Proposed Commercial Building

8b Murray Rose Avenue, Sydney Olympic Park

Noise & Vibration

Development Approval Phase

Report Number 610-10015R1

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1 INTRODUCTION

SLR Heggies Pty Ltd has been engaged by FDC Construction & Fitout Pty Ltd to provide specialist consulting services in relation to noise and vibration associated with the development of a six storey commercial office building at 8b Murray Rose Avenue, Sydney Olympic Park.

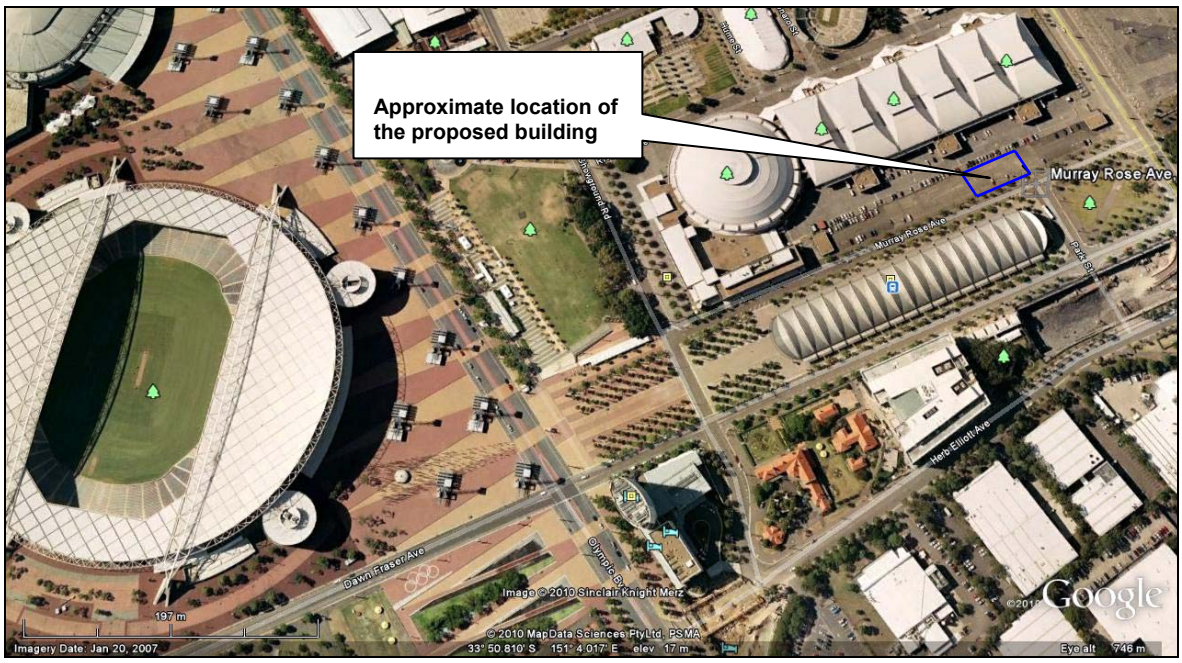
The proposed commercial office building will be designed to achieve a high level of sustainability by targeting 5 Star Green Star Office Design V3 and 4.5 Star NABERS Energy ratings. To encourage and recognise buildings that are designed to maintain internal noise levels at an appropriate level up to two points are awarded where it is demonstrated that for 95% of the building NLA, the building achieves ambient internal noise levels in accordance with AS/NZS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors*.

This report presents the results of an assessment of the proposed development to ensure that the building design will achieve the requirements of the Green Star – Office as Built V3 Technical Manual in regard to IEQ-12 Internal Noise Levels and as such, will qualify to be awarded the two credit points available and will also comply with Sydney Olympic Park Authority (SOPA) requirements.

2 SITE LOCATION

The proposed development is to be constructed at 8b Murray Rose Avenue, Sydney Olympic Park. The site forms part of the Jacaranda Square and Sydney Olympic Park Railway Station precinct and was previously utilised for carparking on the southern side of the Exhibition Complex and Ross, Binnie and Buring Pavilions at the Sydney Showground. The site is located approximately 30 m north of the Olympic Park rail line and approximately 500 m to the east of ANZ Stadium. The proposed development site is shown in **Figure 1**.

Figure 1 Site Location

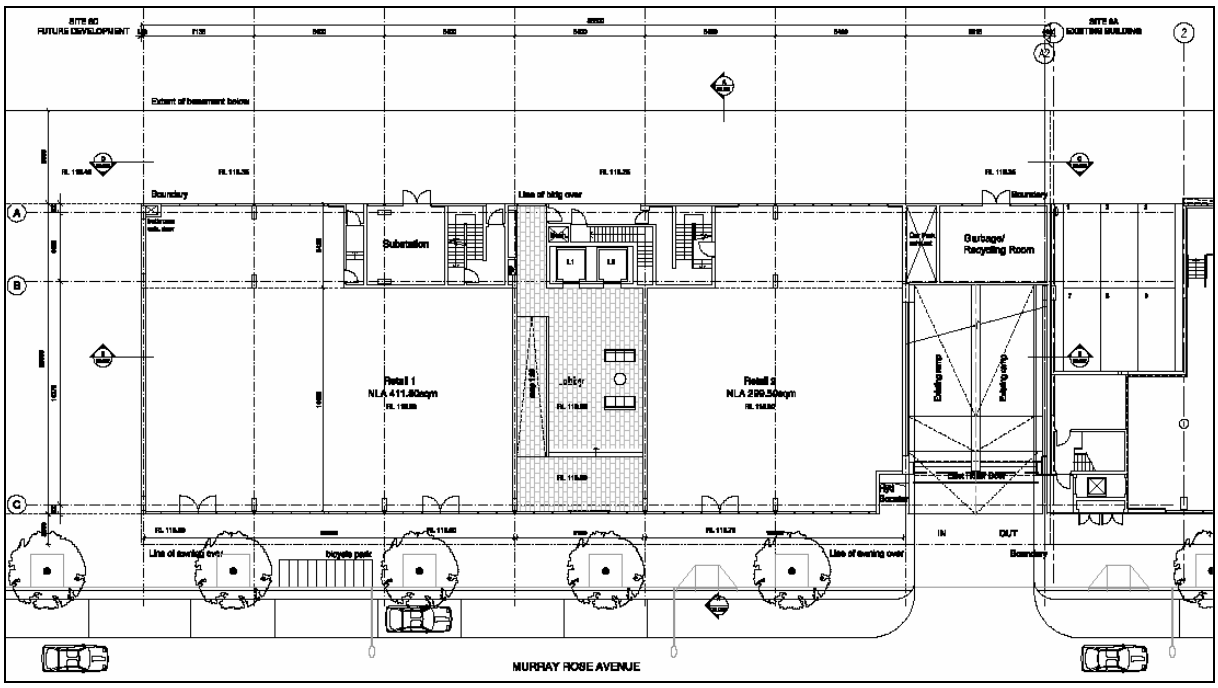


Aerial image courtesy of Google Earth

3 PROJECT DESCRIPTION

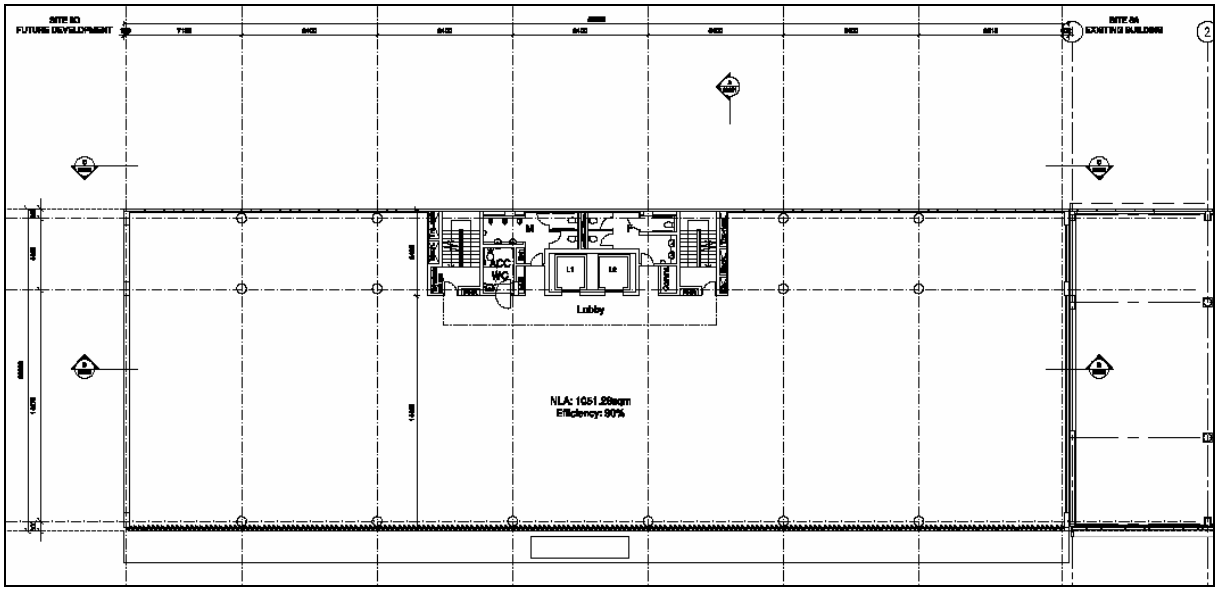
The proposed commercial office building has been designed to integrate aesthetically with the Olympic Park Railway Station and Jacaranda Square. The southern facade forms a continuous and unified elevation with the development of Site 8. The building will be six storeys in height and provide two basement carparking levels, foyer and retail tenancies at ground level, five floors of general office space and a rooftop plantroom. The ground floor plan, typical floor plan and roof plant plan are shown in **Figure 2**, **Figure 3** and **Figure 4**.

Figure 2 Ground Floor Plan



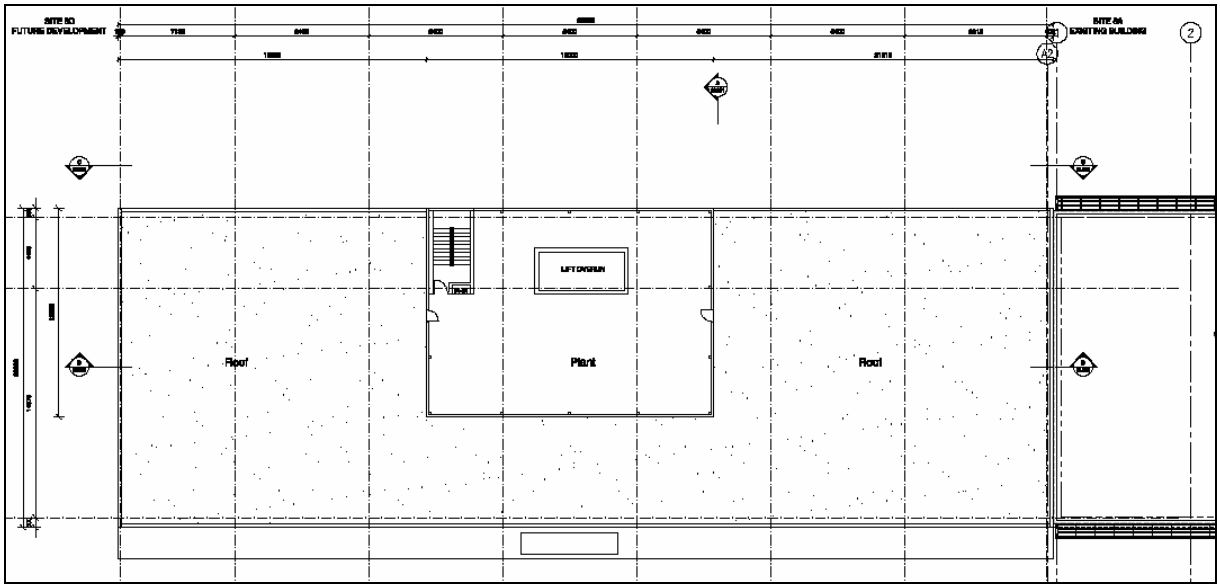
Drawing courtesy of FDC Construction & Fitout Pty Ltd

Figure 3 Typical Office Floor Plan



Drawing courtesy of FDC Construction & Fitout Pty Ltd

Figure 4 Level 6 Plant Plan



Drawing courtesy of FDC Construction & Fitout Pty Ltd

The northern and southern facades will comprise clear double glazing. The northern facade will incorporate smooth faced precast panels with double glazed infill panels. The southern facade will comprise clear floor to ceiling double glazing. The walls on the eastern and western ends of the building will be constructed of smooth faced precast concrete. A glazed screen projected above the level of the last occupied floor matches the parapet height of the adjoining Site 8a building.

The typical office floor plan will provide approximately 1054.3 m^2 Nett Lettable Area (NLA). The floor plan aims at ensuring flexibility for future tenants. The building core is located centrally on the northern facade of the building.

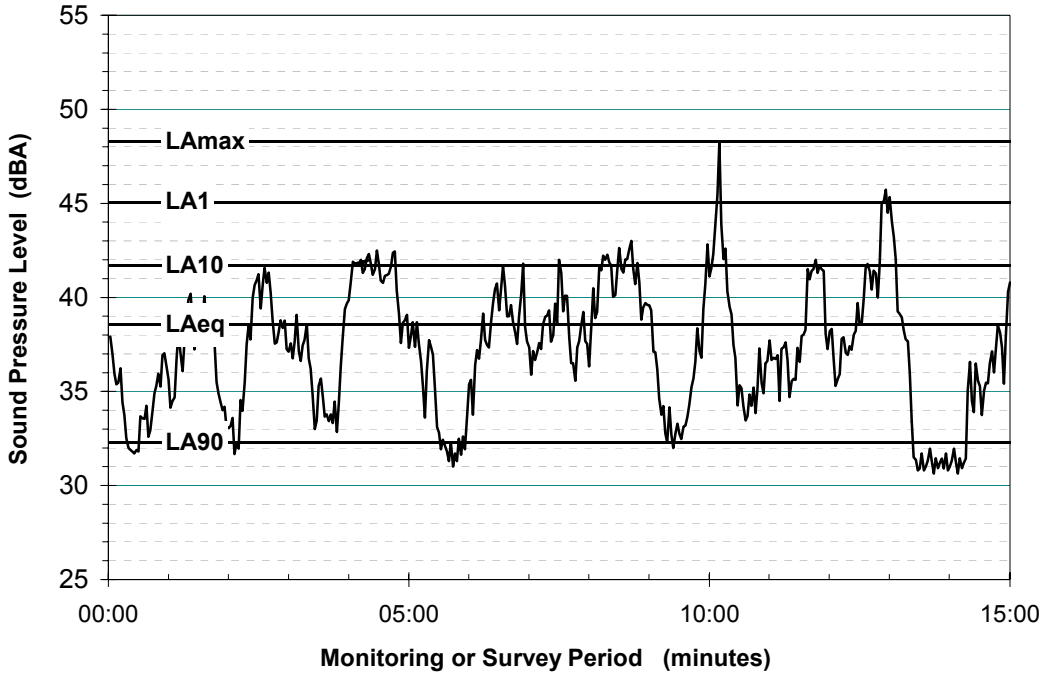
4 ACOUSTIC TERMINOLOGY USED IN THE REPORT

4.1 Acoustical Descriptors and Typical Noise Levels

This report makes repeated reference to certain statistical noise level descriptors, in particular the L_{A10}, L_{Aeq}, L_{A90}, L_{A1} and L_{Amax} noise levels, depicted graphically in **Figure 5**.

- The L_{A10} noise level is the A-weighted sound pressure level exceeded 10% of a given measurement period and is utilised normally to characterise typical average maximum noise levels.
- The L_{Aeq} is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound over the same measurement period.
- The L_{A90} noise level is the A-weighted sound pressure level exceeded 90% of a given measurement period and is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the "background" level.
- The L_{A1} noise level is the A-weighted sound pressure level exceeded 1% of a given measurement period and is utilised normally to characterise typical maximum noise levels.
- The L_{Amax} noise level is the maximum A-weighted sound pressure level measured over the given measurement period.

Figure 5 Graphical Display of Statistical Noise Level Descriptors



A range of typical noise levels is shown in **Table 1**.

Table 1 Typical Noise Levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130 120 110	Threshold of pain Heavy rock concert Grinding on steel	Intolerable Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerb side of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to Quiet
40 30	Inside private office Inside bedroom	Quiet to Very quiet
20	Unoccupied recording studio	Almost silent

4.2 A-Weighting or dBA Levels

The overall level of a sound is usually expressed in terms of dBA, as is the case in Australian Standard (AS) 1055 *Acoustics – Description and measurement of environmental noise*, which is measured using the "A-weighting" filter incorporated in sound level meters. These filters have a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound.

Different sources having the same dBA level generally sound about equally as loud, although the perceived loudness can also be affected by the character of the sound (eg the loudness of human speech and a distant motorbike may be perceived differently, although they are of the same dBA level).

4.3 Sensitivity to Noise Levels Changes

A change of up to 3 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness.

5 DESIGN CRITERIA

5.1 Internal Noise Environment

The building must conform to the design objectives and development controls of the Sydney Olympic Park Authority. Environmental emissions from the proposed development must also meet the requirements of the relevant statutory authorities.

The proposed commercial office building design will be targeting 5 Star Green Star Office Design V3 and 4.5 Star NABERS Energy ratings. To encourage and recognise buildings that are designed to maintain internal noise levels at an appropriate level up to two points are awarded where it is demonstrated that for 95% of the building NLA, the building achieves the 'Satisfactory' ambient internal noise levels in accordance with AS/NZS 2107:2000 *Acoustics – Recommended design sound levels and reverberation times for building interiors* as follows:

Building Services Design

- One point is awarded where, within the entire base building general office space, noise from the building services does not exceed an L_{Aeq} of 40 dBA.

Overall Building

- One point is awarded where within the base building office space, the sound level does not exceed an L_{Aeq} of 40 dBA.

In the evaluation of the overall noise level within the base building office space consideration must also be given to the potential for regenerated noise from rail movements on the underground Sydney Olympic Park rail line. Vibration generated by rail movements can travel through the ground and into the building structure where it can then re-radiate as airborne noise within the building itself. Levels of regenerated noise from rail movements must be at least 10 dB below the design criterion for airborne noise intrusion.

In addition we understand the following **Sound Performance Standard** is required by SOPA:

> *Sound Performance Standard means the design and construction of the Facility is capable of delivering a sound performance standard of not more than an average of all the readings taken from different places within the facility of 40_{L10}dB(A) (determined when the building is vacant and air conditioning plant is not operational) inside the Facility assuming that at the time the relevant readings inside the building are taken, noise sourced outside the Facility from land the subject of the RAS Lease and including land known as the Carnival site (being identified as part lot 1000, DP 1127564 on Australia Avenue east of the RAS exhibition halls and known as car park P6) is not more than 80_{L10}dB(A).*

The SOPA requirement appears intended to ensure that noise emissions from the Sydney Showground, principally occurring during the staging of the Sydney Royal Easter Show, will not exceed an L_{A10} of 40 dBA within the proposed future office space. This requirement is consistent with IEQ 12 given that the equivalent L_{Aeq} would be in the order of 37 dBA. Furthermore, to meet the Green Star IEQ requirement of an overall building noise level not exceeding L_{Aeq} 40 dBA, the level of external noise intrusion and building services noise must each be designed to achieve an L_{Aeq} of 37 dBA in order that the overall cumulative noise level (external noise ingress + building services noise) does not exceed L_{Aeq} 40 dBA.

5.2 Environmental Noise Emissions

Noise generated by the development itself, ie noise emissions from mechanical plant and equipment, should be designed to comply with the requirements of the Department of Environment, Climate Change and Water's *Industrial Noise Policy* (INP).

The INP criteria for industrial (eg mechanical plant and equipment) noise sources have two components:

- Controlling the *intrusive* noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level *amenity* for particular land uses for residents and sensitive receivers in other land uses.

Intrusiveness Criterion

In setting an "Intrusive" noise goal, a statistically rigorous estimate of the ambient (background) L_{A90} noise level, termed the RBL, needs to be established at the nearest sensitive receivers. An "RBL plus 5 dBA" criterion is then applied to the 15-minute L_{Aeq} noise emissions of the noise source in question at the receivers of interest (normally at their property boundary).

Intrusive Design Goal: $L_{Aeq(15minute)} \leq$ RBL + 5 dBA

Section 3.1 of the INP recommends that, where the RBL is found to be below 30 dBA, it is set at 30 dBA. This requirement is not relevant to this situation.

Amenity Criterion

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise. If present, the existing noise level from industry is generally measured. If it approaches the criterion value, then noise levels from new industries need to be designed so that the cumulative effect does not produce noise levels that would significantly exceed the criterion. For high-traffic areas there is a separate amenity criterion.

The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. In order to determine the amenity noise goal, the maximum ambient L_{Aeq} noise levels within an area should not normally exceed the acceptable noise levels specified in **Table 2**. Where existing L_{Aeq} noise levels approach or exceed the acceptable noise levels given in **Table 2**, L_{Aeq} noise design goals are set below the existing L_{Aeq} levels in order to limit any further increase or "creep" in the ambient levels.

An extract from the NSW INP that relates to the amenity criteria recommended for the receiver type relevant to this assessment is given in **Table 2**.

Table 2 Amenity Criteria - Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq}[1] Noise Level	
			Acceptable	Recommended Maximum
Commercial premises	All	When in use	65 dBA	70 dBA

Notes:

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

2 For Monday to Saturday, Daytime 7.00 am – 6.00 pm; Evening 6.00 pm – 10.00 pm; Night-time 10.00 pm – 7.00 am.

3 On Sundays and Public Holidays, Daytime 8.00 am – 6.00 pm; Evening 6.00 pm – 10.00 pm; Night-time 10.00 pm – 8.00 am.

6 PRELIMINARY ACOUSTICAL DESIGN EVALUATION

6.1 Ground-borne Noise from Olympic Park Rail Line

The prediction of ground-borne noise levels within a building can be performed using measured vibration levels taken at the footings of the proposed structure. To conduct this exercise, the following formula, as taken from the *Association of Noise Consultants - Measurement & Assessment of Groundborne Noise & Vibration Guidelines 2001*, has been implemented:

Lp = Lv – 27 dB where: Lp = RMS noise level during a train passby event
Lv = RMS vibration velocity level of the floor

Vibration levels at the footings of the proposed building were measured for around 15 individual train passbys on the Sydney Olympic Park Rail Line. The measurements were made on 18 October 2010 between the approximate hours of 10:30 am and 1:30 pm, at two locations representative of the facade which faces the station. Measurements which were unduly affected by other sources of vibration in the area (ie vehicular movements on adjacent roads, pedestrians walking past the measurement site, etc) were considered erroneous and excluded from the data set.

To calculate ground-borne noise within the building the 95th percentile vibration data measured at the footing has been used in combination with the above formula. It should be noted that ground-borne noise levels are only considered significant below frequencies of 315Hz. The overall ground-borne noise level has therefore been calculated over the 5 Hz – 315 Hz range.

Table 3 Predicted Structure-borne Noise Level Associated with Train Passbys

Location	Predicted 95th Percentile Ground-borne Noise Level (dBA)
Footings of Proposed Building at facade facing Sydney Olympic Park Station	23

The results in **Table 3** indicate that the predicted 95th percentile ground-borne noise level from train passbys within the proposed building would be in the region of 23 dBA.

6.2 Airborne Noise Intrusion – Glazing Design

Ambient noise levels in the Sydney Olympic Park environs are generally lower than those typically experienced in commercial urban areas due to the decentralised nature of the precinct and the subsequent low traffic volumes.

6.2.1 Southern Facade

The southern facade of the future building will not be exposed to significant levels of noise. The highest levels likely to impinge on the facade at this location would be generated by intermittent traffic on Murray Rose Avenue.

The southern facade of the proposed building will comprise double glazing. The selection of the double glazed system employed will be based upon thermal considerations and as such will incorporate a fairly narrow airspace (usually around 12 mm to 25 mm) between the internal and external glazing. Given the areas involved the glazing thickness is unlikely to be less than 6 mm. The demonstrated acoustical performance of a typical commercial system employing 6mm glass panels separated by a12 mm airspace is Rw 29. This system will enable the satisfactory noise level of 40 dBA (L_{Aeq}) for general office space, recommended by AS/NZS 2107:2000, to be comfortably achieved.

It is recommended that the external and internal panels of the double glazed system are of dissimilar thickness to avoid a coincidence dip at higher frequencies.

6.2.2 Northern Facade

The maximum noise exposure of the northern facade will occur during the period of the Sydney Royal Easter Show. The SOPA Sound Performance Standard addresses this scenario. In accordance with SOPA's requirement, with an L_{A10} noise level of 80 dBA at the boundary of the Carnival site (carpark P6), the noise level received at the northern facade of the proposed building, a distance of approximately 100 m to the west is calculated to be around 45 dBA. Assuming double glazed units comprising internal and external panels of 6 mm glass separated by a 12 mm airspace and minimum tested performance of Rw 29, the predicted noise level within the office space due to airborne noise ingress from the Carnival site is likely to be in the order of 15 dBA to 22 dBA. The actual resulting internal noise level will be dependent upon the surface finishes within the office space and the amount of absorption provided by the ceiling tiles and carpet.

The actual ambient L_{A10} noise level at the northern facade of the proposed building is likely to be higher than 45 dBA due to the influence of general ambient noise from the Showground during the staging of the Sydney Royal Easter Show however typical commercial double glazing will enable the requirements of IEQ 12 and AS/NZS 2107:2000 to be comfortably achieved within the general office space.

It is recommended that the external and internal panels of the double glazed system are of dissimilar thickness to avoid a coincidence dip at higher frequencies.

6.3 Building Services Noise

Precise mechanical plant selection is unknown at this stage, as plant selection will take place during the detailed design phase of the project.

It is anticipated that the building will be serviced by typical mechanical ventilation /air -conditioning equipment. The plant is expected to operate during daytime hours only (that is, not beyond midnight).

It is likely that the criteria set out in **Section 5.1** can be met through the use of conventional noise control methods (e.g.: selection of equipment on the basis of quiet operation and, where necessary, providing full enclosures, localised barriers, silencers and lined ductwork).

The mechanical plant associated with the development must be reviewed by an appropriately qualified acoustic consultant at the detailed design stage when final plant selections have been made and ductwork layout is complete.

6.4 Environmental Noise Emissions

Noise emissions from carpark exhaust systems, roof top plant room etc shall not exceed 65 dBA at adjacent commercial premises and at the boundary of the site.

7 CONCLUSION AND RECOMMENDATIONS

SLR Heggies Pty Ltd has conducted a Development Approval Phase review of noise and vibration issues associated with the construction of a six storey commercial office building at 8b Murray Rose Avenue, Sydney Olympic Park. This assessment has been carried out in accordance with NSW regulatory requirements and this report is to form part of a Development Application in support of the proposed development.

This report presents the results of an assessment of the proposed development to ensure that the building design will achieve the requirements of the Green Star – Office as Built V3 Technical Manual in regard to IEQ-12 Internal Noise Levels and as such, will qualify to be awarded the two credit points available and will also achieve the SOPA requirements in relation to acceptable internal noise levels.

The scope of the assessment involved a survey of the existing levels of groundborne vibration currently experienced at the site due to rail movements on the nearby underground rail line, establishment of assessment criteria for noise ingress to future general office space and noise emissions from the proposed building; an assessment of noise intrusion to future office space given calculated levels of regenerated noise and the calculated levels of ambient noise at the northern and southern facades relative to appropriate criteria; and, recommendations for glazing systems capable of achieving the internal noise levels required. Criteria for environmental noise emissions from the building itself are also given. The findings are as follows:

Internal Noise Levels

- Levels of regenerated noise due to rail movements on the nearby underground rail line will enable the design criteria for internal noise to be achieved.
- Compliance with IEQ-12 and SOPA requirements for internal noise levels can be achieved with double glazing on the northern and southern facades. The double glazing used should comprise, at a minimum, external and internal panels of 6 mm glass separated by a12 mm airspace. It is acoustically preferable for the external and the internal glazing to be of different thicknesses, for example 6 mm and 10 mm glass, rather than comprising panes of the same thickness (eg 6mm and 6 mm).
- Compliance with project specific noise goals can be achieved by the mechanical services design with the incorporation of appropriate acoustical design. Noise emissions to office space must be reviewed when the mechanical design has been finalised.

Environmental Noise Emissions

- Environmental noise emissions from mechanical services should be designed so that operational levels do not exceed an L_{Aeq} of 65 dBA at the boundary of the site and adjoining commercial premises in accordance with INP requirements. This design goal can be achieved with the implementation of appropriate noise controls. Noise emissions to the external environment must be reviewed when the mechanical design has been finalised.

8 CLOSURE

This report has been prepared by SLR Heggies Pty Ltd with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of FDC Construction & Fitout Pty Ltd; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR Heggies.

SLR Heggies disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.