based on the above, determine the number of "equivalent events" that were effectively granted in the approval (this requires review of background noise level, the permissible noise emission and the number of events per year).

- Adopt a similar number of "equivalent events" for The Star Sydney special events. This is, in effect, using the approval of a similar site as an objective way to determine a reasonable level of noise impact that the special events may create.
- Then, determine a schedule of events that could be implemented at The Star Sydney that uses the same number of "equivalent events". This requires:
 - An understanding of the proposed event types (be it music performance, function or similar) and prediction of the noise level the event will generate at nearby development.
 - The further above background noise level the special event is predicted to be, the more "equivalent events" are taken up by that particular event. This is done by adopting the event "weighting" system (figure 3.4 of the Noise Guide for Local Government – the louder the event, the higher the weighting)
 - Knowing the weighting for a particular event type, a schedule of events can be created such that the overall number of "equivalent events" is consistent an agreed amount.

This effectively allows event organisers some flexibility in use of the-site - they can have more relatively quiet events per year, of fewer but louder events per year.

Outdoor special event use should be subject to a Noise Management Plan created in accordance with the POEO Act and Noise Guide for Local Government. These management plans will typically provide a set of noise emission criteria (as per 8.2.1 or 8.2.2 above) and detail noise monitoring and management strategies to allow noise impacts to be measured, respond to community feedback and update management practices if needed.

9 External Noise Intrusion Criteria

The site is moderately impacted by external noise.

- The primary local noise impacts will be from the other parts of the site itself (podium outdoor dining), Pyrmont Bridge Road traffic noise and overlooking of existing plant items on roof top of nearby development.
- Upper levels of the two towers will also be impacted to a degree by distant noise from the Western Distributor and the Darling Harbour precinct.

The following acoustic standards and guidelines will be considered:

- State Environment Planning Policy (Infrastructure) 2007 ('ISEPP') and Department of Planning (DoP) publication "Development Near Rail Corridors & Busy Roads – Interim Guideline" 2008 ('DoP Guideline')
- Sydney Council Development Control Plan 2012 (effective 14 December 2012).
- The Apartment Design Guideline.

These documents provide standards and guidance for residential development in areas affected by external noise, including road traffic.

9.1 Typical Acoustic Criteria

9.1.1 ISEPP/ DoP Guideline

Given the average daily traffic volume on the Western Distributor exceeds 40,000, the requirements set out by the ISEPP are applicable to the site.

Table 2: ISEPP Internal Noise Criteria	Table 2:
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Condition	Occupancy	Design Internal Noise Level
Windows closed	Bedroom (10pm – 7am)	35dB(A)L _{eq(9hr)}
	Living / Dining /Kitchen (24 hours)	40dB(A)L _{eq(15hr)}

In addition, Department of Planning Guideline identifies internal noise goals under window open conditions. In the event that this noise goal is exceeded when windows are left open, supplementary ventilation (natural or provided by fan) should be provided.

Table 2.	Donortmont	of Dianning	Trigger f	ar Drawisian	of Cum	lamantan	Vantilation
Table 5.	Department	OF Flaining	myyeric		or Subb	Jementary	/ ventilation

Condition	Occupancy	Design Internal Noise Level
Trigger for provision of supplementary	Bedroom (10pm – 7am)	45dB(A)L _{eq(9hr)}
ventilation	Living / Dining /Kitchen (24 hours)	50dB(A)L _{eq(15hr)}

9.1.2 Apartment Design Guideline

The Apartment Design Guideline (Section 4J) provides significant design guidance with respect to the design of buildings in noise affected areas.

With respect to the application of the ADG:

- Although there are sections in the ADG that set numerical performance targets, there is no numerical performance requirement with respect to noise levels in section 4J. This must be considered a deliberate decision.
- The introduction of the ADG states that demonstration of compliance for sections not containing numerical targets is shown through adopting the Design Guidance. The fact that the introduction to the ADG explains how to demonstrate compliance for sections that do not set performance requirements is further evidence that not applying a numerical performance requirement was a deliberate decision, and not an omission.
- To apply a numerical target for an internal noise level that is based on a DCP or some other document is clearly not consistent with the ADG. Pursuant to clause 6A of SEPP65:

6A Development control plans cannot be inconsistent with the Apartment Design Guide.

(1)This clause applies in respect to the objectives, design criteria and design guidance set out in Parts 3 and 4 of the Apartment Design Guide for the following...

(g) natural ventilation

(2) If a development control plan contains provisions that specify requirements, standards of controls in relation to a matter to which this clause applies, those provisions are of no effect.

Specific design guidance is summarised below.

Objective 4J1 – Design Guidance and Response:

To minimise impacts the following design solutions may be used:

- *Physical separation between buildings and the noise or pollution source*. This could include set back or a physical obstacle (noise screen).
- Residential uses are located perpendicular to the noise source and where possible buffered by other uses.
- Non-residential buildings are sited to be parallel with the noise source to provide a continuous building that shields residential uses and communal open space.
- Non-residential uses are located at lower levels vertically separating the residential component from the noise or pollution source.

- Buildings should respond to both solar access and noise. Where solar access is away from the noise source, dual aspect apartments with shallow building depths are preferable.
- Landscape design reduces the perception of noise and acts as a filter for air pollution generated by traffic and industry.

Objective 4J2 – Design Guidance and Response:

Design solutions to mitigate noise include:

- Limiting the number and size of openings facing noise sources.
- *Providing seals to prevent noise transfer through gaps.*
- Using double or acoustic glazing, acoustic louvres or enclosed balconies.
- Using materials with mass and or sound insulation or absorption properties eg solid balcony balustrades, external screens and soffits.

9.1.3 City of Sydney

Relevant sections in the Sydney City Council DCP (Section 4.2.3.11) are presented below for information purposes (the ISEPP, Department of Planning Guidelines and ADG would be considered to be higher order documents).

Relevant acoustic criteria from the City of Sydney DCP are as follows:

Table 4: City of Sydney Internal Noise Criteria

Condition	Occupancy	Design Internal Noise Level
Windows closed	Bedroom (10pm – 7am)	35dB(A)L _{eq worst 1hr}
	Living / Dining /Kitchen (24 hours)	45dB(A)L _{eq worst 1hr}
Windows open	Bedroom (10pm – 7am)	45dB(A)Leq worst 1hr
	Living / Dining /Kitchen (24 hours)	55dB(A)Leq worst 1hr
Windows closed and air-conditioning	Bedroom (10pm – 7am)	38dB(A)Leq worst 1hr
on*	Living / Dining /Kitchen (24 hours)	48dB(A)L _{eq worst 1hr}

* Applies in the event that the "windows open" noise goal cannot be met at a particular site.

9.2 Recommended Design Approach

Given there are multiple guidelines outlined above, each with differing requirements with respect to internal noise levels (windows open or closed) and the necessity or otherwise of supplementary ventilation, it is recommended that a simplified approach is adopted in the assessment of façade design and external noise impacts:

• Facade design (glass thicknesses) must be sufficient to ensure that internal noise levels with windows closed complies with the ISEPP (table 2).

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- Acoustic design of new residences should adopt *design guidance* from the Apartment Design Guideline, where feasible.
- Acoustic design should be conducted with a view to providing a natural/passive ventilation path to apartments while minimising external noise transmission.
- An internal noise goal of 45dB(A) (bedrooms) and 50dB(A) (living areas) under naturally ventilated conditions will be targeted (being consistent with the *Development Near Rail Corridors and Major Roads* trigger level for supplementary ventilation). This is adopted as a "natural ventilation" noise target as implicitly the DoP trigger level implies that it is acceptable to have internal noise levels of up to 45/50dB(A) in situations where a natural fresh air source is provided. However, this is a guideline, but not an enforceable criterion. (To make a numerical (noise level) outcome mandatory cannot be enforceable pursuant to SEPP 65 clause 6A).
- Apartments to also be provided with mechanically supplied supplementary ventilation if the 45dB(A)/50dB(A) noise trigger referred to above is not achieved under naturally ventilated conditions.

9.3 Commentary

Not all design ADG guidance options would be applied in all instances. Appropriate design guidance items would be adopted depending on site conditions.

At the subject site, given the external noise levels (be it from existing noise or future operational noise from the redeveloped Star) will be moderate but not extremely high, potential feasible design options to provide noise control while enabling natural ventilation of apartments will be:

- Balcony design.
 - This is likely to be the most effective means to provide noise control and allow for natural ventilation. Design options will include partial balcony enclosure (operable facade elements or wind screens similar to those envisaged in the City of Sydney Wind Affected Balconies design).
 - Another balcony design option involves providing ventilation via a low height window to the room (below balustrade level). This can be used for apartments with a relatively deep balcony (more than 2m). The design requires use of a solid balustrade (no gaps), a noise absorptive lining to underside of balcony over (50mm Echosoft) and a low level openable window to the room (below balustrade height for the purpose of ventilating). Typically, this approach can only be used for apartments well above the noise source.
- Use of cross ventilation to assist with natural ventilation Typically an apartment bedroom will require an open window area of approximately 5% of the floor area of the room. However, in the event that apartment is cross ventilated, the size of this opening can be reduced while maintaining suitable airflow to ventilate the room. Commonly, this open area will become approximately 1.25% of the floor area of the room. This provide 6dB(A) benefit

compared to a "window open" scenario. Design of this nature requires consultation with a ventilation consultant.

- Acoustic Plenums and Passive Acoustic Ventilators:
 - A passive acoustic ventilator allows fresh airflow into an apartment without relying on a fan. By incorporating noise absorptive elements into the ventilator, the airflow can be provided while still reducing noise from outside to inside.
 - An acoustic ventilator (often called an acoustic plenum) will often consist of a length of internally insulated ducting or similar running from a facade opening and into the apartment ceiling space (allowing airflow from outside to inside). The longer the plenum, the more noise it removes (however the greater the spatial problems to incorporate it, and the greater the necessity to ensure that the airflow through the plenum is not restrained to the degree that natural airflow stops occurring).
 - This requires coordination with a ventilation consultant, however plenums provide significant reduction of outside noise while still allowing for natural ventilation of apartments.
 - Given the external noise environment (not exceptionally high), treatments of this nature are not likely to be necessary.

Adopting design options as outlined above, it will be feasible to provide future residents with good acoustic amenity and passively supplied fresh air.

Design of this nature is integral if the alternative criteria for podium noise emission assessment is adopted (see section 6.2) in order to better utilise the podium/outdoor areas of the site.

10 Light Rail and Potential Metro Noise and Vibration

Incorporation of a potential Metro Station below residential development or a reconfiguration of the light rail station entrance opening onto Pirrama Road is capable of being designed such that the noise and vibration impact on existing and future residences is minimised.

10.1 Typically adopted acoustic guidelines

Light Rail and Metro infrastructure in the vicinity of the site will not be surface rail. As such, it will be rail vibration and noise from building services from the station boxes that is the primary concern.

The rail vibration assessment is broken into two parts:

- Structure borne/ground borne noise requirements are assessed with respect to the Department of Planning Guideline *Development Near Rail Corridors and Busy Roads*.
- The assessment for human comfort in accordance with the EPA document 'Assessing Vibration; a technical guideline' (DECC, 2006) and structure borne/ground borne noise requirements from the Department of Planning Guideline Development Near Rail Corridors and Busy Roads.

10.1.1 Rail Ground-borne noise

The Department of Planning Guideline provides recommended criteria for ground-borne or regenerated rail noise for residential developments.

The table below provides a summary of the recommended noise limits for this project.

Occupancy	Period	Recommended Maximum Design Noise Level, L _{Amax (slow)}
Habitable Rooms	Day Time (7am to 10pm)	40
	Night Time (10pm to 7am)	35
Commercial (Offices)	When in use	45
Community spaces (Function Room)	When in use	45
Retail (Restaurant)	When in use	50

 Table 5:
 Recommended internal noise criteria for regenerated rail noise

Notes:

1. L_{Amax (slow)} is A-weighted maximum sound pressure level measures using "Slow" response time for 95% of rail pass-by events.

2. Internal noise criteria not covered by the ISEPP have been determined in accordance with AS2107.

10.2 Rail tactile vibration

Table 2.4 of the EPPA Guideline 2006 presents acceptable vibration dose values for intermittent vibration. Table 6 below outlines DEC's requirements.

Location	Period	Preferred VDV m/s ^{1.75}	Maximum VDV m/s ^{1.75}
Residences	Day time (7am – 10pm)	0.20	0.40
	Night time (10pm – 7am)	0.13	0.26
Offices	Day time (7am – 10pm)	0.40	0.80
	Night time (10pm – 7am)	0.40	0.80

Table 6: Acceptable VDVs for intermittent vibration in residential buildings m/s^{1.75}

10.2.1 Station Plant and Equipment Noise

This is typically required to comply with the EPA Noise Policy for Industry (see Section 7).

10.3 Commentary

The potential Metro Station and Light Rail Station are not incompatible with the proposed rezoning application and redevelopment works. Specifically, they will not excessively impact existing and future residential development. Through appropriate noise controls (discussed above) and design, noise and vibration impacts can be suitably managed:

- Potential Metro Station Site:
 - Criteria such as the above are typically adopted by the Metro proponent (Sydney Metro or similar).
 - In the acoustic design of the station box, it is typical that the train track is vibration isolated such that the remainder of the building does not require further acoustic treatment to protect the occupants above from rail induced vibration.
 - Being an underground station, ventilation systems are extensive. Again, it will be a typical requirement imposed by the Metro proponent that plant and equipment noise comply with the EPA Noise Policy for Industry. This typically requires coordination and a "noise budget" system to ensure that the different components of the station development (tunnel ventilation, station plant, over station development) do not create a cumulative noise problem.
 - In light of this, there is no reason why residential development located above the station would be an incompatible land use (and in fact is already proposed at Pitt Street and Waterloo Metro Stations).
- With respect to the reconfigured opening to the Light Rail station within the Star building:
 - The primary noise emission path will be from the Pirrama Road opening (which faces the existing residences at the Sydney Wharf Apartments.
 - Given the distance, noise from a light rail movement emitted via the opening would not be expected to be any higher than a bus passby on Pirrama Road (in fact, the bus passby would be expected to be louder given its proximity to the apartments).

 It would be necessary that appropriate acoustic design is undertaken for any PA system serving the station to ensure that noise spill is compliant with EPA Noise Policy for Industry requirements.

The proposed changes to Light Rail infrastructure or the potential Metro Station development does not require development of site specific noise controls, and is not incompatible with the proposed change in use at the Star sight.

11 Operational Noise – Noise from Traffic Generation

An intensification of use of the Star site will potentially create additional traffic, which in turn will potentially create new noise impacts.

11.1 Typical Acoustic Criteria - NSW Road Noise Policy

Noise impacts from potential increases in traffic on the surrounding road is typically assessed in accordance with the NSW *Road Noise Policy* (DECCW, 2011) (RNP).

The following RNP road traffic noise criteria would apply.

Table 7: RNP Road Traffic Noise Criteria – Noise from New Traffic Impacting Residential Development

		Assessment Criteria, dB(A)	
Road Category	Type of Project/Land Use	Day 7am – 10pm	Night 10pm – 7am
Freeway/arterial/sub- arterial roads	Existing residences affected by additional traffic on existing roads generated by land use developments	L _{Aeq,(15 hour)} 60 (external)	L _{Aeq,(9 hour)} 55 (external)
Local Roads		L _{Aeq,(1 hour)} 55 (external)	L _{Aeq,(1 hour)} 50 (external)

Further to the above, the RNP states the following for land use developments generating additional traffic:

"For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use development, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'."

The RNP states that in assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

11.2 Commentary

The Road Noise Policy remains an appropriate noise control in the assessment of additional noise created as a result of traffic generated by the development.

Acoustic assessment typically requires a detailed assessment of traffic volumes and noise levels on the surrounding road network, and would be undertaken at Development Application Stage.

In the event that traffic increases are such that noise levels criteria set out in section 11.1 are not achievable, it will be necessary to consider the vehicle travel paths to and from the site (to reduce traffic increases) or to consider "at property" acoustic treatments to dwellings that are excessively noise impacted.

In our opinion, at property treatments are unlikely to be required. Traffic noise control recommendations would be developed at Development Application stage following detailed traffic modelling of the redeveloped site.

Alternative criteria to the RNP are not required in a site specific DCP.

12 Construction Noise

The NSW *Interim Construction Noise Guideline* (ICNG, 2009) provides guidelines for assessing noise generated during the construction phase of developments.

The key components of the guideline that are incorporated into this assessment include:

• Use of L_{Aeq} as the descriptor for measuring and assessing construction noise.

NSW noise policies, including the INP, RNP and RING have moved to the primary use of L_{Aeq} over any other descriptor. As an energy average, L_{Aeq} provides ease of use when measuring or calculating noise levels since a full statistical analysis is not required as when using, for example, the L_{A10} descriptor.

- Application of reasonable and feasible noise mitigation measures
- As stated in the ICNG, a noise mitigation measure is feasible if it is capable of being put into practice, and is practical to build given the project constraints.
- Selecting reasonable mitigation measures from those that are feasible involves making a judgement to determine whether the overall noise benefit outweighs the overall social, economic and environmental effects.

The ICNG provides two methods for assessment of construction noise, being either a quantitative or a qualitative assessment. A quantitative assessment is recommended for major construction projects of significant duration, and involves the measurement and prediction of noise levels, and assessment against set criteria. A qualitative assessment is recommended for small projects with a duration of less than three weeks and focuses on minimising noise disturbance through the implementation of reasonable and feasible work practices, and community notification.

It is noted that Pyrmont is not covered within the area to which the City of Sydney Code of Practice 1992 for Construction Hours/ Noise within the Central Business District and therefore, any construction activities will be assessed in accordance with the ICNG only.

Potential impacts of the construction on surrounding areas with respect to noise and vibration should be addressed in the future planning and development stages through a Demolition, Excavation and Construction Noise and Vibration Management Plan.

13 Recommendations

With respect to acoustic criteria that should be implemented in a site specific DCP:

- For the assessment of noise from external entertainment areas (Star podium, Hotel Pool etc) an internal noise criteria should be permitted to be adopted for new residential apartments to enable better activation of entertainment spaces (see section 6.2/6.3). These criteria should not apply to special event noise.
- Plant and equipment noise should be assessed with reference to the Noise Policy for Industry. The internal noise criteria in the City of Sydney standard conditions of consent (clause (b)), should only be applied for noise through common walls/floors of the same building, It should not be applied with respect to external noise emissions as it is unnecessarily stringent and inappropriate for a site where significant rezoning and redevelopment is envisaged (see section 7.2/7.3).
- Criteria for assessment of internal noise levels and natural ventilation for apartments should follow the approach outlined in section 9.2 to avoid the inconstancies between the City of Sydney DCP, Development Near Rail Corridors and Bust Roads guideline and the Apartment Design Guideline.
- Special events should be subject to a site specific Noise Management Plan (developed in accordance with the POEO Act and Noise Guide for Local government. These events should not be subject to typical Office of Liquor and Gaing Guidelines (see section 8).

In preparation of Development Application documentation, we recommend:

- A detailed noise survey of the site (background noise levels and existing road traffic noise levels) should be undertaken.
- Comprehensive list of acoustic performance requirements to be determined, including proposing alternative criteria (or non-application of some typical criteria) where justifiable (as discussed above).
- Detailed review of spatial planning of the site to identify all key areas of potential significant noise generation should be undertaken (vehicle noise, patron/entertainment noise, plant and equipment noise, etc.). Distinguish between areas that can in principle be addressed through acoustic treatment (plant and equipment noise) and areas that may also rely on site management (special events and outdoor dining areas) in order to operate without excessive noise impact.
- Identify any activities that would fall under a Special Event use (which would be subject of a separate application and Noise Management Plan.

- Conduct a comprehensive study of future traffic generation by the site and comparison against EPA Road Noise Policy Guidelines. Determine if the proposed development is capable of complying with the EPA guidelines (most likely the 2dB(A) increase criteria relative to existing conditions will be applicable). If necessary, formulate justification/mitigation measures (alternative routing, at-property mitigation).
- In principle analysis of external noise impacts (Star podium, entertainment noise), and conduct residential tower facade design to investigate viability of natural ventilation options for the site (balcony design/acoustic plenums, etc.).
- In principle analysis of the effect of reconfiguration of Light Rail station changes (opening to Pirrama Road).

14 Conclusion

This report has been prepared on behalf of The Star Entertainment Group (The Star) in support of its Key Site Master Plan under the Pyrmont Place Strategy.

In our opinion the site is capable of supporting the proposed uses envisaged as part of the rezoning application.

There are a number of acoustic planning controls that have been identified that should be considered either in addition to or as an alternative to commonly adopted noise emission guidelines. These relate primary to noise associated with special event use of the site, noise from retail/outdoor dining/entertainment areas and increases in road traffic noise as a result of the intensification of use of the site. These alternatives are proposed with a view to maximising the utilisation of the site, inclusive of public realm spaces. This is consistent with the intention of DPIE/City of Sydney with respect to redevelopment of the Pyrmont Peninsula, to our understanding.

These alternative controls should be encapsulated in the site specific DCP to enable them to be considered in a merit assessment of any Development Application lodged for the site.

APPENDIX A Glossary of terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L ₉₀ noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds:
	0dB The faintest sound we can hear
	30dB A quiet library or in a quiet location in the country
	45dB Typical office space. Ambience in the city at night
	60dB CBD mall at lunch time
	70dB The sound of a car passing on the street
	80dB Loud music played at home
	90dB The sound of a truck passing on the street
	100dB The sound of a rock band
	115dB Limit of sound permitted in industry
	120dB Deafening
dB(A)	A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L _{Max}	The maximum sound pressure level measured over a given period.
L _{Min}	The minimum sound pressure level measured over a given period.

L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L ₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L ₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L _{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L _{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.