

ACOUSTIC LOGIC CONSULTANCY

noise and vibration consultants
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LOWY INSTITUTE SYDNEY - REVIEW OF ACOUSTIC CRITERIA AND IMPACTS

1. INTRODUCTION

Acoustic Logic Consultancy has been engaged to conduct a review of the noise and vibration impacts which will potentially impact on the Lowy Institute as a result of the proposed Sydney City Grid Project at 33 Bligh Street Sydney. This review has been conducted in conjunction with the Environmental Assessment for Stage 2A(l) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D.

The proposed Sydney City Grid Project has a shared boundary to the existing heritage listed Lowy Institute Building.

2. THE LOWY INSTITUTE

The Lowy Institute building is a Heritage Listed building which includes ornate building constructions which would be considered of Heritage Significance. The building includes a sandstone faced with ornate plastering (include plaster on lath) which may be damaged by any undue vibrations.

The Lowy institute building is frequently occupied by academics conducting works which results in a high sensitivity to any extraneous noise events.

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3. ACOUSTIC IMPACTS

Noise and vibration will potentially impact the Lowy Institute building during the construction stage of the project (including demolition, excavation and construction) as well as during normal operations of the building once the building has been completed.

Noise and vibration impact during construction and during operation of the building on completion are discussed in the sections below.

3.1 CONSTRUCTION PERIOD

Noise and vibration will potentially impact of the Lowy institute building during the construction period of the project. The construction period includes the demolition, excavation and construction of the project.

Due to the close of the proposed development to the Lowy Institute building, the heritage significance of the building and the operations being conducted within the institute careful investigation and control of noise and vibration generated during the construction period of the project will is required.

Based on the information included within the projects Environmental Assessment the expected period of construction is 94 weeks for Stage 2A(i) of the development, including the following:

1. Demolition period – 26 weeks
2. Bulk excavation – 30 weeks
3. Stub tunnel and shaft excavation – 30 weeks
4. bridging structure over metro tunnels – 8 weeks

No information indicating the period of works for Stage 2A(ii) of the develop has been provided.

Both the Environmental Assessment for Stage 2A(i) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D include discussions and criteria for the control of noise impact on neighbouring properties as part of the construction period which are discussed in the sections below.

3.1.1 Construction Noise Criteria

As the proposed development is located within the Sydney City Central Business District noise during the construction of the project will be required to comply with the "Code of Practice for Construction Hours/Noise within the Central Business District". The criteria requires that the LA avg maximum noise emitted from activities on the construction site and measured over 15 minute period must not exceed the background noise levels measured in that time period in the absence of construction noise as detailed below.

Table 1 – City of Sydney Council Construction Noise Criteria

DAY	TIME ZONE	CATEGORY	NOISE CRITERIA
Monday to Friday	07:00 to 08:00	1	Background + 5dB(A)
	08:00 to 19:00	1	Background + 10dB(A)
Saturday	07:00 to 08:00	1	Background + 5dB(A)
	08:00 to 17:00	1	Background + 10dB(A)

Both the Environmental Assessment for Stage 2A(i) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D indicate that the construction noise impact from the site are required to comply with the DECC "Interim Construction Noise Guideline" but fail to identify the City of Sydney Council construction noise criteria.

The DECC identifies noise levels associated with construction noise as an $L_{Aeq(15\text{ min})}$ noise level which will be significantly less than the LA avg maximum noise level as identified by the City of Sydney Council requirements.

A summary of the DECC "Interim Construction Noise Guildlines" is detailed in the table below

Table 2 – DECC Construction Noise Criteria

RECEIVER TYPE	NOISE GOAL L_{Aeq} (15 min)	TIME	COMMENTS
Residential	Background noise + 10 dB(A)	Monday to Friday 7am to 6pm	1. Where the predicted noise levels are expected to exceed noise goal the proponent should apply all feasible and reasonable work practices to minimise noise impact
		Saturday 8am to 1pm	2. The proponent should identify all potentially impacted receivers of the nature, period and duration of proposed works
	High Noise Affected 75 dB(A)	Monday to Friday 7am to 6pm	1. The high noise level represent the point above which there may be strong community reaction.
		Saturday 8am to 1pm	2. The proponent should very carefully consider if there is any other feasible or reasonable work practices to minimise noise impact. 3. The proponent should identify all potentially impacted receivers of the nature, period and duration of proposed works

A summary of the proposed construction noise goals presented within the Environmental Assessment for Stage 2A(i) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D is detailed in the table below.

Table 3 – Construction Noise Goals for the Lowy Institute

REPORT	LOCATION	CONSTRUCTION NOISE GOALS
Environmental Assessment for Stage 2A(i) of the City (dated 2010)	External noise level on Bligh Street	68 dB(A) L_{Aeq}
Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D	External noise level on Bligh Street	68 dB(A) L_{Aeq}

No noise level criteria for internal noise levels have been provided. Based on the sensitivity of the operations within with Lowy Institute internal noise levels during the construction stages of the project should be disused and presented.

Based on the City of Sydney Council "Code of Practice for Construction Hours/Noise within the Central Business District" the following construction noise goals for internal and external areas of the Lowy Institute should be included in the impact of the proposed development.

Table 4 – Suitable Construction Noise Goals for the Lowy Institute

LOCATION	DAY	TIME ZONE	NOISE GOAL dB(A) Lav Max	CONSTRUCTION NOISE GOALS dB(A) Lav Max
External noise levels	Monday to Friday	07:00 to 08:00	Background + 5dB(A)	63
		08:00 to 19:00	Background + 10dB(A)	68
	Saturday	07:00 to 08:00	Background + 5dB(A)	63
		08:00 to 17:00	Background + 10dB(A)	68
Internal noise levels	Monday to Friday	07:00 to 08:00	Background + 5dB(A)	50*
		08:00 to 19:00	Background + 10dB(A)	60*
	Saturday	07:00 to 08:00	Background + 5dB(A)	50*
		08:00 to 17:00	Background + 10dB(A)	60*

* Note: Background noise levels have been based on the recommended maximum noise level for office areas within the Australian Standard AS2107:2000 of 45 dB(A). The existing background noise level within the Lowy institute is likely to be below the recommended maximum noise level within the Australian Standard and should be investigated prior to works commencing, and the internal noise goals amended accordingly.

No investigation into existing internal noise levels have been conducted as part of the Environmental Assessment for Stage 2A(i) of the City (dated 2010) or the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D.

3.1.2 Construction Noise Impact to the Lowy Institute

The Environmental Assessment for Stage 2A(i) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D identifies that noise and vibration generated from the proposed construction that has the potential to impact on the amenity of surrounding receivers. The report goes on to state that noise and vibration is likely to comply with noise goals at residences however daytime excavation noise is predicated to exceed noise goals within neighbouring commercial properties.

Table 9-14 Environmental Assessment for Stage 2A(i) of the City (dated 2010) and table 6-1 of the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D indicates that expected noise levels associated with the proposed development at external façade of the Lowy institute building of up to 77 dB(A) is expected. The report goes on to state that reasonable and feasible mitigation measures will be implemented, however no details of these controls are provided.

No predictions of internal noise levels within the Lowy Institute building are presented. Internal noise levels within the Lowy institute will be result of air born noise intrusion via the buildings façade as well as structure born noise transmitted as a result of activities generating impacts within the site (such as hydraulic hammering, saw cutting, rock ripping, concrete munching and the like). Structure bone vibration will then be radiated from the building structure as audible noise. It is likely that structure bone vibration will be the predominant source of internal noise impact within the Lowy institute building during the demolition and excavation periods of the development.

Omission of internal noise impacts from the submitted noise and vibration impact reports represents a serious oversight which is likely to be the major source of negative noise impact on the Lowy institute building. Based on previous experience it is highly likely that noise generated during the 26 weeks of demolition and 30 weeks of bulk excavation will generate noise impact which will cause adverse impacts within the Lowy Institute building. The expected internal noise levels may be of a magnitude which prevents which prevents existing operations from being conducted comfortably.

3.2 CONSTRUCTION VIBRATION

The Environmental Assessment for Stage 2A(i) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D both provide criteria for the control of vibration impact on the Lowy Institute building during the construction period of the project.

Based on the heritage significance of the building and its ornate construction, vibration levels should be specified to ensure no structural or architectural damage is risked during the development of the Sydney City Grid Project.

The Environmental Assessment for Stage 2A(i) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D present suitable construction vibration criteria based on the British Standard BS 6472:1992: "Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz) and the German Standard DIN 4150-3 (1999-02): "Structural Vibration – Effects of Vibration on Structures".

A summary of the standards is provide below.

3.2.1 German Standard DIN 4150-3 (1999-02)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in the Table 5 below.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 5 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE	PEAK PARTICLE VELOCITY (mms ⁻¹)			
	At Foundation at a Frequency of			Plane of Floor of Uppermost Storey
	< 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (eg buildings that are under a preservation order)	3	3 to 8	8 to 10	8

3.2.2 British Standard BS 6472:1992

British Standard BS 6472:1992 develops criteria relating to levels of building vibration that may be expected to give rise to "adverse comment", in the frequency range most applicable to impacts associated with construction, which is 1 to 80Hz. These threshold values are used as criteria for assessing the loss of amenity and are presented below in Table 6.

Table 6 – BS 6472:1992 Criteria to Avoid "Adverse Comment"

Type of Occupancy	Time of Day	Peak Particle Velocity (mms ⁻¹) between 1Hz to 80Hz Likely to Cause "Adverse Comment"			
		Continuous Vibration		Intermittent Vibration and Impulsive Vibration Excitation with Several Occurrences per day	
		Vertical	Horizontal	Vertical	Horizontal
Residential	Day	0.3 to 0.6	0.8 to 0.6	8.4 to 12.6	24 to 36
	Night	0.2	0.6	2.8	8
Offices	Day	0.6	1.6	18	51
	Night	0.6	1.6	18	51
Workshops	Day	1.2	3.2	18	51
	Night	1.2	3.2	18	51

3.2.3 Specified Construction Vibration Criteria

The Environmental Assessment for Stage 2A(i) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D goes on to recommended the following construction vibration criteria for peak particle velocities and rms vibrations.

Table 7 – Construction Vibration Criteria PPV

Structure Type	Site Control Criteria		Minimal Risk of Cosmetic Damage
	Warning Level	Halt Level	
Commercial buildings	20 mm/s	25 mm/s	25mm/s (4 Hz and above)
Residential buildings	8 mm/s	10 mm/s	7.5 mm/s to 10 mm/s (4 Hz to 15 Hz) 10 mm/s to 25 mm/s (15 Hz to 40 Hz)
Heritage Buildings	2.4 mm/s	3 mm/s	1.5 mm/s to 4 mm/s (4 Hz to 15 Hz) 4 mm/s to 5 mm/s (15 Hz to 40 Hz)

Table 8 – Construction Vibration Criteria rms values for Continuous and Impulsive Vibration Acceleration (m/s²) 1- 80 Hz

Location	Assessment Period	Preferred Values		Maximum values	
		z- Axis	x- and y- axis	z- Axis	x- and y- axis
Critical Areas	Day or Night Time	0.0050	0.0036	0.010	0.0072
Residences	Day time	0.010	0.0071	0.020	0.014
	Night Time	0.007	0.005	0.014	0.010

Based on the Heritage Significance and ornate building constrictions of the Lowy Institute building the vibration criteria specified for heritage buildings should be adopted for construction vibration impacts, as indicted in bold in the tables above.

In addition to the vibration criteria above a detailed methodology of the requirements in the event 'warning level' and/or 'halt level' is exceeded should be further developed, the current noise and vibration assessment are lacking in this area. The recommended methodology follows:

Warning Event - In the event that the warning levels are found to be of repetitive/cyclic nature (ie multiple events within a one minute period) the following method will be undertaken.

1. Determining the offending plant/equipment/process generating the warning levels.
2. Contact the Acoustic and Vibration consultant for advice regarding the potential for plant/activity to cause damage.
3. In the event it is advised that damage is possible plant/activity generating vibration will be stopped.
4. Conduct an assessment of potential mitigation methods to ensure vibration warning levels are generally not exceeded.
5. Implement mitigations.

Halt Event – For all stop work events the steps below will be followed.

1. Notify the neighbours of the event within an approved period.
2. Determining the offending plant/equipment/process generating the stop work levels and cease their operation.
3. Conduct an assessment of potential mitigation methods, with the aid of Acoustic and Vibration consultant, to ensure halt event levels are not exceeded.
4. Implement mitigations, this may include changing methods of work, moving equipment or the like.
5. Builder to notify affected party's and arrange inspection of relevant areas to determine if any damage has occurred.

3.2.3 Noise and Vibration Monitoring

Neither Environmental Assessment for Stage 2A(i) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D provide details of the required monitoring to be conducted during the construction period of the project. Noise and vibration monitoring will be an important requirement within the Lowy Institute building to ensure both the buildings protection from potential damage due to vibration as well as the assessment of noise impact on the amenity of occupants.

The noise and vibration impact assessment should provide a minimum requirement for the monitoring of noise and vibration within the Lowy Institute building. The recommended minimum monitoring requirements in our opinion should include the following:

1. A minimum of 3 noise monitors located as follow: one externally to the building and two internally at potentially worst affected locations as identified by the Lowy Institute.

Noise monitoring should be conducted for the entirety of the construction period or as agreed with the Lowy Institute building. Recorded noise levels should be reported on a agreed period, typically fortnightly.

2. A minimum of 3 vibration monitors located as follow: All three monitors located internally at potentially worst affected locations as identified by the Lowy Institute at locations which will represent impact from works. Monitors may be moved during various periods of the development to ensure the potentially worst vibration impacts are being monitored.

Vibration monitoring should be conducted for the entirety of the demolition and excavation period and no less than the period until the structure is complete above ground. Reporting of warning and halt levels should be conducted as detailed in the section above and on a agreed period, typically fortnightly.

In addition to the noise and vibration monitoring a register of complaints should be kept on sight and a suitable response methodology developed, which is lacking in the current noise and vibration assessment. The current noise and vibration impact statement is not suitable for the managing and registering of neighbours complaints.

The recommend methodology is detailed below:

1. A register of complaints received/communication with the local community shall be maintained with information as detailed below.
2. Where noise/vibration complaints require noise/vibration monitoring, results from monitoring shall be retained.
3. Any noise exceedences occurring including, the actions taken and results of follow up monitoring.
4. If a noise complaint is received the complaint should be recorded on a Complaint Form. The complaint form should list:
 - The name and address of the complainant (if provided).
 - The time and date the complaint was received.
 - The nature of the complaint and the time and date the noise was heard.
 - The name of the employee who received the complaint.
 - Actions taken to investigate the complaint, and a summary of the results of the investigation.
 - Indicate what operations were occurring on site at the time of the complaint.
 - Required remedial action, if required
 - Validation of the remedial action.
 - Summary of feedback to the complainant.

3.3 NOISE MANAGEMENT PLAN

The Environmental Assessment for Stage 2A(i) of the City (dated 2010) or the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D does not include a detailed construction noise and vibration management plan. Although general controls have been discussed a detailed management plan including all noise and vibration controls, proposed activities as well as noise and vibration monitoring locations and methodologies should be provided prior to a Construction Certificate being provided. The requirement of a detailed construction noise and vibration management plan should be a requirement of the conditions of consent as a minimum.

4. OPERATIONAL NOISE AND VIBRATION

Neither the Environmental Assessment for Stage 2A(i) of the City (dated 2010) or the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D include noise and vibration criteria for operational noise in the event the development is completed.

As the proposed Sydney City Grid Project is located in the Sydney CBD district it should be required to comply with the requirements of the City of Sydney Council Development Control Plan as well as the DECCW and Australian Standards requirements. The recommended minimum noise and vibration criteria for the control of the buildings operational noise and vibration follow:

The use of the premises should not give rise to any one or more of the following:

- a) Transmission of Vibration to any place of different occupancy greater than that specified in AS2670.
- b) An indoor sound pressure level in any place of different occupant (and/or public place) greater than 3 dB above the L_{90} background level in any octave band from 31.5 Hz to 8,000 Hz centre frequencies inclusive between the hours of 8am and 10pm daily and 0 dB above the L_{90} background between 10pm and 8am the following morning. However, when the L_{90} background level in frequencies below 63 Hz are equal or below the threshold of hearing, as specified by the equal loudness controls for octave bands of noise, this sub-clause does not apply to any such frequency.
- c) A sound level at any point on the boundary of the site greater than the background levels specified in the Australian Standard 1055, Acoustics – Description and Measurement of Environmental Noise.
- d) An "offensive noise" as detailed in the Noise control Act 1975.
- e) The method of the measurement of vibration in (a) and sound in (b), (c) and (d) must be carried out in accordance with AS2973 for vibration measurements and AS1055 for outdoor sound level measurements and AS2107 for indoor sound level measurements.

Providing operational noise and vibration levels impacting the Lowy Institute building as a result of operational noise from the proposed Sydney City Grid Project comply with the City of Sydney Council criteria detailed above a suitable amenity for occupants will be ensured.

5. CONCLUSION

Acoustic Logic Consultancy has been engaged to conduct a review of the noise and vibration impacts which will potentially impact on the Lowy Institute as a result of the proposed Sydney City Grid Project at 33 Bligh Street Sydney. This review has been conducted in conjunction with the Environmental Assessment for Stage 2A(I) of the City (dated 2010) and the Noise and Vibration Impact Assessment conducted by Wilkinson Murray version D.

This report details the review of the reports submitted and provided comments on the suitability or otherwise of the proposed criteria for the construction period and operational noise of the proposed project.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,

A handwritten signature in black ink that reads "B.G. White." The signature is written in a cursive, slightly slanted style.

ACOUSTIC LOGIC CONSULTANCY PTY LTD
Ben White