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## 1 INTRODUCTION

This report presents our noise and vibration assessment for the planning proposal of the mixed-use development at 4-6 Bligh Street, Sydney.

Major noise issues related to the proposed development are as follows:

- External noise intrusion into the proposed development.
- Noise emissions from the proposed restaurants, function areas and swimming pool in the development.
- Noise emissions from mechanical plant servicing the development.
- Future structure borne noise impacts on the site from train movements along the proposed Sydney Metro tunnel.
- Construction noise impacts on neighbouring buildings.

Vibration issues related to the proposed development are below:

- Vibration impacts on the site from train movements along the proposed Sydney Metro tunnel.
- Vibration generated by demolition/excavation/construction activities impacting neighbouring buildings.
- Vibration generated by demolition/excavation/construction activities impacting the proposed Sydney Metro rail tunnel.

Noise emission from the project site has been assessed in accordance with:

- NSW EPA Industrial Noise Policy.
- NSW Office of Liquor, Gaming and Racing (OLGR) requirements
- City of Sydney Council DCP 2012.

The noise assessment is based on the architectural drawings supplied by Architectus, titled "4-6 Bligh Street", dated 23/06/2017;

**Table 1 – Architectural Drawings List**

<b>Drawing Number</b>	<b>Drawing Title</b>	<b>Issue</b>
RD1001	Basement Level 04 Plan	5
RD1002	Basement Level 03 Plan	5
RD1003	Basement Level 02 Plan	5
RD1004	Basement Level 01 Plan	5
RD1006	Ground Level Plan	6
RD1007	Level 01 Plan (Commercial)	6
RD1008	Level 03-07 Plan (Typical Commercial)	6
RD1009	Level 8 Plan (Podium Gym)	6
RD1010	Level 9 Plan (Podium Gym/Pool)	3
RD1011	Level 10 Plan (Podium Roof/Hotel Lobby)	5
RD1012	Level 11 Plan (Podium Transfer/Plant)	5
RD1013	Typical Hotel Plan	5
RD1014	Level 30 Plan (Mid Plant Level)	6
RD1015	Level 50 Plan (Hotel Club Lounge)	4
RD1016	Level 51 Plan (Function)	5
RD1017	Level 52 Plan (Hotel Roof Terrace)	6
RD1018	Level 53 Plan (Hotel Roof Mezzanine)	6
RD1019	Level 54 Plan (Tower Roof Plant)	5
R2001	Section	5

## 2 SITE DESCRIPTION / PROPOSED DEVELOPMENT

The proposed development will be located at 4-6 Bligh Street, Sydney.

The Planning Proposal seeks to increase the maximum Floor Space Ratio (FSR) applicable to the site at 4-6 Bligh Street Sydney in the Sydney Local Environmental Plan (SLEP) 2012, from a base FSR of 8:1 plus bonuses, to a maximum FSR of 22:1 including bonuses. This would be facilitated through a site-specific SLEP clause which would allow for additional floor space if it is for the purpose of 'commercial premises' and 'hotel or motel accommodation'.

The accompanying indicative architectural scheme provides for a new mixed use hotel and commercial building with height of 55-storeys or 205 metres / RL 225.880, and FSR of 20.3:1. An additional floor space efficiency factor is to be allowed for during the design competition which will bring the maximum FSR to 22:1.

The indicative architectural scheme comprises:

- 10 storey podium, including hotel entrance lobby, commercial lift lobby, food and beverage facilities, plant, commercial offices, meeting/conference rooms, gym space, and landscaped podium with formal hotel lobby
- 37 storeys of hotel (each level including 11 rooms, with a total of 407 rooms)
- 4 levels at rooftop including hotel club lounge, function space, restaurant and bar, and publicly accessible landscaped terrace
- 4 basement levels including 17 car parking spaces, 2 loading spaces, plants, end of trip facilities and waste management facilities. The loading spaces will be located within the internal basement car park on basement level 1.

Roadways in the vicinity of the site are as follows:

- Bligh Street to the immediate west of the site, which carries medium volumes of traffic;
- Hunter Street located approximately 40m south of the site, which carries medium to high volumes of traffic;
- Chifley Square/Phillip Street located approximately 40m east of the site, which carries medium to high volumes of traffic; and
- Bent Street located approximately 90m north-east of the site, which carries medium to high volumes of traffic.

In addition, the proposed Sydney Metro Rail tunnel will be located near to the site. The exact location of the rail tunnel has not been finalised at this stage.

Refer to figure 1 below which is an aerial photo of the existing development.

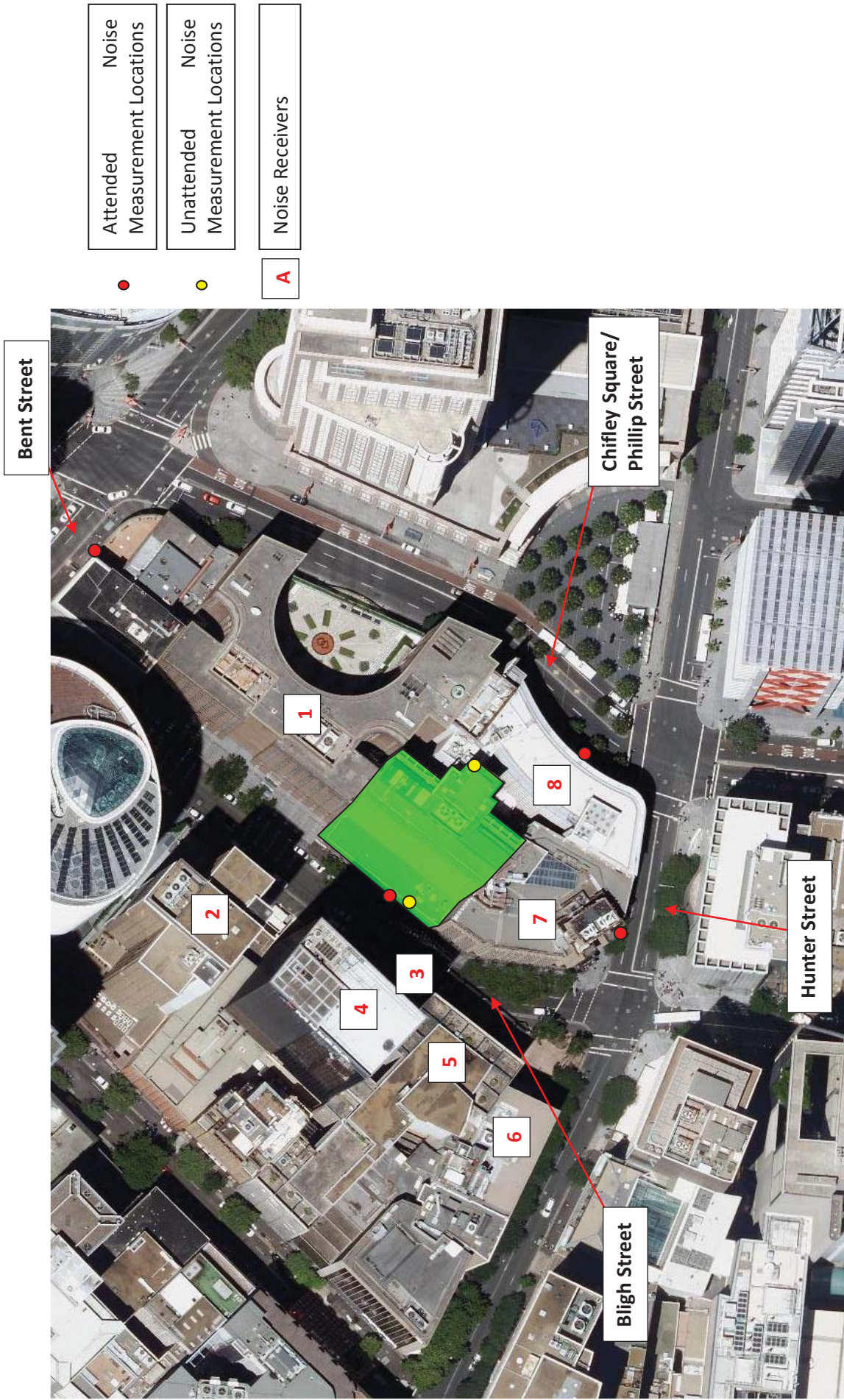


Figure 1 – Site Map

Site investigation indicates that the nearest noise receivers around the project site are below:

- Receiver 1 - Sofitel Sydney Wentworth Hotel located to the immediate east of the site at 61-101 Phillip Street, Sydney. This receiver has fixed glazing on the Bligh Street façade and operable glazing on the Phillip Street façade of the building. The operable glazing does not have line of sight to the project site.
- Receiver 2 - Multi-storey commercial building located to the north of the site across Bligh Street at 10 O'Connell Street. This receiver has fixed glazing facing project site.
- Receiver 3 - Four storey commercial building to the north-west of the site across Bligh Street at 31 Bligh Street. This receiver is a heritage-listed building and has operable glazing facing the project site.
- Receiver 4 - Multi-storey commercial building (Bligh Chambers) located to the north-west of the site across Bligh Street at 25 Bligh Street. This receiver has fixed glazing facing the project site.
- Receiver 5 - Proposed commercial development (currently under construction) located to the west of the site across Bligh Street.
- Receiver 6 - Multi-storey commercial building located to the south-west of the site across Bligh Street at 37 Bligh Street. This receiver has fixed glazing facing project site.
- Receiver 7 - Multi-storey commercial building located to immediate south-west of the site at 66 Hunter Street. This receiver has fixed glazing with line of sight to the project site.
- Receiver 8 - Multi-storey commercial building located to immediate south-east of the site at 1 Chifley Square. This receiver has fixed glazing facing the project site.

Refer to figure 1 above for an aerial photograph of the site.



### 3 NOISE DESCRIPTORS

Environmental noise constantly varies in level, due to fluctuations in traffic speed, vehicle types, road conditions and traffic densities. Accordingly, it is not possible to accurately determine prevailing traffic noise conditions by measuring a single, instantaneous noise level. To accurately determine the effects of traffic noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters. These parameters are used to measure how much annoyance would be caused by a particular noise source.

In the case of environmental noise, three principle measurement parameters are used, namely  $L_{10}$ ,  $L_{90}$  and  $L_{eq}$ .

The  $L_{10}$  and  $L_{90}$  measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement interval.

The  $L_{10}$  parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the  $L_{90}$  level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The  $L_{90}$  parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the  $L_{90}$  level.

The  $L_{eq}$  parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period.  $L_{eq}$  is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of traffic noise.

Current practice favours the  $L_{eq}$  parameter as a means of measuring traffic noise, whereas the  $L_{10}$  parameter has been used in the past and is still incorporated in some codes. For the reasons outlined above, the  $L_{90}$  parameter is not used to assess traffic noise intrusion.

The  $L_1$  parameter represents the noise level exceeded for 1% of the measurement period.

## 4 EXTERNAL NOISE INTRUSION ASSESSMENT

The primary external noise sources that will impact the proposed development will be traffic noise from the surrounding roadways and noise from mechanical plant servicing the surrounding buildings.

### 4.1 ASSESSMENT CRITERIA

The determination of an acceptable level of noise within the internal spaces of the development requires consideration of the activities carried out within the space and the degree to which noise will interfere with those activities.

This development will be assessed against the requirements of the City of Sydney Council Development Control Plan 2012 (DCP), the NSW Department of Planning's *Development Near Rail Corridors and Busy Roads (Interim Guideline)* and Australian Standard AS2107:2016.

#### 4.1.1 Sydney Development Control Plan 2012

Section 4.2 of the Sydney DCP 2012 relates to objectives and provisions for residential flat developments. Part 4.2.3.11 of this section of DCP 2012 outlines the following acoustic controls for new developments affected by traffic noise:

(7) *The repeatable maximum  $L_{Aeq(1hour)}$  for residential buildings and serviced apartments must not exceed the following levels:*

(a) *for closed windows and doors:*

- i) 35dB for bedrooms (10pm-7am); and*
- ii) 45dB for main living areas (24 hours).*

(b) *for open windows and doors:*

- i) 45dB for bedrooms (10pm-7am); and*
- ii) 55dB for main living areas (24 hours).*

(8) *Where natural ventilation of a room cannot be achieved, the repeatable maximum  $L_{Aeq(1hour)}$  level in a dwelling when doors and windows are shut and air conditioning is operating must not exceed:*

- (a) 38dB for bedrooms (10pm-7am); and*
- (b) 48dB for main living areas (24 hours).*

#### 4.1.2 NSW Department of Planning's 'Development Near Rail Corridors and Busy Roads (Interim Guideline)'

Section 3.5 of the NSW Department of Planning's 'Development Near Rail Corridors and Busy Roads (Interim Guideline)' states:

*"The following provides an overall summary of the assessment procedure to meet the requirements of clauses 87 and 102 of the Infrastructure SEPP. The procedure covers noise at developments for both Road and Rail.*

- *If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
  - *in any bedroom in the building: 35dB(A) at any time 10pm-7am*
  - *anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40dB(A) at any time."*

#### 4.1.3 Australian Standard AS2107:2016

Australian Standard AS2107:2016 "Recommended design sound levels and reverberation times for building interiors" stipulates the following internal noise criteria which are relevant for the proposed development:

**Table 2 – AS2107:2016**

<b>Type of occupancy/activity</b>	<b>Design Sound Level Range dB(A)<sub>L<sub>eq</sub></sub></b>
Hotels and motels in inner city areas – Sleeping Areas (night time)	35-40
Dining rooms (to be used for Function Room)	40-45
Foyers and recreation areas	45-50
Bars and lounges	< 50
Restaurants	40-50
Board and conference rooms	30-40
Executive office	35-40
General office areas	40-45
Meeting room	40-45
Sports & Clubs Building – Leisure centre and Gaming (for Gym)	40-50



#### 4.1.4 Summary of Criteria

This assessment shall be conducted in accordance with the most stringent criteria specified above, which is presented below:

**Table 3 – Internal Noise Level Criteria**

<b>LOCATION</b>	<b>TIME OF DAY</b>	<b>CRITERIA</b>
Hotel Rooms	Day (7am-10pm)	40 dB(A) <sub>Leq(1hour)</sub>
	Night (10pm-7am)	35 dB(A) <sub>Leq(1hour)</sub>
Dining rooms	Day (7am-10pm)	45 dB(A) <sub>Leq(1hour)</sub>
Hotel Function Room	Day (7am-10pm)	40 dB(A) <sub>Leq(1hour)</sub>
Foyers and recreation areas	Day (7am-10pm)	45 dB(A) <sub>Leq(1hour)</sub>
Bars and lounges	Day (7am-10pm)	50 dB(A) <sub>Leq(1hour)</sub>
Restaurants	Day (7am-10pm)	45 dB(A) <sub>Leq(1hour)</sub>
Board and conference rooms	Day (7am-10pm)	38 dB(A) <sub>Leq(1hour)</sub>
Executive office	Day (7am-10pm)	38 dB(A) <sub>Leq(1hour)</sub>
General office areas	Day (7am-10pm)	40 dB(A) <sub>Leq(1hour)</sub>
Meeting room	Day (7am-10pm)	40 dB(A) <sub>Leq(1hour)</sub>
Gym	Day (7am-10pm)	45 dB(A) <sub>Leq(1hour)</sub>

## 4.2 EXTERNAL NOISE MONITORING

### 4.2.1 Noise Monitoring

As part of this assessment, unattended noise monitoring and attended measurements were conducted in the vicinity of the project site to determine the external noise environment that will be impacting the proposed development. The results of these measurements will be used to determine the treatments required to reduce noise levels to the internal spaces of the project site.

### 4.2.2 Unattended Noise Measurements

Unattended noise measurements were obtained using two Acoustic Research Laboratories Pty Ltd noise loggers. The locations of the noise monitors were as follows:

**Logger 1:** This monitor was located on Level 3 balcony/podium level of 4-6 Bligh Street with the microphone facing Bligh Street. The monitor was on site from the 1<sup>st</sup> to the 8<sup>th</sup> June 2017.

**Logger 2:** This monitor was set up on the south-eastern corner of the level 18 rooftop of 4-6 Bligh Street. The microphone was had partial view of Hunter Street, Chifley Square/Phillip Street and Elizabeth Street. The monitor was on site from the 8<sup>th</sup> to the 16<sup>th</sup> June 2017.

The loggers were programmed to store 15-minute statistical noise levels throughout the monitoring period. The noise monitor was calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator. No significant drift was detected. All measurements were taken on A-weighted fast response mode. Refer to Appendices 1 and 2 for the unmanned noise monitoring data of the site.

### 4.2.3 Attended Measurement Locations

The unattended noise monitoring was supplemented by attended measured conducted around the project site.

Attended measurements were conducted at the following locations (refer to figure 1):

- Along Bligh Street, 4m from the kerb;
- Along Hunter Street, 4m from the kerb;
- Along Chifley Square/Phillip Street, 5m from the kerb; and
- Along Bent Street, 4m from the kerb.

Attended noise measurements were conducted on the 1<sup>st</sup> June 2017 between 8:00am and 9:30am. Measurements were undertaken using a Norsonics Type 140 precision sound level analyser, set to A-weighted fast response. The precision sound level analyser was calibrated before and after the measurements using a Norsonics 1251 sound level calibrator. No significant drift was recorded.

#### 4.2.4 Measured/Predicted Noise Levels

The following table presents the resultant noise levels at the proposed site location based on the attended and unattended noise measurements.

**Table 4 – Traffic Noise Levels at Proposed Site Location**

Location	Period	Noise Level
Western Façade (facing Bligh Street)	Day (7am – 10pm)	69dB(A) <sub>Leq (1 hour)</sub>
	Night (10pm – 7am)	67dB(A) <sub>Leq (1 hour)</sub>
Eastern Façade (facing Chifley Square/Phillip Street)	Day (7am – 10pm)	66dB(A) <sub>Leq (1 hour)</sub>
	Night (10pm – 7am)	64dB(A) <sub>Leq (1 hour)</sub>

#### 4.2.5 Methodology of External Noise Intrusion Assessment

External noise intrusion will primarily be as a result of noise transfer through the windows and doors, as these are relatively light building elements, which offer less resistance to the transmission of sound. Noise transfer through masonry external walls will not be significant and need not be considered further.

The constructions necessary to attenuate external noise impacts to levels complying with those detailed in section 4.1 above, are set out in section 4.3. The predicted noise levels have been based on the expected level and spectral characteristics of the external noise, the area of building elements exposed to traffic noise, the absorption characteristics of the rooms and the noise reduction performance of the building elements.

### 4.3 RECOMMENDED TREATMENTS

The treatments set out in this section will ensure compliance with the internal noise criteria from external noise impacts.

Calculations take into account the size and orientation of windows, facade transmission losses and room sound absorption characteristics.

#### 4.3.1 Recommended Glazing

The recommended glazing assemblies are outlined in the glazing mark-up presented in Appendix 3.

The proposed glazing thickness will satisfy all acoustic requirements. Thicker glazing may be required for structural, safety or other purposes. Where it is required to use thicker glazing than scheduled, this will also be acoustically acceptable.

**Note: glazing to be reviewed at CC stage based on construction drawings.**

In addition to meeting the minimum glazing thickness requirements given, the design of the window mullions, perimeter seals and the installation of the windows/doors in the building openings shall not reduce the STC/R<sub>w</sub> rating of the glazing assembly below the values nominated in the table above. All external windows and doors listed are required to be fitted with Q-Ion type acoustic seals. **Note that mohair of fin type seals will not be acceptable for the windows requiring acoustic seals.**

The window/door suppliers should provide evidence that the systems proposed have been tested in a registered laboratory with the recommended glass thicknesses and comply with the minimum listed STC/R<sub>w</sub> requirements. Also, the glazing installer should certify that the window/doors have been constructed and installed in a manner equivalent to the tested samples.

**Table 5 - Minimum STC/R<sub>w</sub> of Glazing (with Acoustic Seals)**

Glazing Assembly	Minimum STC/R <sub>w</sub> of Installed Window (with acoustic seals)
6.38mm laminated	31
10.38mm laminated	35
12.38mm laminated	37

#### 4.3.2 External Walls

For external walls of masonry construction, no acoustic upgrade is required. There should be no vents on the internal skin of external walls. All penetrations in the internal skin of external walls should be acoustically sealed. In the event lightweight external constructions are used, these are to be reviewed at CC stage.

### **4.3.3 Roof/Ceiling Construction**

The proposed concrete slab roof does not require any acoustic upgrade. Penetrations in ceilings (such as for light fittings etc.) must be sealed gap free with a flexible sealant. Any ventilation openings in the ceilings would need to be acoustically treated to maintain the acoustic performance of the ceiling construction.

### **4.3.4 External Doors**

Any glass doors should be constructed using glazing thickness set out in section 4.3.1. Full perimeter acoustic seals around the doors are required.

### **4.3.5 Ventilation and Air Conditioning**

As internal levels cannot be achieved with windows open, it is recommended that an alternative outside air supply system or air conditioning be installed to meet AS 1668.2 requirements.

Any mechanical ventilation system that is installed should be acoustically designed such that the acoustic performance of the recommended constructions is not reduced by any duct or pipe penetrating the wall/ceiling/roof.

Noise emitted to the property boundaries by any ventilation system shall comply with EPA or Local Council guidelines.

## 5 RAILWAY VIBRATION ASSESSMENT

The future Sydney Metro Rail tunnel will be located near the project site. The exact location of the rail tunnel has not been finalised at this stage.

Trains induce ground borne vibration that is transmitted through the subsoil. These vibrations can be perceptible close to railways, as tactile vibrations and as structure borne noise.

### 5.1 PROJECT VIBRATION OBJECTIVES

#### 5.1.1 Tactile Vibration

Human comfort is normally assessed with reference to the British Standard BS 7385 Part 2 1993 or Australian Standard AS 2670.2 1990.

The Interim Guideline references the EPA *Assessing Vibration- A technical guideline* which recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)".

British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" is recommended by the RIC's and SRA's Interim Guidelines for Councils "Consideration of rail noise and vibration in the planning process" as this standard includes guidance for the assessment of human response to building vibration including intermittent vibrations such as that caused by trains.

Human response to vibration has been shown to be biased at particular frequencies, which are related to the orientation of the person. This standard provides curves of equal annoyance for various orientations. These curves are applied as correction filters such that an overall weighted acceleration level is obtained. As the orientation of the resident is unknown or varying the weighting filter used is based on the combined base curve as given in ISO 2631 & Australian Standard 2670 "Evaluation of Human Exposure to Vibration and Shock in Buildings (1 to 80Hz)" which represents the worst case of the X, Y and Z axes. Filtered measurements are made in all three co-ordinate axes and the highest value axis used.

This standard assesses the annoyance of intermittent vibration by using the Vibration Dose Value (VDV). Alternatively the VDV may be estimated by the eVDV which is derived by a simpler calculation using an empirical factor. The VDV or eVDV is calculated for the two periods of the day being the "Daytime" (6am-10pm) and "Night time" (10pm-6am). The overall value is then compared to the levels in the table below. For this project the aim will be for a low probability of adverse comment.

**Table 6 - Vibration Dose Values ( $m/s^{1.75}$ ) above which various degrees of adverse comment may be expected in residential buildings.**

Place	Low Probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings 16hr day (Daytime)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8hr night (Night time)	0.13	0.26	0.51

### 5.1.2 Structure Borne Noise

The Department of Planning 'Development Near rail Corridors and Busy Road – Interim Guideline' only requires structure borne noise assessment to be conducted where buildings or adjacent lands are over railway tunnels. Section 3.6.2 of the standard states the following:

*"...Where buildings are constructed over or adjacent to land over tunnels, ground-born noise may be present without the normal masking effects of air born noise. In such cases, residential buildings should be designed so that the 95<sup>th</sup> percentile of train pass-bys complies with a ground-born L<sub>Amax</sub> noise limit of 40 dB(A) (daytime) and 35 dB(A) (night time) measured using the "slow" response time setting on a sound level meter.*

*The Interim Guidelines for the Assessment of Noise from Rail Infrastructure Projects (DECC 2007) provides further guidance on this issue."*

There is no documented rail structure borne noise level objectives for commercial buildings. Given this, structure-borne noise impacts from future train movements in the Metro tunnel on the commercial areas of the development will be formulated with reference to the Australian Standard AS2107:2000.

The rail induced structure borne noise criteria for the development are presented in the table below.

**Table 7 – Internal Structure Borne Noise Level Criteria (from Train Pass-bys in Future Sydney Metro Rail Tunnel)**

<b>Location</b>	<b>Structure Borne Noise Criteria dB(A)<sub>L<sub>Max, slow</sub></sub></b>
Ground Level – F & B Tenancy	40
Level 1- Commercial	40
Hotel Room	< 35, Inaudible

## **5.2 RECOMMENDATIONS**

Given that the exact location of the Metro Rail tunnel has not been finalised at this stage, it is not possible to determine the vibration impacts on the project site from rail movements. It is assumed that the new rail line of the Metro Rail will be vibration isolated from the rail tunnel structure.

A detailed assessment of vibration impacts on the project site from the operation of the future Metro Rail tunnel should be carried out once Sydney Trains have finalised the location of the rail tunnel and determined the vibration isolation treatment of the rail tracks.



## 6 NOISE EMISSION ASSESSMENT

Noise emissions from the site should be assessed to ensure that the amenity of nearby land users are not adversely affected.

Potential noise sources which should be assessed are:

- Noise generated by mechanical plant servicing the development;
- Noise from licensed premises located within the development (i.e. restaurant tenancies, hotel function room);
- Noise from the operation of the gym and swimming pool;
- Noise from the operation of the loading dock (located on basement level 1).

Noise emission criteria will be determined based on the following documents:

- City of Sydney Council DCP
- NSW EPA Industrial Noise Policy
- NSW Office of Liquor, Gaming and Racing (OLGR)

### 6.1 BACKGROUND NOISE MONITORING

Background noise levels for the site were determined using unattended noise loggers and attended measurements conducted around the project site.

Unattended noise measurements were obtained using two Acoustic Research Laboratories Pty Ltd noise loggers. The locations of the monitors are as follows:

**Logger 1:** This monitor was located on Level 3 balcony/podium level of 4-6 Bligh Street with the microphone facing Bligh Street. The monitor was on site from the 1<sup>st</sup> to the 8<sup>th</sup> June 2017.

**Logger 2:** This monitor was set up on the south-eastern corner of the level 18 rooftop of 4-6 Bligh Street. The microphone had a partial view of Hunter Street, Chifley Square/Phillip Street and Elizabeth Street. The monitor was on site from the 8<sup>th</sup> to the 16<sup>th</sup> June 2017.

The loggers were programmed to store 15-minute statistical noise levels throughout the monitoring period. The noise monitors were calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator. No significant drift was detected. All measurements were taken on A-weighted fast response mode. Noise levels measured during significant periods of adverse weather conditions were omitted from the calculated noise levels, see Section 4.3 below for a further discussion on weather affected data.

Unattended monitoring was used to determine representative background noise levels in the vicinity of the development as well as assisting in correlating the short term measurements to

ensure the period in which short term measurements were taken are representative of repeatable worst case conditions for a whole day. Appendices 1 and 2 summarise the data recorded.

## **6.2 ATTENDED NOISE MEASUREMENTS**

Attended noise measurements were undertaken to compliment the unattended noise monitoring on the 1<sup>st</sup> June 2017 between 8:00am and 9:30am. Measurements were conducted around the project site as detailed in section 4.2.3.

Measurements were undertaken using a Norsonics Type 140 precision sound level analyser, set to A-weighted fast response. The precision sound level analyser was calibrated before and after the measurements using a Norsonics 1251 sound level calibrator. No significant drift was recorded.

### 6.3 MEASURED EXISTING BACKGROUND NOISE LEVELS

Background noise data have been processed based on requirements of NSW EPA Industrial Noise Policy. The summarised rating background noise data is presented in the table below.

**Table 8 – Rating Background Noise Level**

Location	Period/Time	Representative Background Noise Level dB(A) L <sub>90</sub>
Level 3 Balcony/Podium Facing Bligh Street	Day (7am-8am)	64
	Day (8am-6pm)	64
	Evening(6pm-10pm)	63
	Night (10pm-7am)	60
	Night (10pm-Midnight)	62
	Night (Midnight-7am)	59
Level 18 Rooftop Facing Chifley Square/Phillip Street	Day (7am-8am)	63
	Day (8am-6pm)	63
	Evening (6pm-10pm)	62
	Night (10pm-7am)	58
	Night (10pm-Midnight)	61
	Night (Midnight-7am)	58

Manned background noise measurement results are summarised below.

**Table 9 – Manned Background Noise Measurement Results**

Location	31.5 Hz	63Hz	125Hz	250Hz	500Hz	1K Hz	2K Hz	4K Hz	8KHz	A-Weight
Bligh St	68	68	63	64	61	60	55	48	38	65
Hunter St	67	67	64	64	62	60	57	47	37	66
Chifley Sq	66	66	65	63	61	60	56	47	35	64
Bent St	71	71	67	63	62	60	56	48	38	66

### 6.3.1 Meteorological Conditions During Monitoring Period

Section 3.4 of the NSW Environment Protection Authority (EPA) Industrial Noise Policy document outlines the following with regards to meteorological impacts on noise monitoring:

*“Noise monitoring should not be conducted (or the data should be excluded) when average wind speeds (over 15-minute periods or shorter) at microphone height are greater than 5 m/s, or when rainfall occurs.”*

However, the same section of this policy also outlines that;

*“Exceptions to this rule are allowed, provided the proponent is able to show that the wind-induced noise on the microphone, and sound levels due to rain, are at least 10 dB below the noise levels (that is, background and/or ambient) under investigation.”*

Weather conditions during the monitoring period have been assessed and the periods of inclement weather are highlighted in the logging data in Appendices 1 and 2.

On review of the monitoring data, the measured  $L_{90}$  noise levels during high wind speed days generally do not increase background noise levels significantly as periods with little to no wind. This demonstrates that even though wind speeds measured at Observatory Hill exceed EPA guidelines, either:

- The wind speed on site at this time was significantly lower than at Observatory Hills (which is likely given Observatory Hills is located in a very exposed area) and/or
- The wind on site was not sufficiently consistent to increase background noise levels compared to calm periods.

Nevertheless, periods where it appears that adverse weather have affected the noise monitoring data have been eliminated when determining the rating background noise level at the site, which is presented in the section above.

## 6.4 NOISE EMISSION CRITERIA

Acoustic objectives will be based on;

- City of Sydney Council DCP
- The EPA Industrial Noise Policy
- NSW Office of Liquor, Gaming and Racing (OLGR).

### 6.4.1 City of Sydney Council DCP

The City of Sydney Council DCP does not have any quantitative noise emission criteria for residential or commercial development. Given this, noise emissions from the site will be formulated with reference to the NSW EPA Industrial Noise Policy and the NSW OLGR.

### 6.4.2 Noise from Mechanical Plant, Loading Dock and Gym – NSW EPA Industrial Noise Policy

The EPA Industrial Noise Policy has two criteria which need to be satisfied namely Intrusiveness and Amenity. These are described below:

- *Intrusiveness Criteria* - This guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the  $L_{eq}$  descriptor not exceed the background noise level by more than 5 dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.
- *Amenity Criteria* - This guideline is intended to limit the absolute noise level from all “industrial” noise sources such as mechanical plant to a level that is consistent with the general environment.

The EPA’s Industrial Noise Policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Noise levels are to be assessed at the property boundary or nearby dwelling, or at the balcony or façade of an apartment.

#### 6.4.2.1 Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the  $L_{eq}$  descriptor do not exceed the background noise level by more than 5dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

Background noise levels adopted are presented in section 6.1. Noise emissions from the site should comply with the noise levels presented below when measured at nearby property boundary.

**Table 10 – Intrusiveness Noise Emission Criteria**

<b>Location</b>	<b>Period/Time</b>	<b>Background Noise Level dB(A) <math>L_{90}</math></b>	<b>Intrusiveness Noise Emission Criteria dB(A) <math>L_{eq(15min)}</math> Background + 5dB</b>
Outside Hotel Windows of Sofitel Wentworth Sydney	Day (7am-6pm)	63	68
	Evening(6pm-10pm)	62	67
	Night(10pm-7am)	58	63

### 6.4.2.2 Amenity Criteria

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment.

The EPA Industrial noise policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface. This site is categorised by surrounding receivers as urban.

For the purposes of this condition:

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays;
- Evening is defined as the period from 6pm to 10pm.
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and public holidays.

**Table 11 - Amenity Noise Emission Goals**

Location	Period/Time	Amenity Noise Emission Criteria (Urban) dB(A) $L_{eq}(\text{Period})$
Nearby Residences (Sofitel Hotel Sydney, Receiver 1)	Day (7am-6pm)	60
	Evening(6pm-10pm)	50
	Night(10pm-7am)	45
Commercial Premises	When in use	65

### 6.4.2.3 Sleep Arousal Assessment (Peak Noise Events)

For noise generating activities that take place during the night time period (10pm-7am) an assessment of potential sleep disturbance should be carried out.

Short duration, intermittent noise events (such as vehicle engine start-ups, vehicle doors closing etc.) are typically assessed with reference to additional acoustic criteria specifically to assess potential sleep disturbance.

Potential impacts have been assessed using the recommended procedure in the Application Notes to the EPA Industrial Noise Policy. As recommended in the Application Notes, when assessing potential sleep arousal impacts, a two stage test is carried out:

- Step 1 - An “emergence” test is first carried out. That is, the  $L_1$  noise level of any specific noise source should not exceed the background noise level ( $L_{90}$ ) by more than 15 dB(A) outside a resident’s bedroom window between the hours of 10pm and 7am. If the noise events are within this, then sleep arousal impacts are unlikely and no further analysis is needed. This is consistent with the Noise Guide for Local Government. The guideline level is set out below.

**Table 5 – Sleep Arousal Criteria (“Emergence”/Background+15dB(A) Test)**

<b>Location</b>	<b>Background Noise Level (10pm-7am) dB(A)<math>L_{90}</math></b>	<b>Emergence Level Criteria dB(A) <math>L_{1(1min)}</math></b>
All Potentially Affected Residential Properties	58	73

- Step 2 - If there are noise events that could exceed the emergence level, then an assessment of sleep arousal impact is required to be carried out taking into account the level and frequency of noise events during the night, existing noise sources, etc. This test takes into account the noise level and number of occurrences of each event with the potential to create a noise disturbance. As is recommended in the explanatory notes of the EPA Industrial Noise Policy, this more detailed sleep arousal test is conducted using the guidelines in the EPA Road Noise Policy. Most relevantly, the Road Noise Policy states:

*For the research on sleep disturbance to date it can be concluded that:*

- *Maximum internal noise levels below 50-55dB(A) are unlikely to awaken people from sleep.*
- *One to two noise events per night with maximum internal noise levels of 65-70dB(A) are not likely to affect health and wellbeing significantly.*



### 6.4.3 Noise from Licensed Premises – NSW Office of Liquor, Gaming and Racing (OLGR)

Music/patron noise emissions from licensed premises within the development to the nearest residential receivers shall comply with the requirements of NSW OLGR as detailed below.

The OLGR provides guidelines for assessing noise emissions due to activity noise including people talking, functions and music. The guidelines are:

- *Before midnight, the L10 noise emissions should not exceed background noise level by more than 5 dB in the octave bands from 31.5Hz to 8k Hz at any residential premises.*
- *After midnight, the L10 noise emissions should not exceed background noise level in the octave bands from 31.5Hz to 8k Hz at any residential premises.*

*After midnight, noise emissions are to be inaudible within any residential premises*

Noise emission objectives have been summarised below based on the background noise data presented in section 6.3 and requirements above.

#### **Before Midnight**

**Table 12 –Noise Criteria before Midnight dB(A) L<sub>10</sub> (background + 5dB)**

Location	31.5 Hz	63Hz	125Hz	250Hz	500Hz	1K Hz	2K Hz	4K Hz	8KHz	A-Weight
Outside Openable Windows of R1 Facing Chifley Square	68	68	67	65	63	62	58	49	37	66

#### **After Midnight**

**Table 13 –Noise Criteria After Midnight dB(A) L<sub>10</sub> (background + 0dB)**

Location	31.5 Hz	63Hz	125Hz	250Hz	500Hz	1K Hz	2K Hz	4K Hz	8KHz	A-Weight
Outside Openable Windows of R1 Facing Chifley Square	60	60	59	57	55	54	50	41	28	58

## **6.5 NOISE EMISSION ASSESSMENT**

The main sources of noise generation from the operation of the development are as follows:

- Mechanical plant servicing the development.
- Licensed Premises (Ground Floor Restaurant, Hotel Function Space, Hotel Roof Restaurant and Terrace).
- Gym and Swimming Pool.
- Loading Dock (located on basement level 1).

### **6.5.1 Recommendations**

#### **6.5.1.1 Mechanical Plant Noise**

The cumulative level of noise emissions from normally operating mechanical plant in the development should comply with the established noise emission criteria.

A detailed assessment of noise emissions from mechanical plant items is not typically undertaken at DA stage because information about plant location, equipment sizing and selection, etc. is not available to enable a realistic appraisal to be carried out.

A detailed review of all external mechanical plant should be undertaken at construction certificate stage (once plant selections and locations are finalised). Acoustic treatments should be determined in order to control plant noise emissions to levels compliant with the requirements of the NSW EPA Industrial Noise Policy as set out in section 6.4.1.

#### **6.5.1.2 Licensed Premises**

The licensed premises associated with the proposed development (i.e. restaurant tenancies, restaurant terraces and the function space) should be subject to a separate development application once a tenant has been determined, and detailed operational information (such as operating hours, patron capacities, whether live bands are proposed etc.) are available.

Patron/music noise emissions from these licensed premises should be assessed in order to ensure that noise emissions comply with the requirements of the NSW OLGR (see section 6.4.3).

#### **6.5.1.3 Gym/Swimming Pool**

Similarly to the licensed premises, the proposed swimming pool should be subject to a separate development application once a tenant has been determined, and detailed operational information (such as operating hours, patron capacities, proposed gym equipment) are available.

Noise emissions from the gym and swimming pool should be assessed in order to ensure that noise emissions are compliant with the requirements of the NSW EPA Industrial Noise Policy as detailed in section 6.4.1.

#### **6.5.1.4 Loading Dock**

The main source of noise associated with the loading dock will be truck movements into and out of the loading dock. Noise emissions from the operation of the loading dock are to comply with the requirements of the NSW EPA Industrial Noise Policy as presented in section 6.4.2.

The loading dock will be located within the internal area of the basement level 1 car park. Given that the loading dock is located within an internal space, noise impacts from the use of the loading dock on the nearest receivers will be minimal and will comply with the requirements of the Industrial Noise Policy.

## 7 CONSTRUCTION NOISE IMPACT

This section of the report presents a preliminary assessment of construction noise impacts from the site.

### 7.1 CONSTRUCTION NOISE CRITERIA

Construction noise impacts from the site to the surrounding noise receivers will be assessed with reference to the following documents:

- NSW EPA Interim Construction Noise Guideline.
- Sydney City Council's "Code of Practice for Construction Hours/Noise within the Central Business District.
- Australian Standard AS2436-2000.

#### 7.1.1 Requirements of NSW EPA Interim Construction Noise Guideline

##### 7.1.1.1 Residential Receivers

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences (in this case the Sofitel Sydney Wentworth Hotel, receiver 1):

- *"Noise affected" level.* Where construction noise is predicted to exceed the "noise effected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise effected level". For residential properties, the "noise effected" level occurs when construction noise exceeds ambient levels by more than  $10\text{dB(A)}_{\text{Leq}(15\text{min})}$ .
- *"Highly noise affected level".* Where noise emissions are such that nearby properties are "highly noise affected", noise controls such as respite periods should be considered. For residential properties, the "highly noise effected" level occurs when construction noise exceeds  $75\text{dB(A)}_{\text{Leq}(15\text{min})}$  at nearby residences.

##### 7.1.1.2 Commercial Receivers

*Due to the broad range of sensitivities that commercial land can have to noise from construction, the process of defining management levels is separated into three categories. The external noise levels should be assessed at the most-affected occupied point of the premises:*

- *offices: external LAeq (15 min) 70 dB(A)*

### 7.1.2 Sydney City Council’s “Code of Practice for Construction Hours/Noise within the Central Business District”

The noise goals for demolition, excavation and construction activities on this project are aimed at minimising adverse impacts within the commercial or residential/hotel buildings. The noise goals adopted by the code of practice are outlined below:

**Table 14 – Construction Noise Criteria**

Day	Time Zone	Noise Criteria L <sub>10</sub> (15 minute)
Monday to Saturday	7am to 8am	Background Noise + 5
Monday to Friday	8am to 7pm	Background Noise + 10
Saturday	8am to 5pm	Background Noise + 10

The Code also mentions that the guidelines for control of construction noise as outlined in AS2436 shall be applied, where appropriate.

### 7.1.3 Australian Standard AS2436:2010 “Guide to Noise Control on Construction, Maintenance and Demolition Sites

The Australian Standard AS2436 states that where all reasonable and available measures have been taken to reduce construction noise, mitigation strategies may be put in place to reduce levels noise levels to within a reasonable and acceptable level.

For the control and regulation of noise from construction sites AS2436:2010 “*Guide to noise control on construction, maintenance and demolition sites*” nominates the following:

- a. That reasonable suitable noise criterion is established,
- b. That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes to locations of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours, and
- c. The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the demolition, excavation and construction site.

The guideline reflects on feasible and reasonable mitigation strategies, management controls and public liaising in an effort to reach realistic compromises between construction sites and potential noise affected receivers.

#### 7.1.4 Construction Noise Management Levels

Construction noise management levels applicable to the development have been determined based on the minimum background noise level recorded and the documents detailed above. Noise management levels for the construction periods of the site are detailed in the table below.

**Table 15 – Construction Noise Management Level to External Boundaries of Noise Receivers**

Receiver	Time of Day	Existing Background Noise Level dB(A) L <sub>A90</sub>	Construction Noise Management Level dB(A) L <sub>eq</sub>
1	Daytime (7:00am to 8:00am)	64	69
	Daytime (8.00am to 6.00pm)	64	74
2-7	Daytime (7:00am to 8:00am)	Assumed not in use	-
	Daytime (8.00am to 6.00pm)	64	74
8	Daytime (7:00am to 8:00am)	Assumed not in use	-
	Daytime (8.00am to 6.00pm)	63	73

## 7.2 CONSTRUCTION NOISE EMISSION ASSESSMENT

### 7.2.1 Source Noise Data

The A-weighted sound power levels for typical equipment/processes anticipated to be used during the construction of the project site are outlined in Table below.

**Table 16 – Sound Power Levels**

STAGE	EQUIPMENT /PROCESS	SOUND POWER LEVEL dB(A) <sub>L10(15min)</sub>
Demolition	Angle Grinder	114
	Excavator with Pneumatic Hammer	118
	Saw Cutter	114
	12t truck	100
	Bull Dozer	114
Excavation	Excavator with Pneumatic Hammer	118
Construction	Angle grinders	105
	Electric Saw	102
	Drill	95
	Hammering	110
	Air compressor	86
	Concrete Pump	105
	Concrete Vibrator	100
	Cement Mixing Truck	105
	Crane	105

The noise levels presented in the above table are derived from the following sources, namely:

- On-site measurements
- Table D2 of Australian Standard 2436-1981
- Data held by this office from other similar studies.

Typical noisy equipment have been measured and converted in Sound Power Level in spectrum as below:

**Table 17 – Measured Sound Power Level of Equipment**

<b>Frequency</b>	<b>63Hz</b>	<b>125 Hz</b>	<b>250 Hz</b>	<b>500 Hz</b>	<b>1K Hz</b>	<b>2K Hz</b>	<b>4K Hz</b>	<b>8K Hz</b>	<b>A Weight</b>
30 Ton Excavator with pneumatic hammer	114	111	112	116	114	109	105	92	118
CFA Piling	99	96	97	101	99	94	90	77	103
Bulldozer	110	107	108	112	110	105	101	88	114
Concrete Vibrator	85	92	106	97	90	86	82	78	100
Crane	90	97	111	102	95	91	87	83	105



### 7.3 NOISE EMISSION PREDICTION

Maximum noise impacts from the construction equipment listed above have been predicted to the nearest noise receivers and presented below.

**Table 18 – Predicted Construction Noise Levels (externally)**

Receiver	Predicted noise Level dB(A) <sub>Leq, 15min</sub>		
	Demolition	Excavation	Construction
1. Sofitel Wentworth Sydney Hotel to Immediate East	87	87	85
2. Commercial Building to North	80	80	72
3. Heritage-listed Commercial Building to North-West	85	85	79
4. Commercial Building (Bligh Chambers) to North-West	82	82	74
5. Future Commercial to West	82	82	74
6. Commercial Building to South-West	76	76	68
7. Commercial Building to Immediate South-West	87	87	85
8. Commercial Building to Immediate South-East	86	86	82

## 7.4 SPECIFIC NOISE EMISSION CONTROLS

Site specific recommendations as follows:

- Appropriate consultation with the immediate adjacent buildings is recommended; that is:
  - Receiver 1: Sofitel Wentworth Hotel located to the immediate east of the site at 61-101 Phillip Street;
  - Receiver 7: Multi-storey commercial building located to the immediate south-west of the site at 66 Hunter Street; and
  - Receiver 8: Multi-storey commercial building located to the immediate south-east of the site at 1 Chifley Square.
- Equipment shall be well maintained.
- Demolition: Stripping out of the internal areas of the structure should be carried out prior to removing the windows in order to contain noise within the building during the strip out process. The façade of the existing building shall be munched off.
- Vehicle Noise:

During demolition, excavation and construction stages the likely primary entry and exit point will be via Bathurst Street.

However, to minimise the impacts from vehicles on all receivers;

  - Truck movements should not commence prior to 7:00am.
  - Trucks and concrete trucks must turn off their engines during idling to reduce impacts on adjacent residential/commercial receivers (unless truck ignition needs to remain on during concrete pumping).
- It is recommended that at CC stage (once a construction program has been developed), a detailed construction noise management plan be prepared to identify any construction activities likely to result in exceedance of the EPA and Council guidelines, and provide noise mitigation strategies to minimise noise impacts.

## 8 CONSTRUCTION VIBRATION IMPACT

It is proposed to adopt the following vibration guidelines, namely:

- German Standard DIN 4150-3 (1999-02): “*Structural Vibration – Effects of Vibration on Structures*” – which will be used to assess and limit building damage risk.
- EPA Assessing Vibration a technical guideline – which contains guidelines to assess and limit impacts on building occupant’s amenity.
- NSW Government Transport for NSW Standard for *Miscellaneous Structures*.

Site investigation indicated that the nearest vibration sensitive receivers are below:

- Receiver 1: Sofitel Wentworth Hotel located to the immediate east of the site at 61-101 Phillip Street;
- Receiver 3: Four storey commercial building to the north-west of the site across Bligh Street at 31 Bligh Street. This receiver is a heritage-listed.
- Receiver 7: Multi-storey commercial building located to the immediate south-west of the site at 66 Hunter Street; and
- Receiver 8: Multi-storey commercial building located to the immediate south-east of the site at 1 Chifley Square.
- In addition, the Sydney Metro Rail Tunnel will be located in the vicinity of the project site, however the exact location of the tunnel has not been finalised at this stage.

## 8.1 CONSTRUCTION VIBRATION CRITERIA

The construction vibration criteria applicable to the nearest vibration sensitive receivers (R1, 3, 7 and 8) are presented below.

### 8.1.1 German Standard DIN 4150-3 (Building Damage Limit)

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 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 19 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration**

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

### 8.1.2 Amenity Criteria (Human Comfort)

Table 2.2 of EPA “Assessing Vibration: A technical guideline” specified the following vibration goal for human comfort:

**Table 20 – Preferred and Maximum Weighted RMS values Vibration Acceleration (m/s<sup>2</sup>) 1-80 Hz**

Location	Assessment Period	Preferred Values Z-axis	Preferred Values X & Y-axis	Maximum Values Z-axis	Maximum Values X & Y-axis
Continuous Vibration					
Residences	Day time	0.010	0.0071	0.020	0.014
Office	Day time	0.020	0.014	0.040	0.028
Impulsive Vibration					
Residence	Day time	0.3	0.21	0.6	0.42
Office	Day time	0.64	0.46	1.28	0.92

Acceptable values for intermittent vibration shall comply with the requirements in Table 2.4 of EPA “Assessing Vibration: A technical guideline” detailed as below.

**Table 21 - Acceptable Vibration Dose Values for Intermittent Vibration (m/s<sup>1.75</sup>)**

Location	Day time preferred value	Day time maximum value
Residences	0.20	0.40
Office	0.40	0.80

### 8.1.3 Vibration Impacts on Rail Corridors/Tunnels (to Sydney Metro Tunnel)

Construction vibration criteria for vibration impacts on the Sydney Metro rail tunnel will be established with reference to the NSW Government’s *Standard for Miscellaneous Structures*. Section 5.2 of the standard outlines the following criteria for vibration impacts on rail tunnels:

#### “5.2 Structures over or adjacent to tunnels

*During construction works, the maximum peak particle velocity (PPV) in the tunnel lining shall not exceed 12.5 mm per second. ‘Traffic light’ management of vibration to the tunnel lining shall be implemented with the following values:*

- *Amber: PPV 6.5 mm/s to 12.5 mm/s – continue with caution and reassess methods*
- *Red: PPV greater than 12.5 mm/s – stop work and find alternative methods”*

#### 8.1.4 Recommended Vibration Limits

The table below presents a summary of the recommended vibration limit criteria at the nearest sensitive receivers.

**Table 22 – Recommended Vibration Limit**

<b>Vibration Receiver</b>	<b>Recommended Vibration Limits PPV (mm/s)</b>
Receiver 1: Sofitel Sydney Wentworth to Immediate East	$\leq 5\text{mm/s PPV}$
Receiver 3: Heritage-listed Commercial Building to North-West	$\leq 3\text{mm/s PPV}$
Receiver 7: Commercial Building to Immediate South-West & Receiver 8: Commercial Building to Immediate South-East	$\leq 20\text{mm/s PPV}$
Future Sydney Metro Rail Tunnel	$\leq 6.5\text{mm/s PPV}$

## 8.2 VIBRATION SAFETY GUARD SYSTEM

Proposed activities that have the potential to produce significant ground vibration include:

- Demolition
- Excavation and anchoring.
- Hydraulic hammering.

### 8.2.1 Safeguards to Protect Sensitive Structures

It is impossible to predict the vibrations induced by the demolition/excavation/construction operations on site at potentially affected receivers. This is because vibration level is principally proportional to the energy impact which is unknown nature of terrain in the area (type if soil), drop weight, height etc.

An acoustic consultant should undertake monitoring of initial demolition/excavation /construction processes when conducted near potentially affected receivers to ensure that vibration criteria set out in section 8.1 are not exceeded.

### **8.2.2 Vibration Monitoring**

The proposed vibration monitoring equipment will consist of Blastronics type monitors with externally mounted geophones. It is recommended that the vibration monitors be installed at the following locations:

- Location 1 – Eastern boundary of the project site with geophone mounted against the wall or floor close to Sofitel Sydney Wentworth building (receiver 1).
- Location 2 – Along the south-eastern façade at ground level of the heritage-listed building at 31 Bligh Street (receiver 3).
- Location 3 – Western boundary of the project site with geophone mounted against the wall or floor close to commercial building at 66 Hunter Street (receiver 7).
- Location 4 – Southern boundary of the project site with geophone mounted against the wall or floor close to commercial building at 1 Chifley Square (receiver 8).
- Location 5 – When possible, within the Sydney Metro Rail Tunnel at the point nearest to the project site.

The monitors are proposed to be fitted with GSM modem and audible alarms for vibration exceedance. In addition, the vibration loggers will be down loaded remotely using the GSM modem. The geophone location will be moved following the detailed demolition/excavation/construction programme.

### **8.2.3 Downloading of Vibration Monitor**

Downloading of the vibration logger will be conducted on a regular basis. In the event exceedance of vibration criteria or alarms occurs, downloading of logger will be conducted more frequently. Results obtained from the vibration monitor will be presented in a graph format and will be forwarded to the project manager for review. It is proposed that reports are provided fortnightly with any exceedance in the vibration criteria reported as detailed in this report.

### **8.2.4 Presentation of Vibration Logger Results**

A fortnightly report will be submitted to project manager via email summarising the vibration events. The vibration exceedance of limit is recorded the report shall be submitted within 24 hours. Complete results of the continuous vibration logging will be presented in fortnight reports including graphs of collected data.

### **8.2.5 Persons to Receive Alarms**

The following personnel will receive GSM alarms:

- Acoustic consultant/advisor (1 person)
- Demolition/excavation/construction site foreman
- Main builder foreman (where applicable)

## 9 CONCLUSION

This report has presented our acoustic assessment for the proposed mixed-use development at 4-6 Bligh Street, Sydney have been assessed. Findings are summarised below.

- External noise intrusion into the proposed development have been assessed with reference to the City of Sydney Council DCP 2012, the NSW Department of Planning's 'Development Near Rail Corridors and Busy Roads (Interim Guideline)' and Australian Standard AS2107:2016. The acoustic treatments in principle necessary to achieve the internal noise criteria have been set out in section 4.3 of this report.
- Criteria for vibration impacts on the project site from the future Sydney Metro rail tunnel have been formulated based on EPA/NSW Planning guidelines and British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)" (see section 5.1). A detailed assessment of vibration impacts on the project site from the future Metro Rail tunnel should be carried out once Sydney Trains have finalised the location of the rail tunnel and determined the vibration isolation treatment of the rail tracks.
- External noise emission criteria for all noise generating operations associated with the proposed development (namely mechanical plant, licensed premises and swimming pool) have been formulated with reference to the City of Sydney Council DCP, the NSW EPA Industrial Noise Policy and NSW OLGR and are presented in section 6.4.
- A preliminary assessment of construction noise emissions has been carried out. Indicative recommendations to minimise noise impacts have been presented in section 7.4 of this report.
- Construction vibration criteria have been setup in this report based on requirements of DIN 4150, the EPA Assessing Vibration a technical guideline and the NSW Government's Transport for NSW Standard for Miscellaneous Structures. Vibration monitoring system has been recommended to ensure that the vibration sensitive receivers around the project site are safely guarded.

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

Yours faithfully,



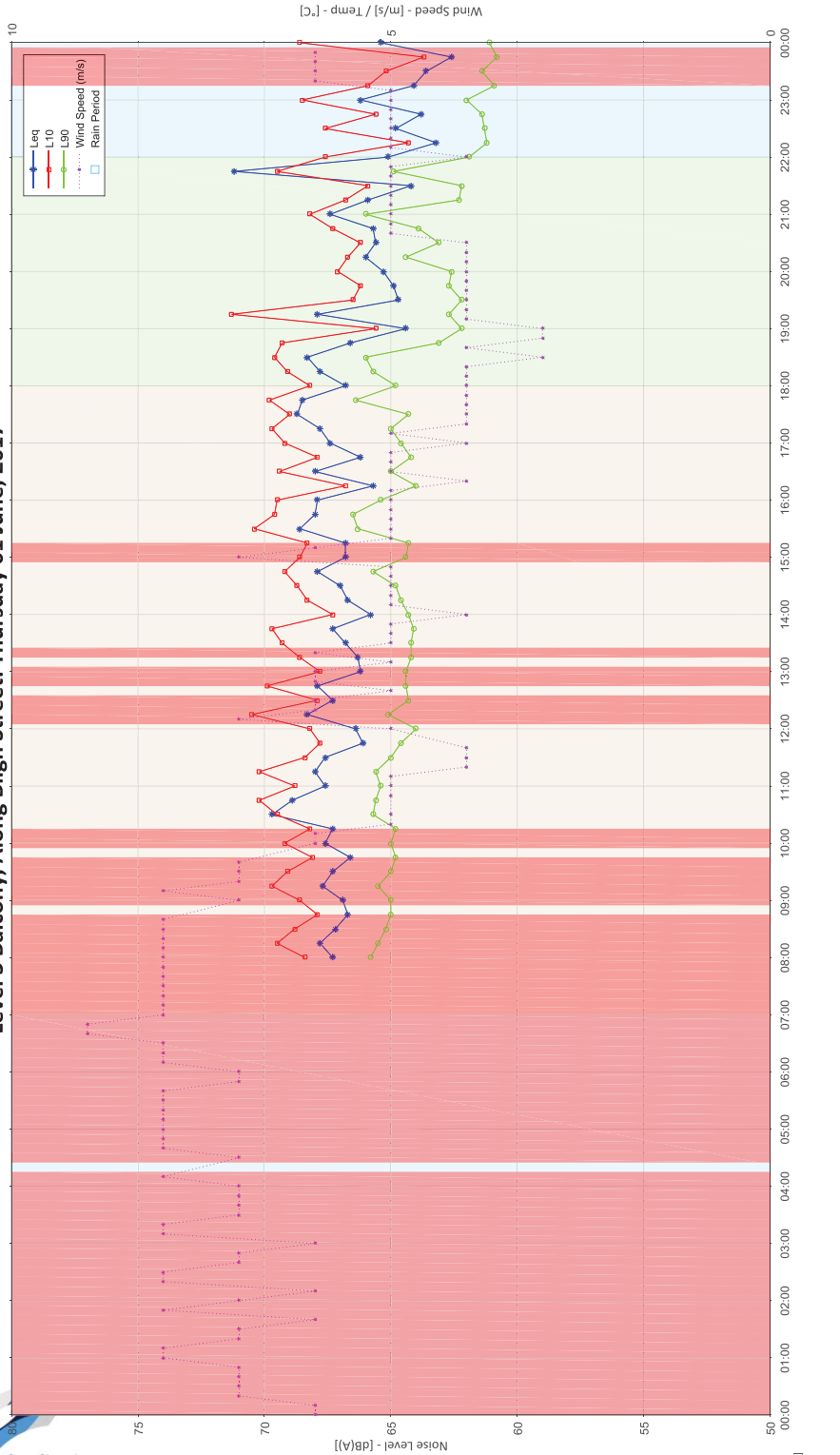
Acoustic Logic Consultancy Pty Ltd  
Justin Leong

Project Engineer



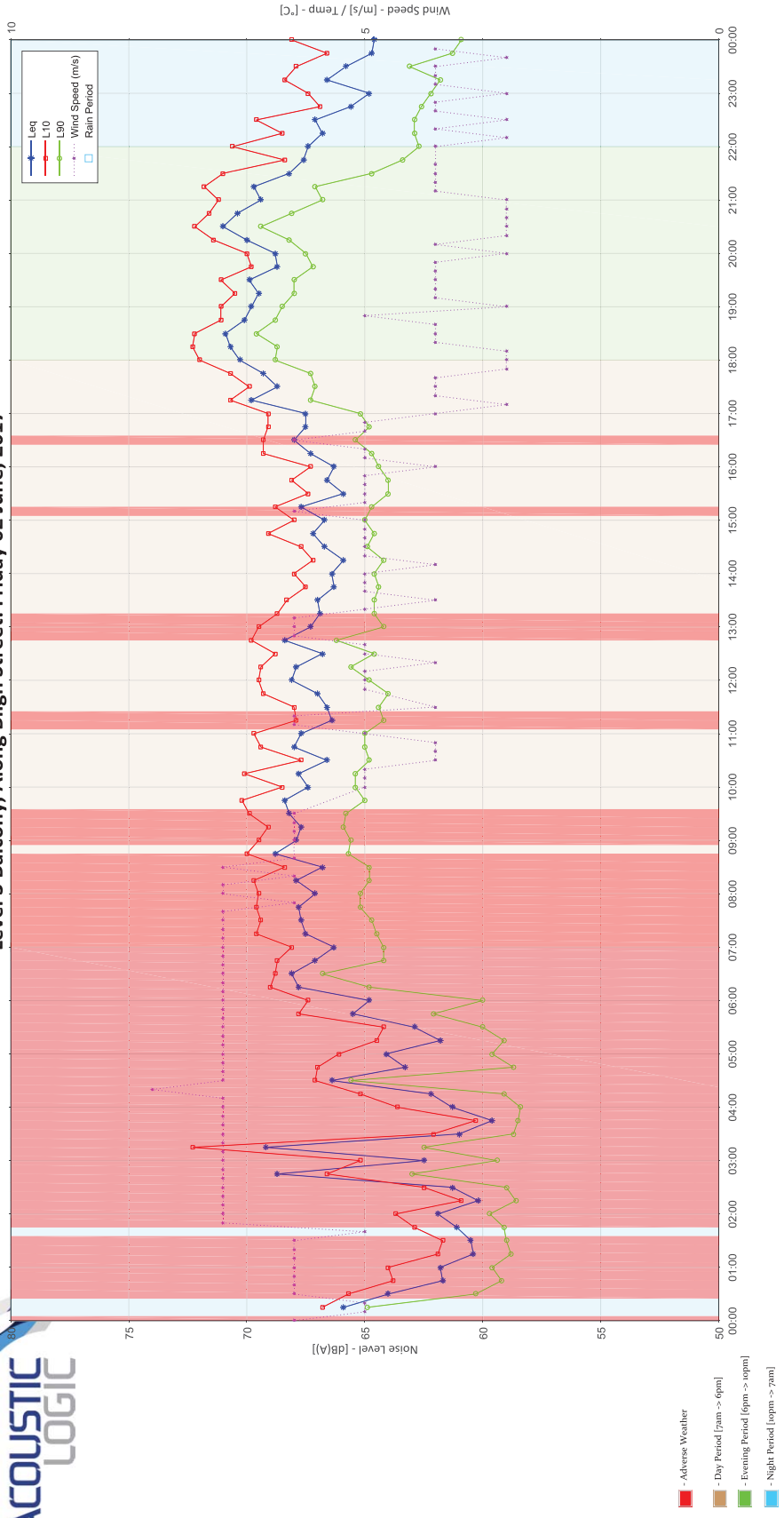
**APPENDIX 1- NOISE MONITOR ALONG BLIGH STREET (LEVEL 3  
BALCONY/PODIUM)**

### Level 3 Balcony, Along Bligh Street: Thursday 01 June, 2017



- - Adverse Weather
- - Day Period (7am -> 6pm)
- - Evening Period (6pm -> 10pm)
- - Night Period (10pm -> 7am)

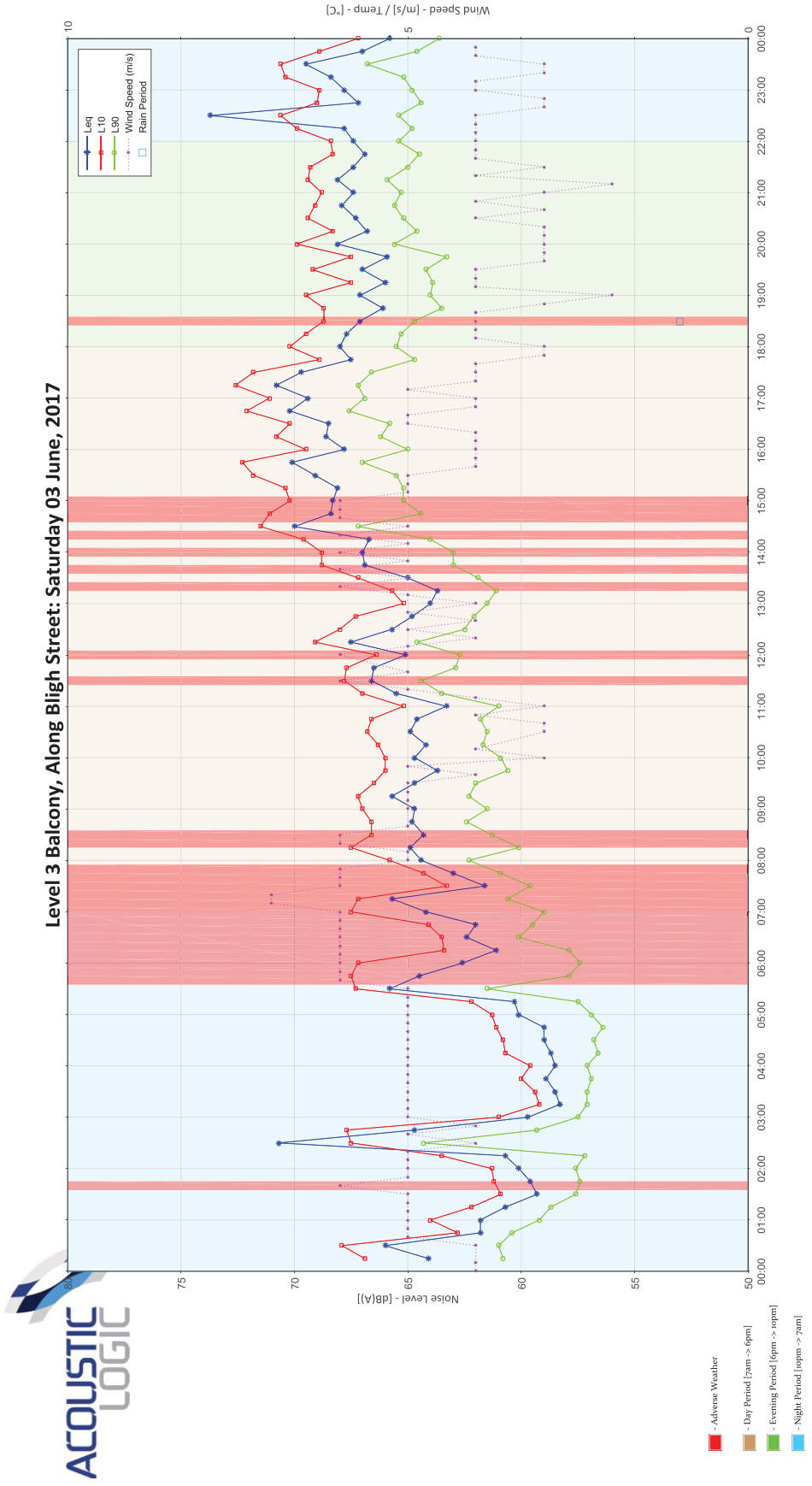
### Level 3 Balcony, Along Bligh Street: Friday 02 June, 2017



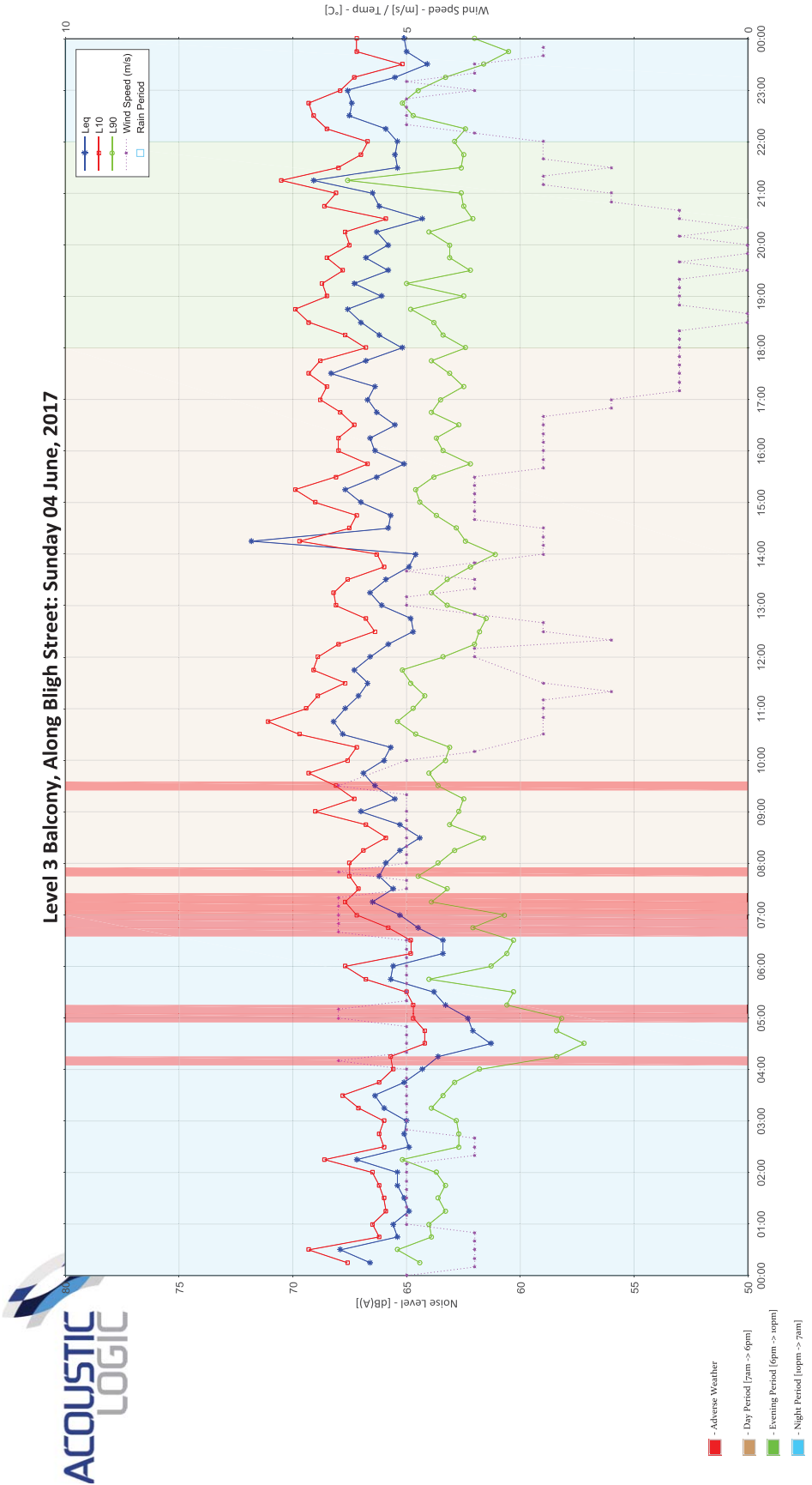
- Adverse Weather
- Day Period (7am -> 6pm)
- Evening Period (6pm -> 10pm)
- Night Period (10pm -> 7am)

- Leq
- L10
- L90
- Wind Speed (m/s)
- Rain Period

# Level 3 Balcony, Along Bligh Street: Saturday 03 June, 2017

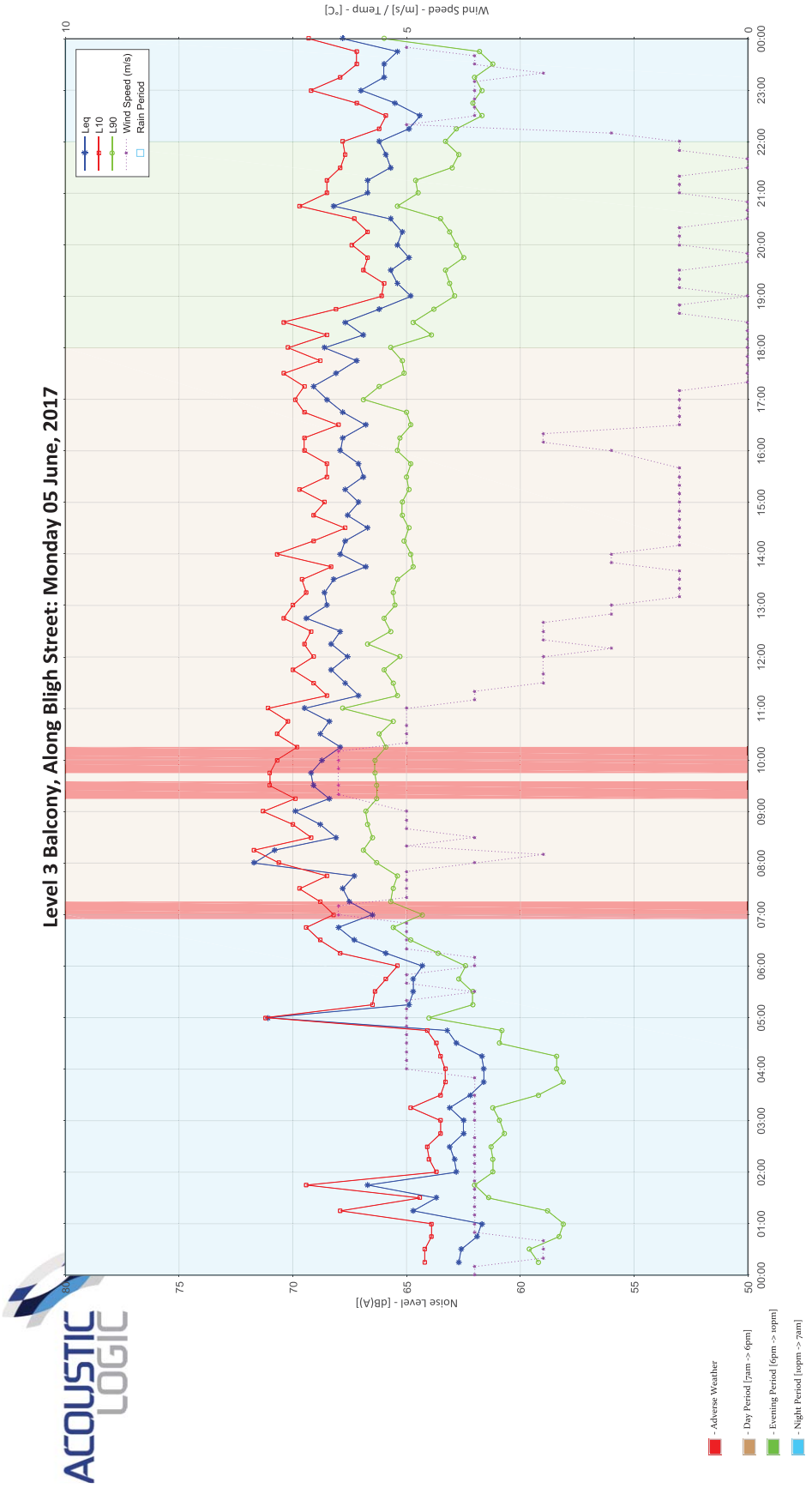


# Level 3 Balcony, Along Bligh Street: Sunday 04 June, 2017

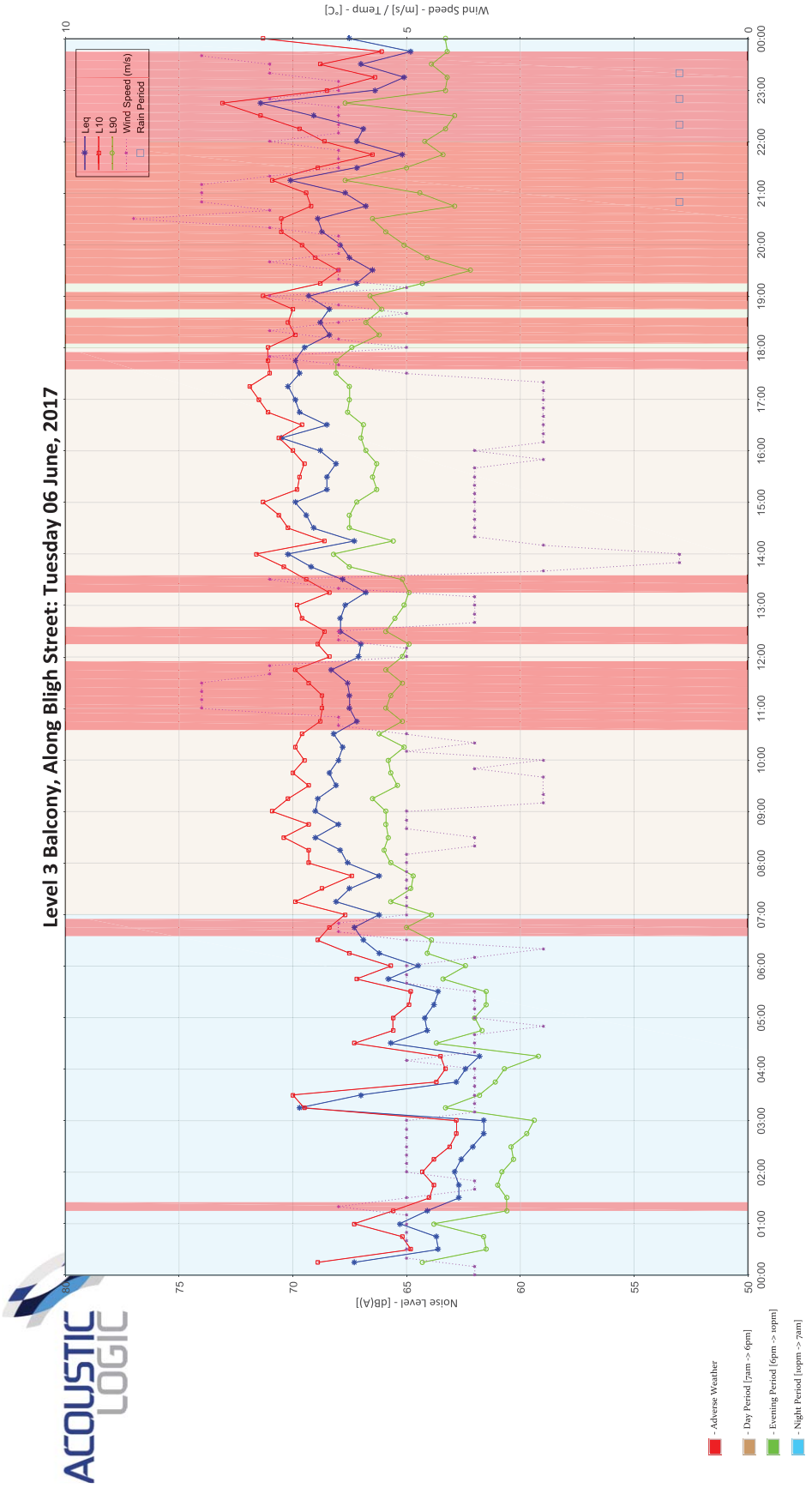


- - Adverse Weather
- - Day Period (7am -> 6pm)
- - Evening Period (6pm -> 10pm)
- - Night Period (10pm -> 7am)

# Level 3 Balcony, Along Bligh Street: Monday 05 June, 2017

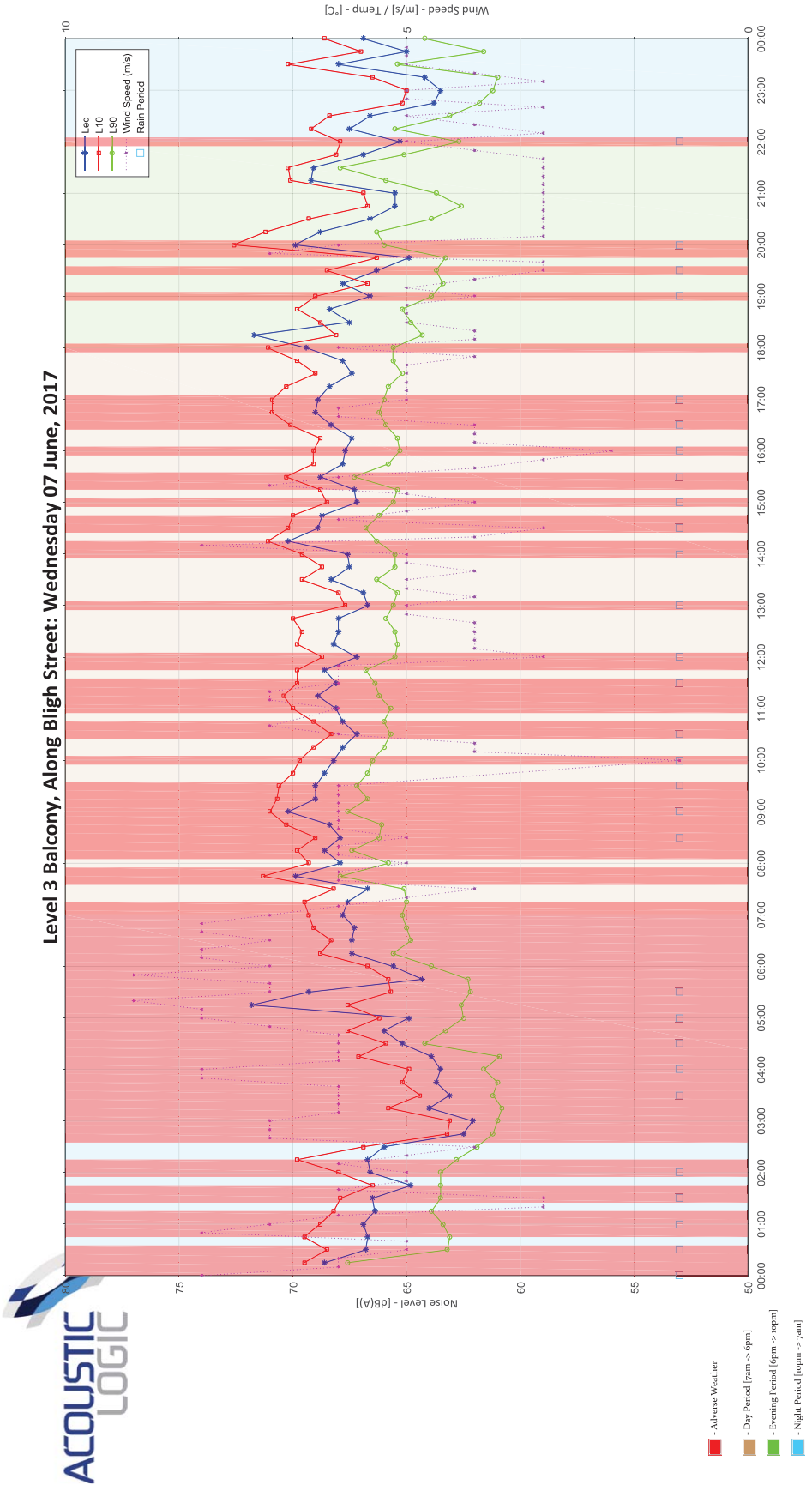


# Level 3 Balcony, Along Bligh Street: Tuesday 06 June, 2017



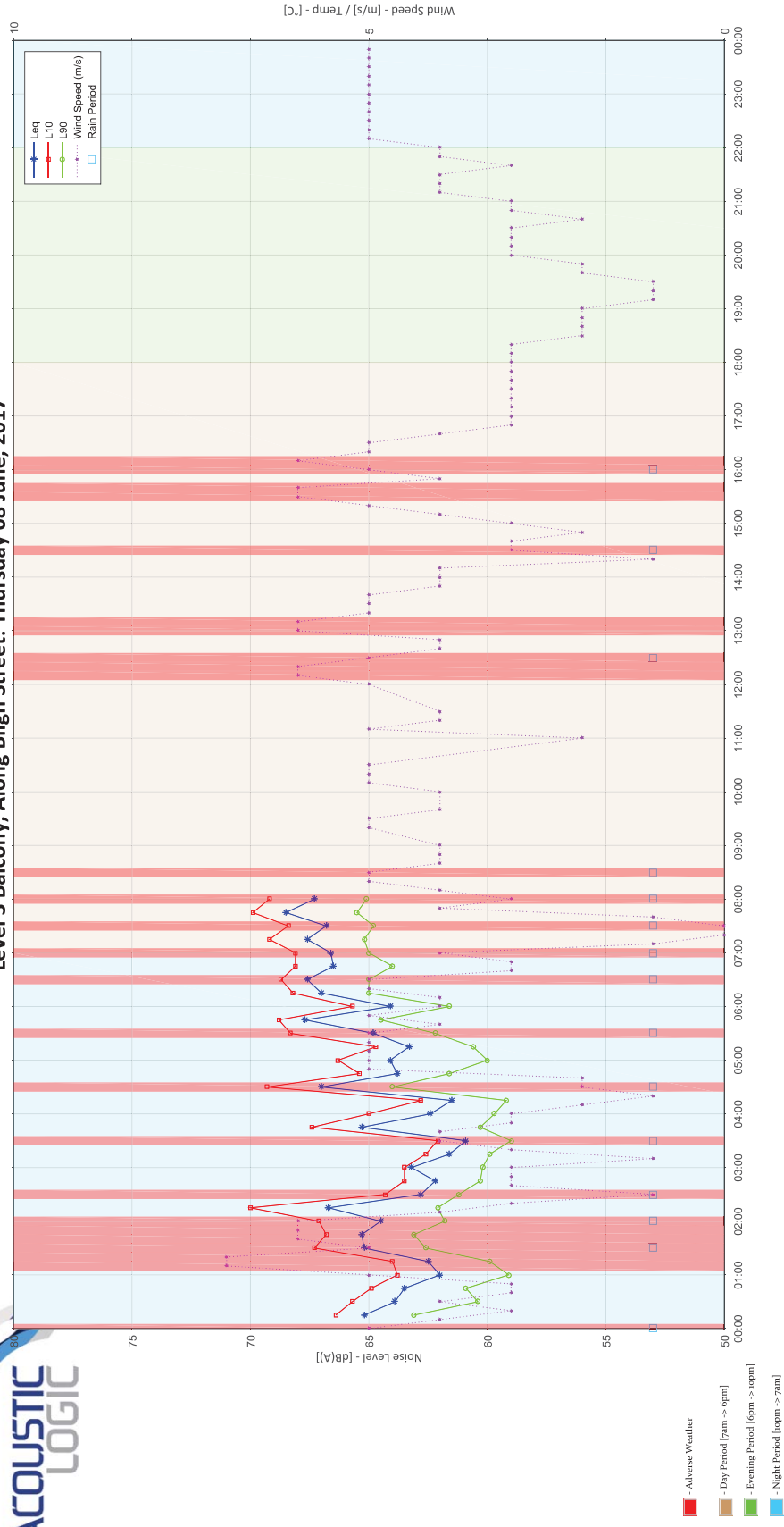
- - Adverse Weather
- - Day Period (7am -> 6pm)
- - Evening Period (6pm -> 10pm)
- - Night Period (10pm -> 7am)

# Level 3 Balcony, Along Bligh Street: Wednesday 07 June, 2017



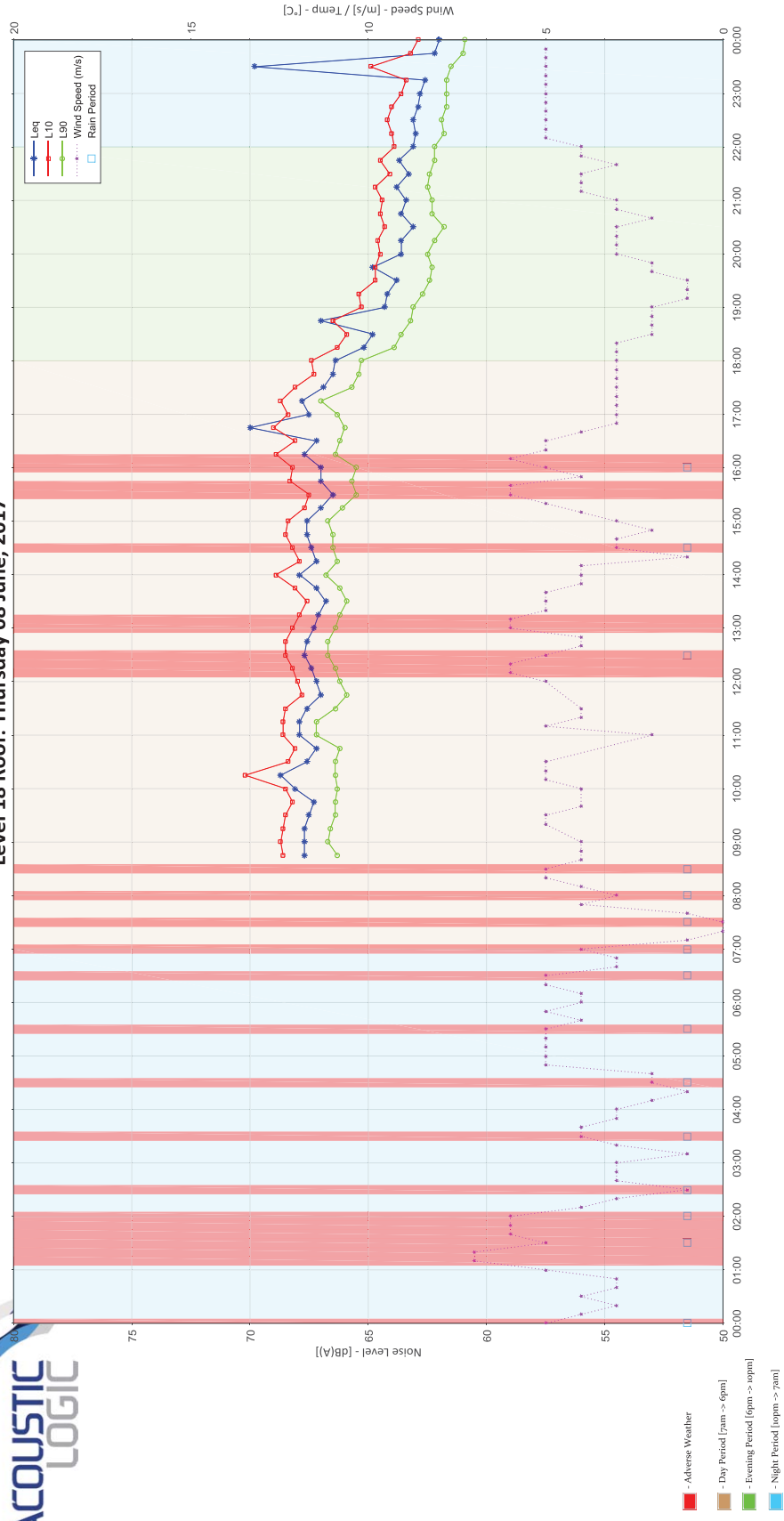


### Level 3 Balcony, Along Bligh Street: Thursday 08 June, 2017

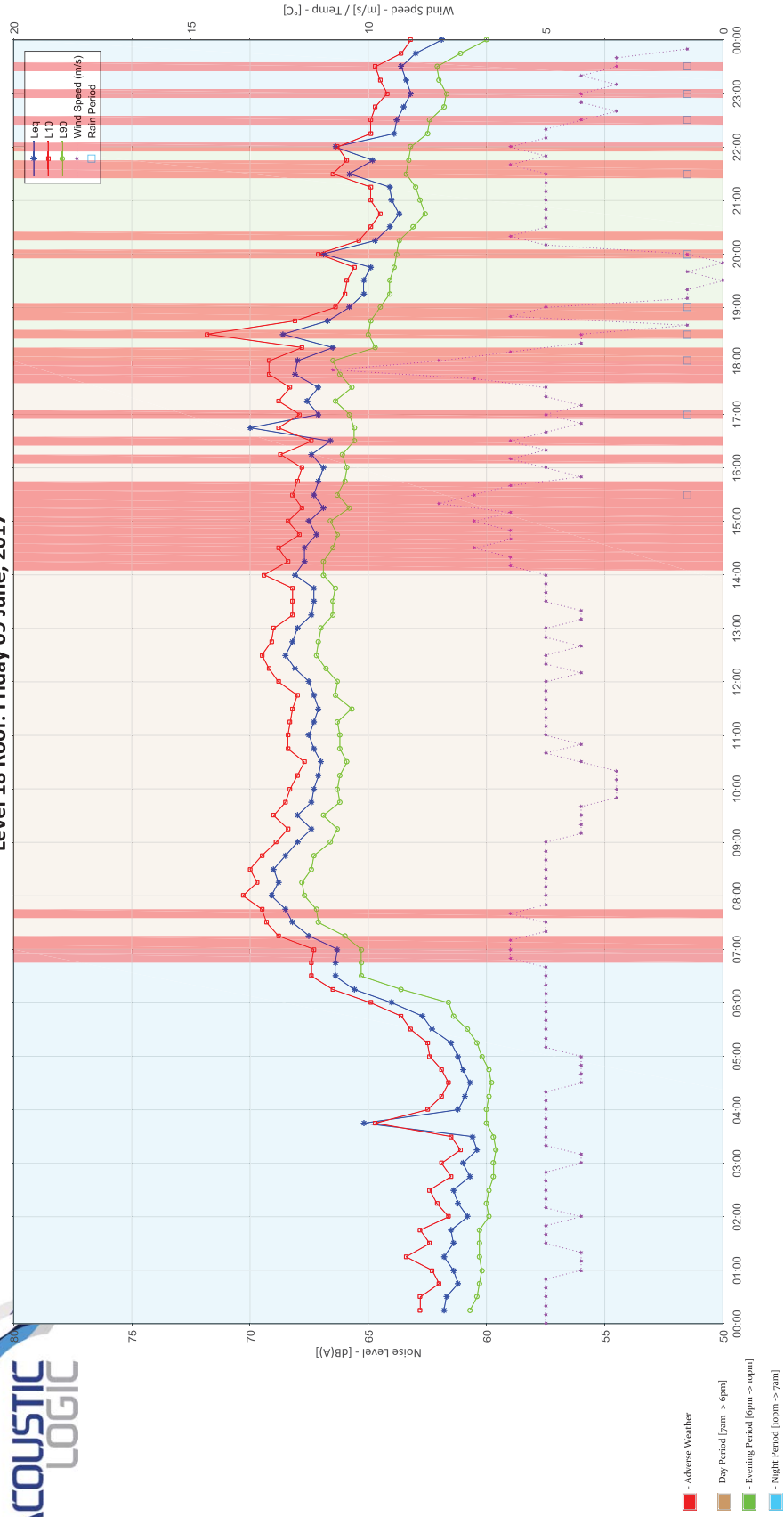


**APPENDIX 2- NOISE MONITOR FACING CHIFLEY SQUARE/PHILLIP STREET  
(LEVEL 18 ROOF)**

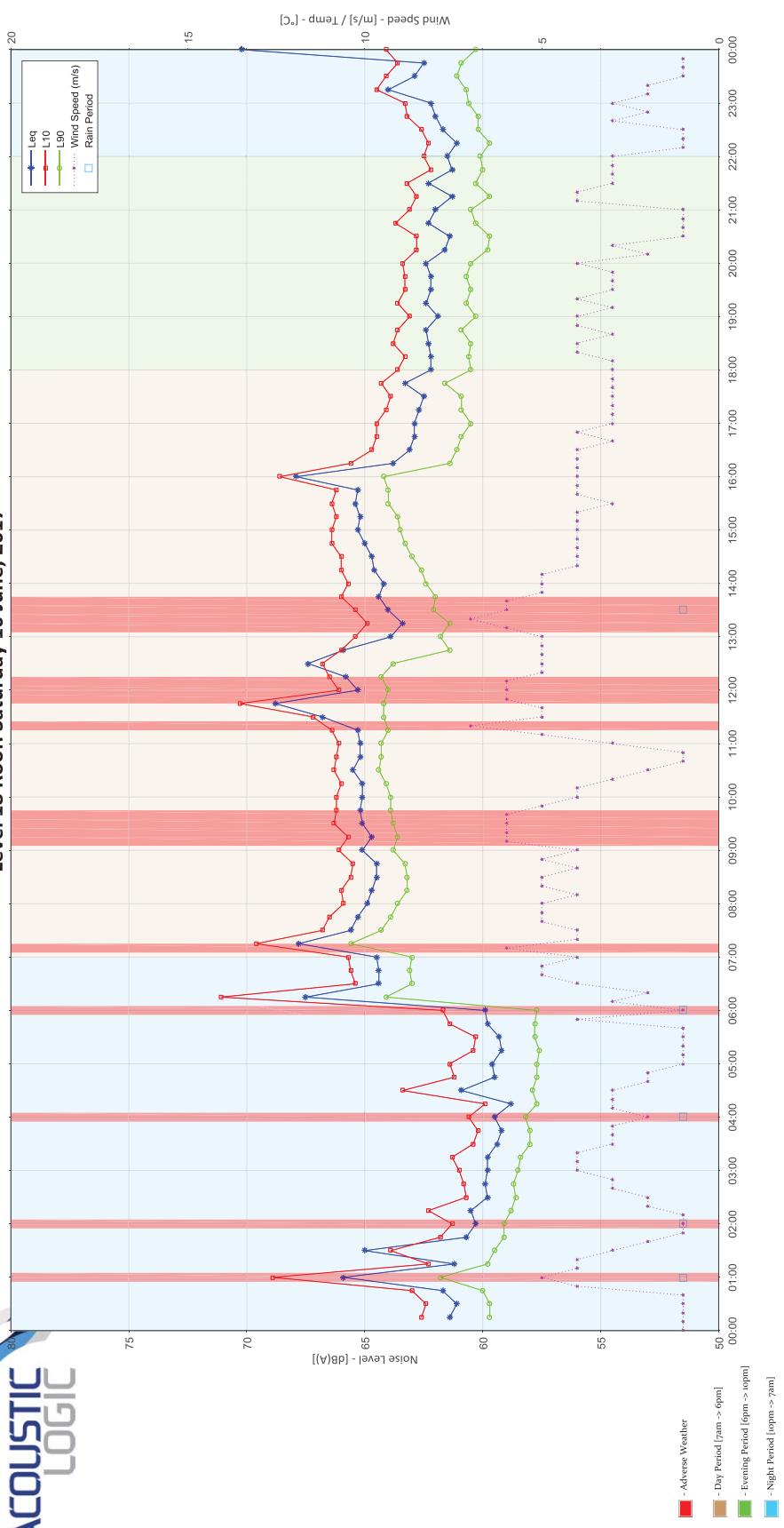
### Level 18 Roof: Thursday 08 June, 2017



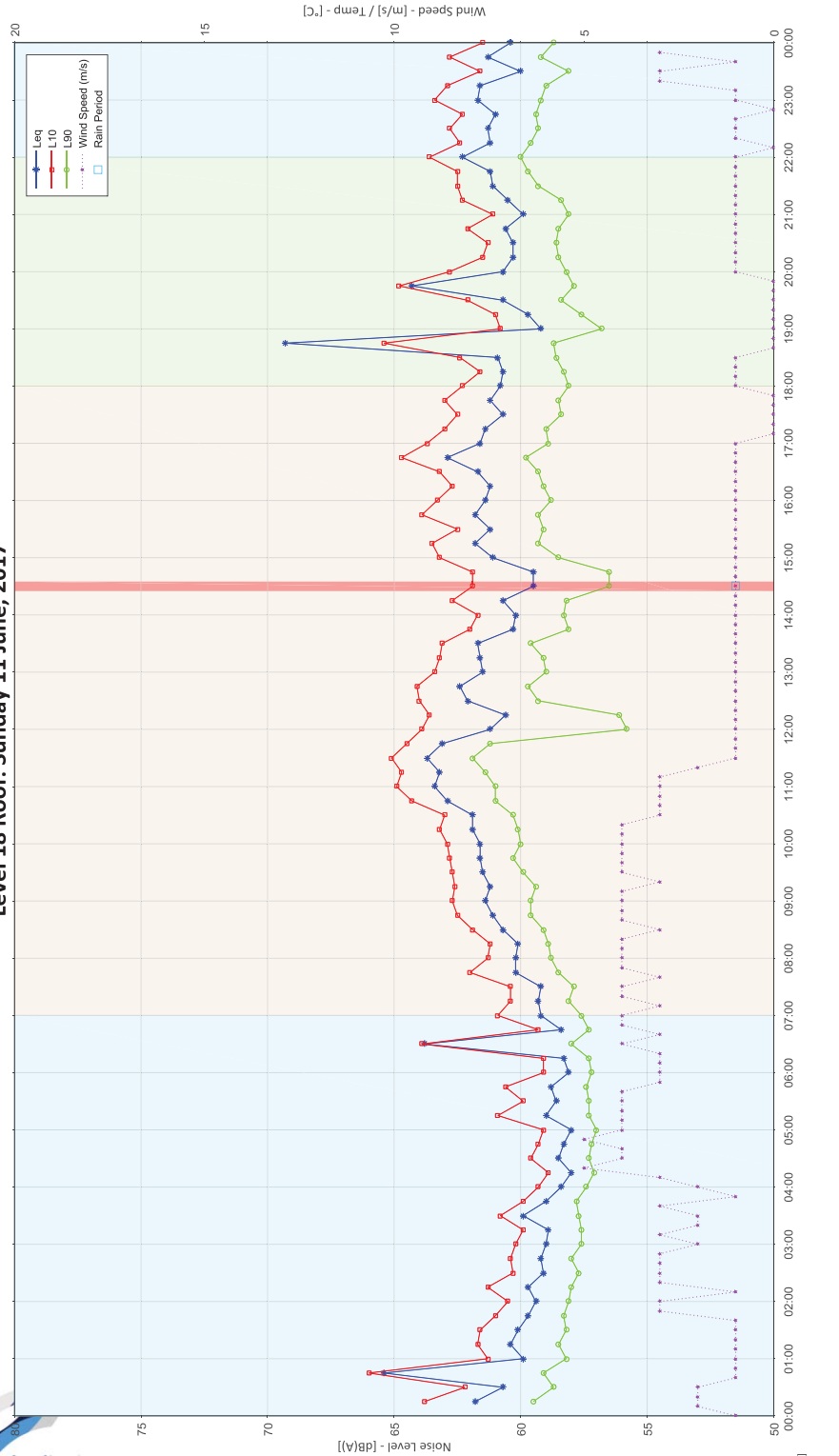
### Level 18 Roof: Friday 09 June, 2017



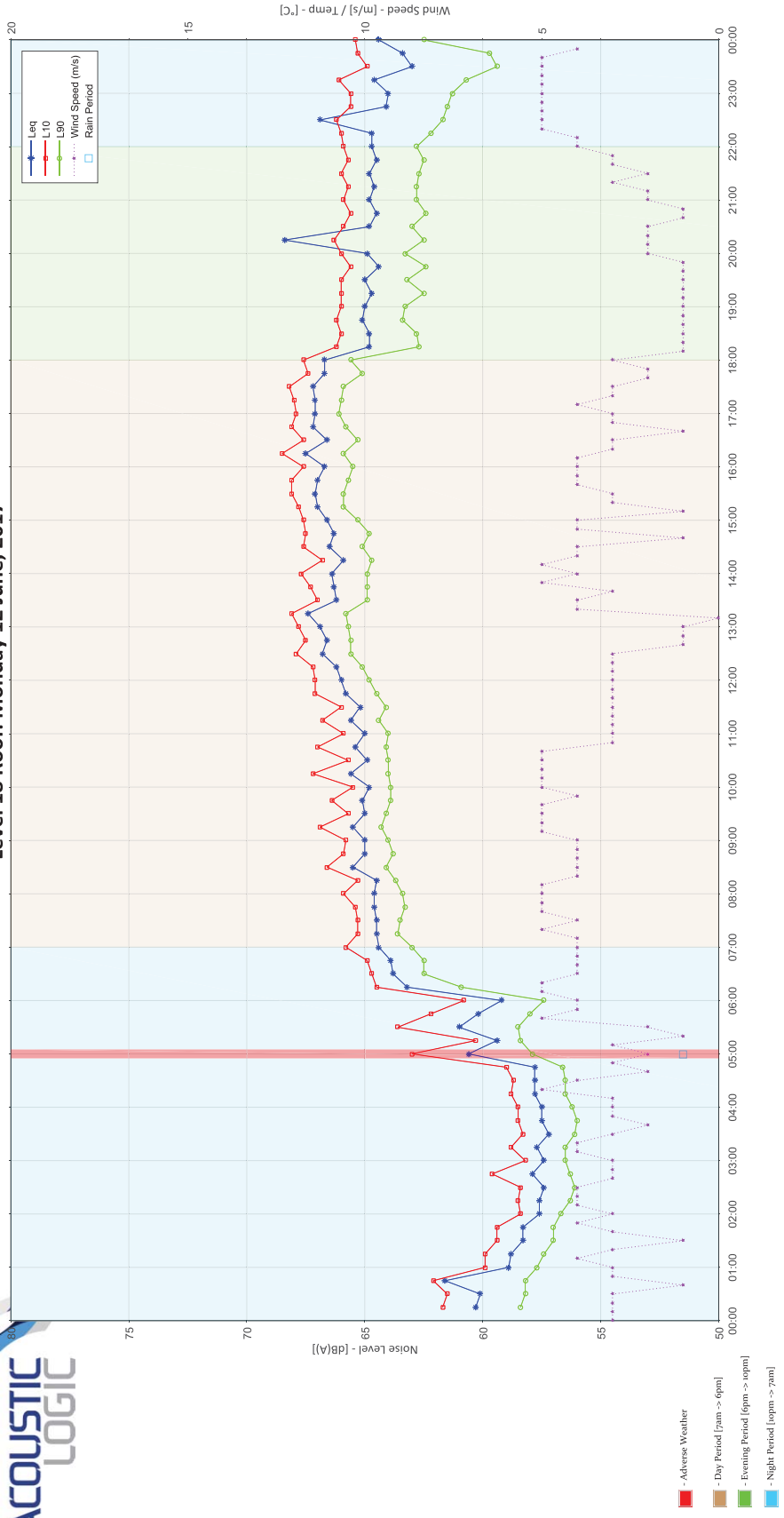
### Level 18 Roof: Saturday 10 June, 2017



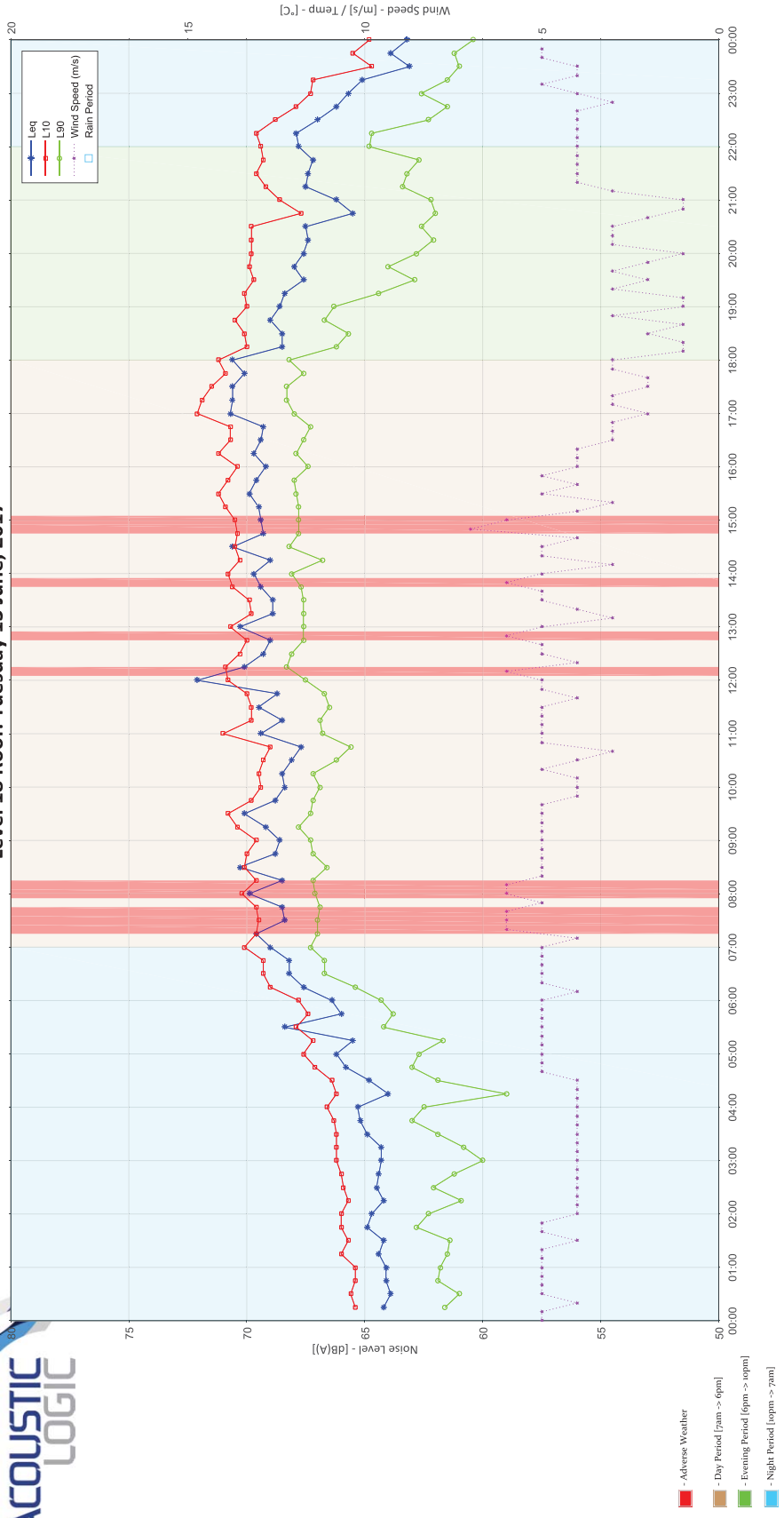
### Level 18 Roof: Sunday 11 June, 2017



Level 18 Roof: Monday 12 June, 2017



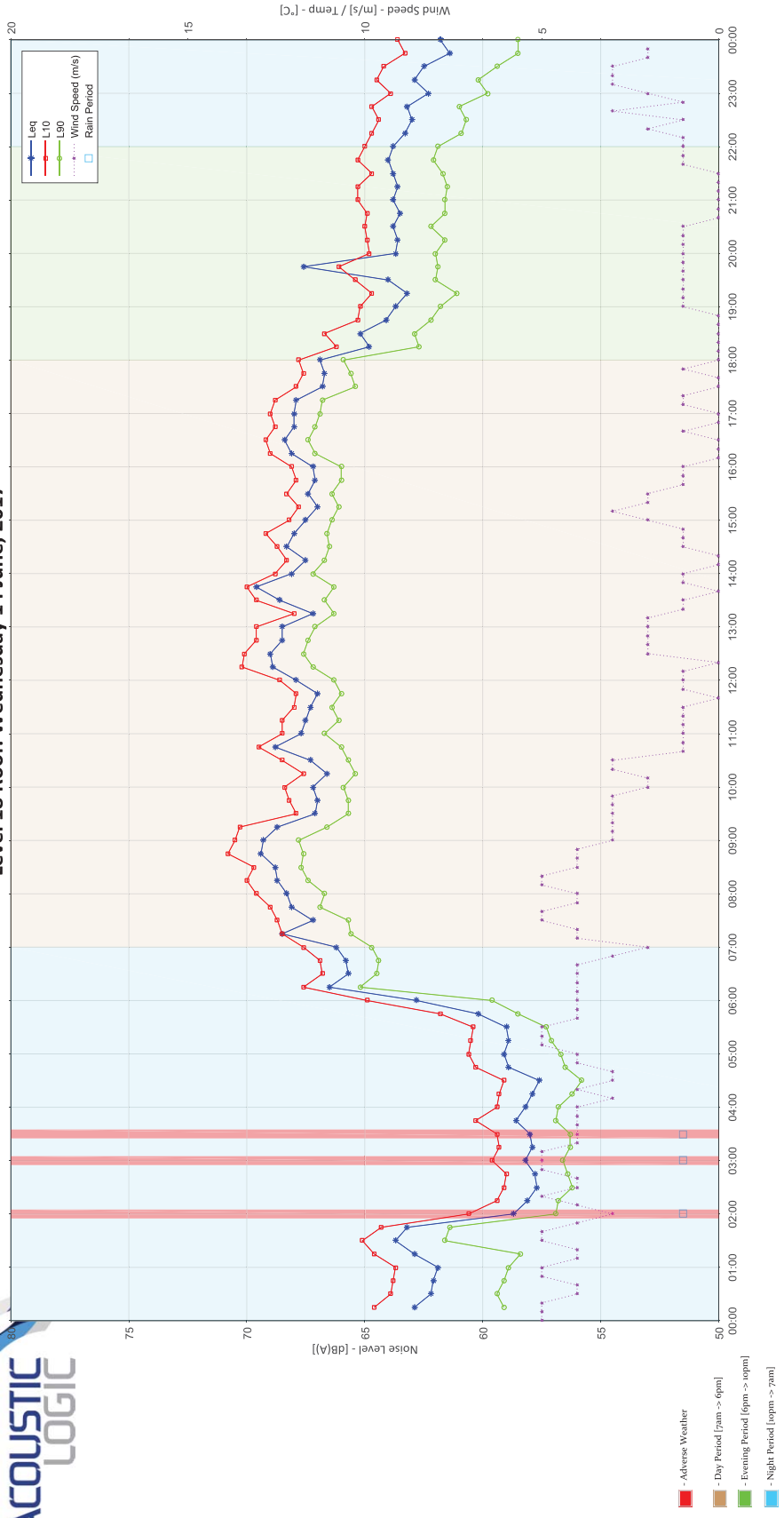
Level 18 Roof: Tuesday 13 June, 2017



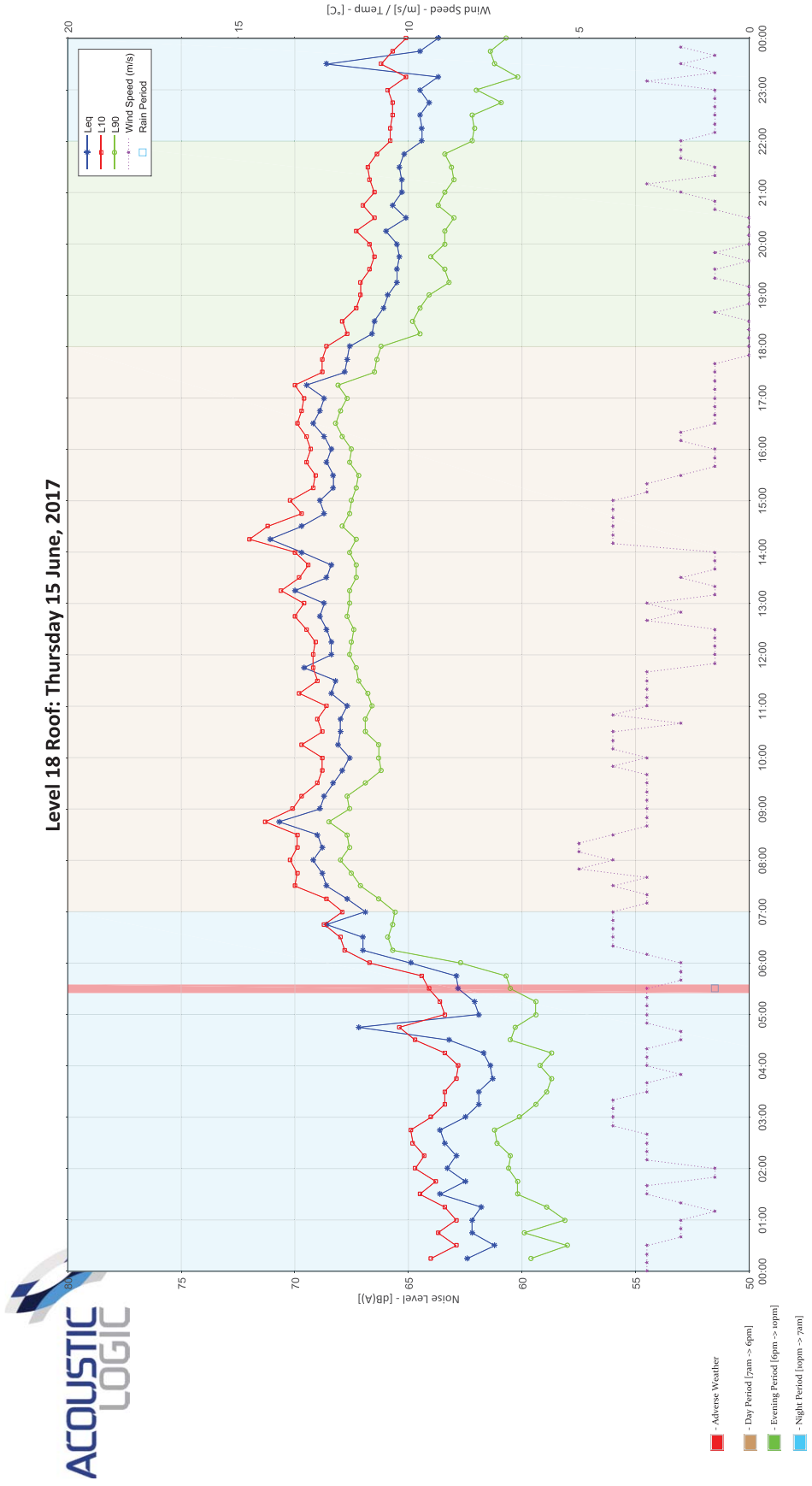
- - Adverse Weather
- - Day Period (7am -> 6pm)
- - Evening Period (6pm -> 10pm)
- - Night Period (10pm -> 7am)



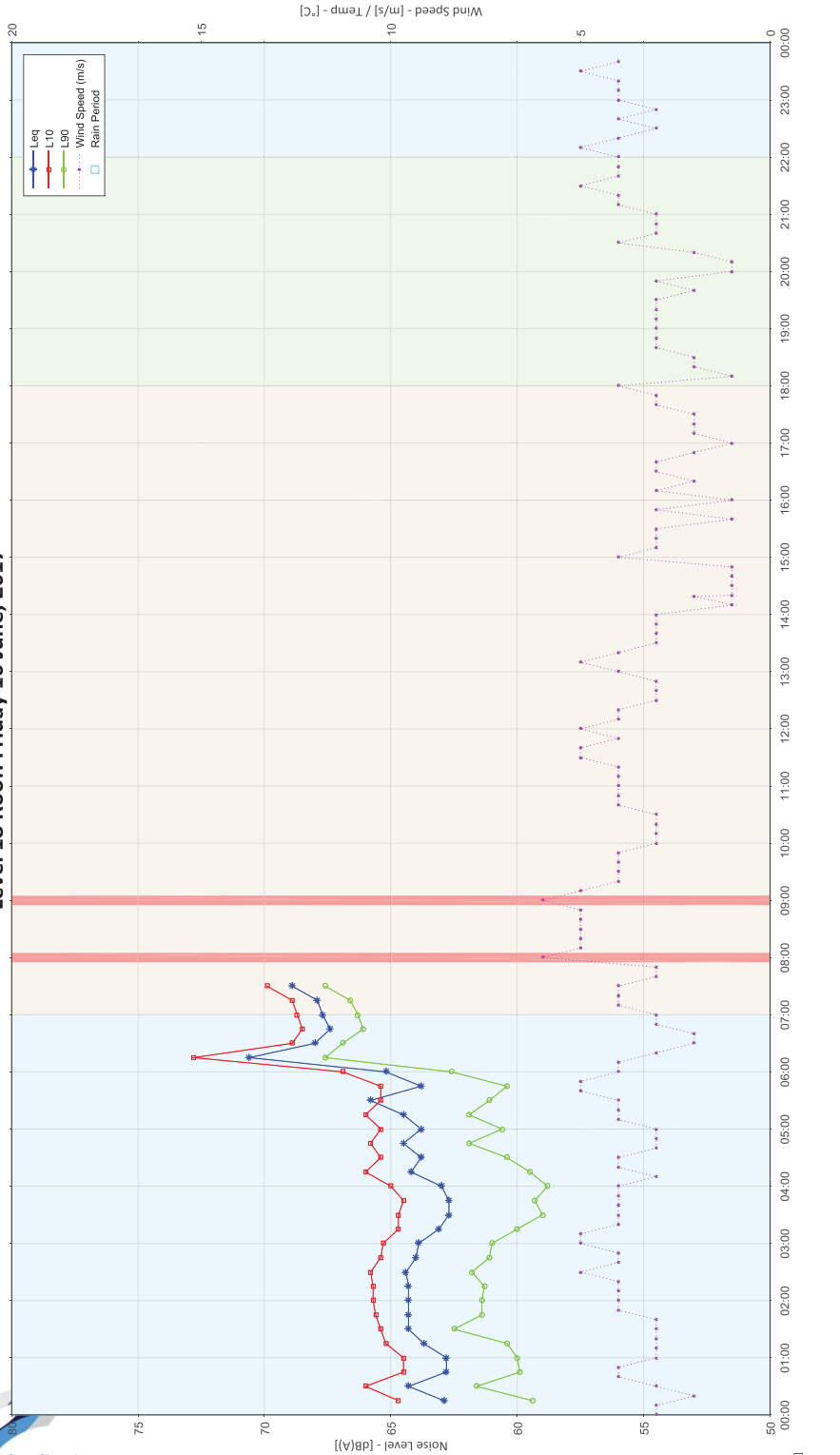
Level 18 Roof: Wednesday 14 June, 2017



# Level 18 Roof: Thursday 15 June, 2017

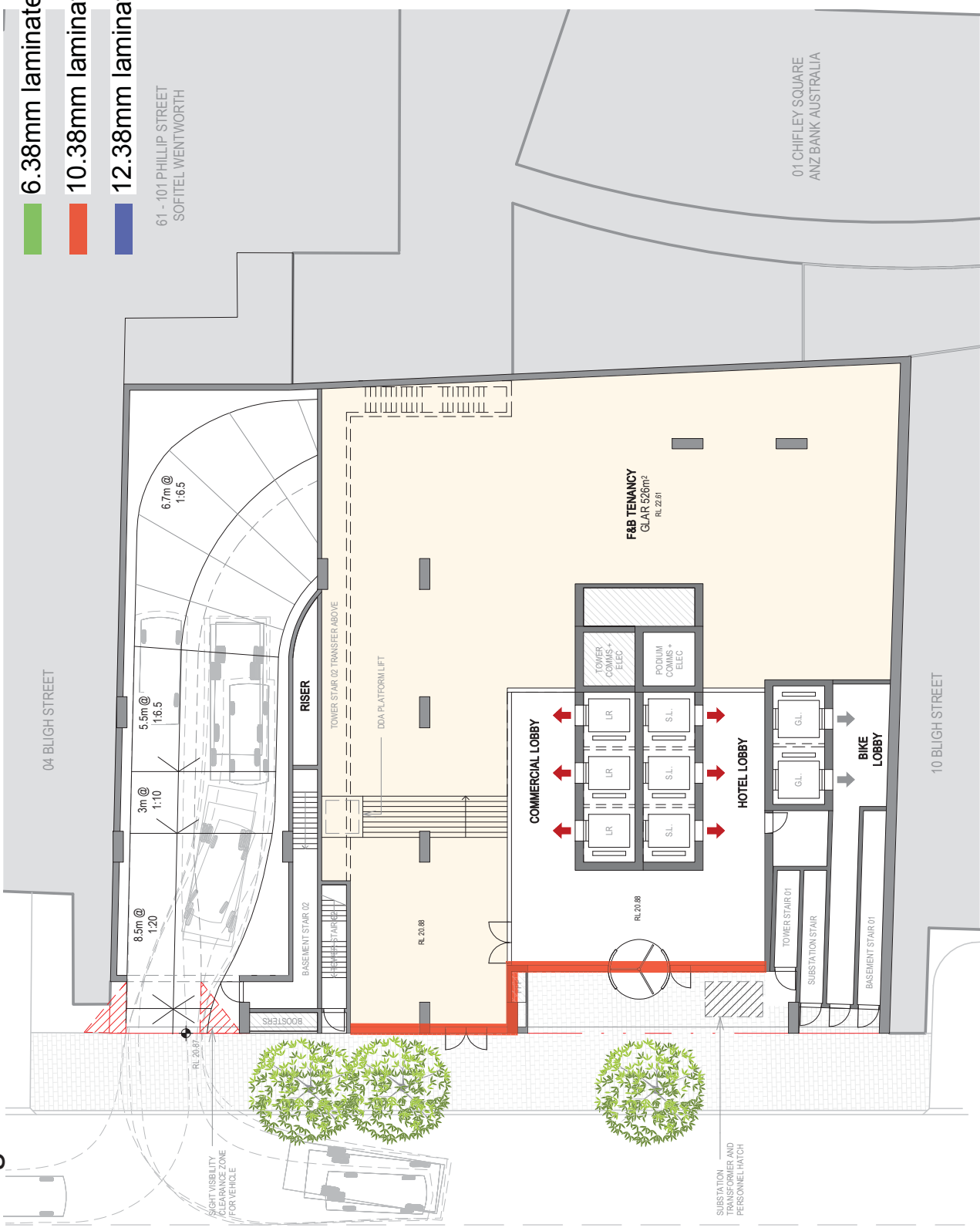


### Level 18 Roof: Friday 16 June, 2017



## **APPENDIX 3 – GLAZING MARK-UP**

# GA - Ground Level Plan - Bligh Street



Drawing:  
 Drawing no: FD1005  
 Issue: 6  
 Scale @ A3: 1 : 200  
 Date: 20/07/17

4-6 Bligh Street, Sydney

Architectus Sydney  
 Level 18 MLC Centre  
 19 Martin Place  
 Sydney NSW 2000  
 sydney@architectus.com.au



architectus™

# GA - Level 01 Plan (Podium Function)



Drawing:  
 Drawing no: RD1006  
 Issue: 6  
 Scale @ A3: 1 : 200  
 Date: 20/07/17

Level 01 Plan (Commercial)

Architectus Sydney  
 Level 18 MLC Centre  
 19 Martin Place  
 Sydney NSW 2000  
 sydney@architectus.com.au



# GA - Level 03-07 Plan (Typical Commercial)



North

# GA - Level 08 Plan (Podium Gym)



Drawing:  
 Drawing no: FD1009  
 Issue: 6  
 Scale @ A3: 1 : 200  
 Date: 20/07/17

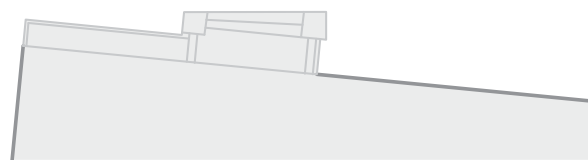
Level 8 Plan (Podium Gym)  
 6  
 1 : 200  
 20/07/17



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 Level 18 MLC Centre  
 19 Martin Place  
 Sydney NSW 2000  
 sydney@architectus.com.au



# GA - Level 09 Plan (Podium Gym/Pool)



- 6.38mm laminated
- 10.38mm laminated
- 12.38mm laminated

61 - 101 PHILLIP STREET  
SOFITEL WENTWORTH

01 CHIFLEY SQUARE  
ANZ BANK AUSTRALIA

Drawing:  
Drawing no: FD1010  
Issue: 3  
Scale @ A3: 1 : 200  
Date: 20/07/17

Level 9 Plan (Podium Gym/Pool)  
3  
20/07/17

4-6 Bligh Street, Sydney



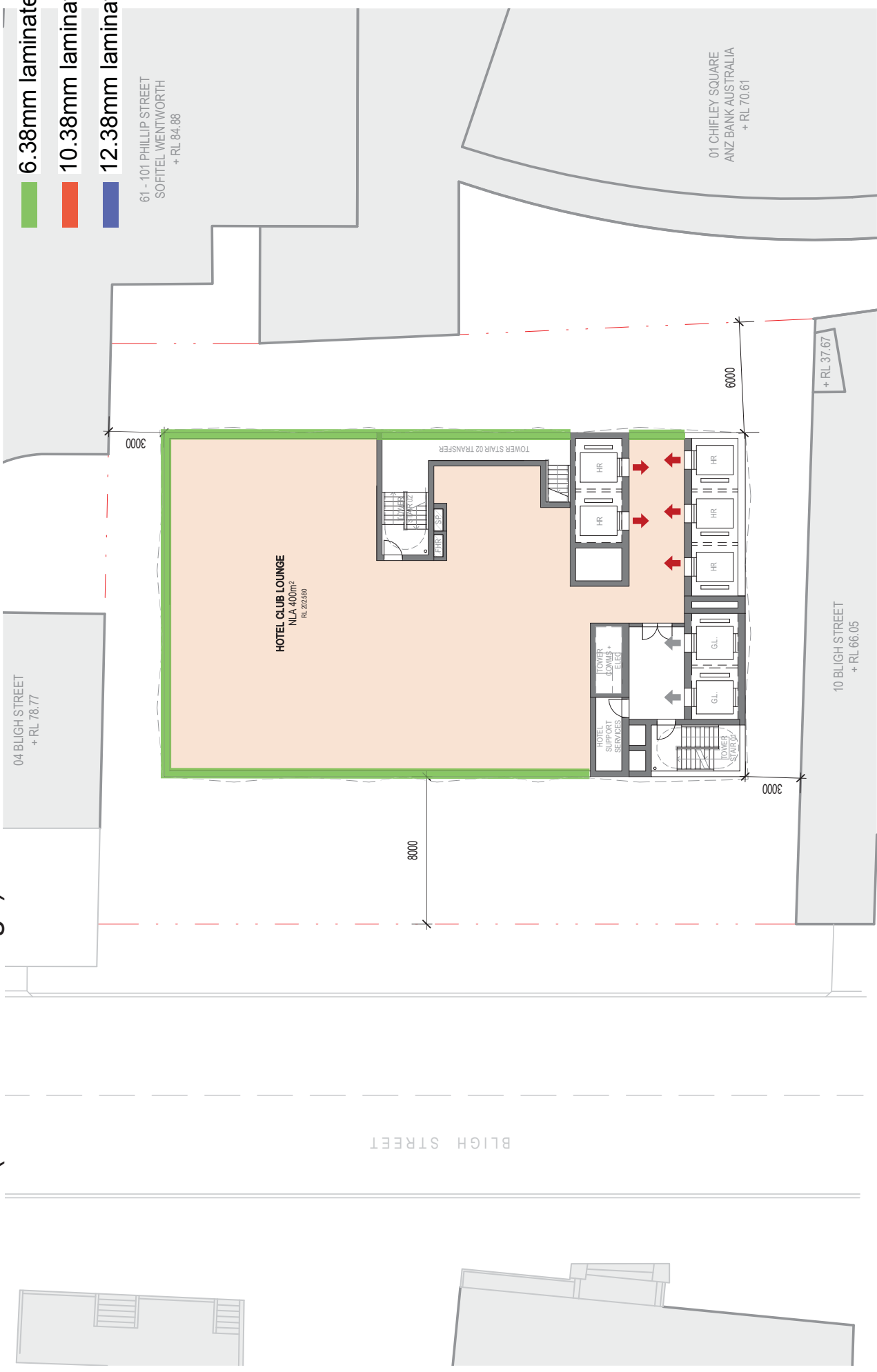
Architectus Sydney  
Level 18 MLC Centre  
19 Martin Place  
Sydney NSW 2000  
sydney@architectus.com.au

architectus™





# GA - Level 50 Plan (Hotel Club Lounge)



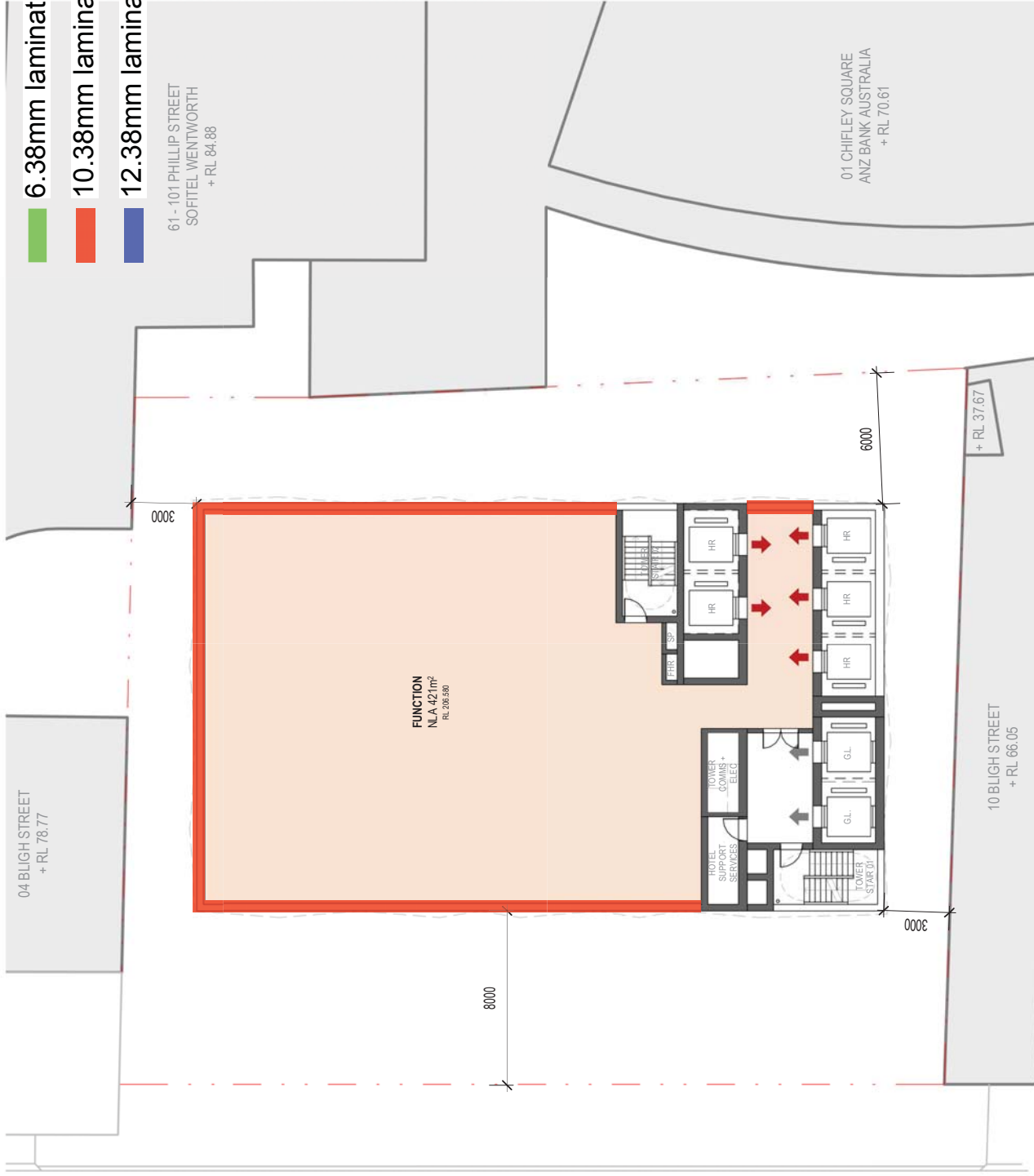
4-6 Bligh Street, Sydney

Drawing:  
 Drawing no: RD1015  
 Issue: 4  
 Scale @ A3: 1 : 200  
 Date: 20/07/17



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 19 Martin Place  
 Sydney NSW 2000  
 sydney@architectus.com.au

# GA - Level 51 (Function)



BLIGH STREET

- 6.38mm laminated
- 10.38mm laminated
- 12.38mm laminated

61 - 101 PHILLIP STREET  
SOFITEL WENTWORTH  
+ RL 84.88

01 CHIFLEY SQUARE  
ANZ BANK AUSTRALIA  
+ RL 70.61

10 BLIGH STREET  
+ RL 66.05

+ RL 37.67

Drawing:  
Drawing no:  
Issue:  
Scale @ A3:  
Date

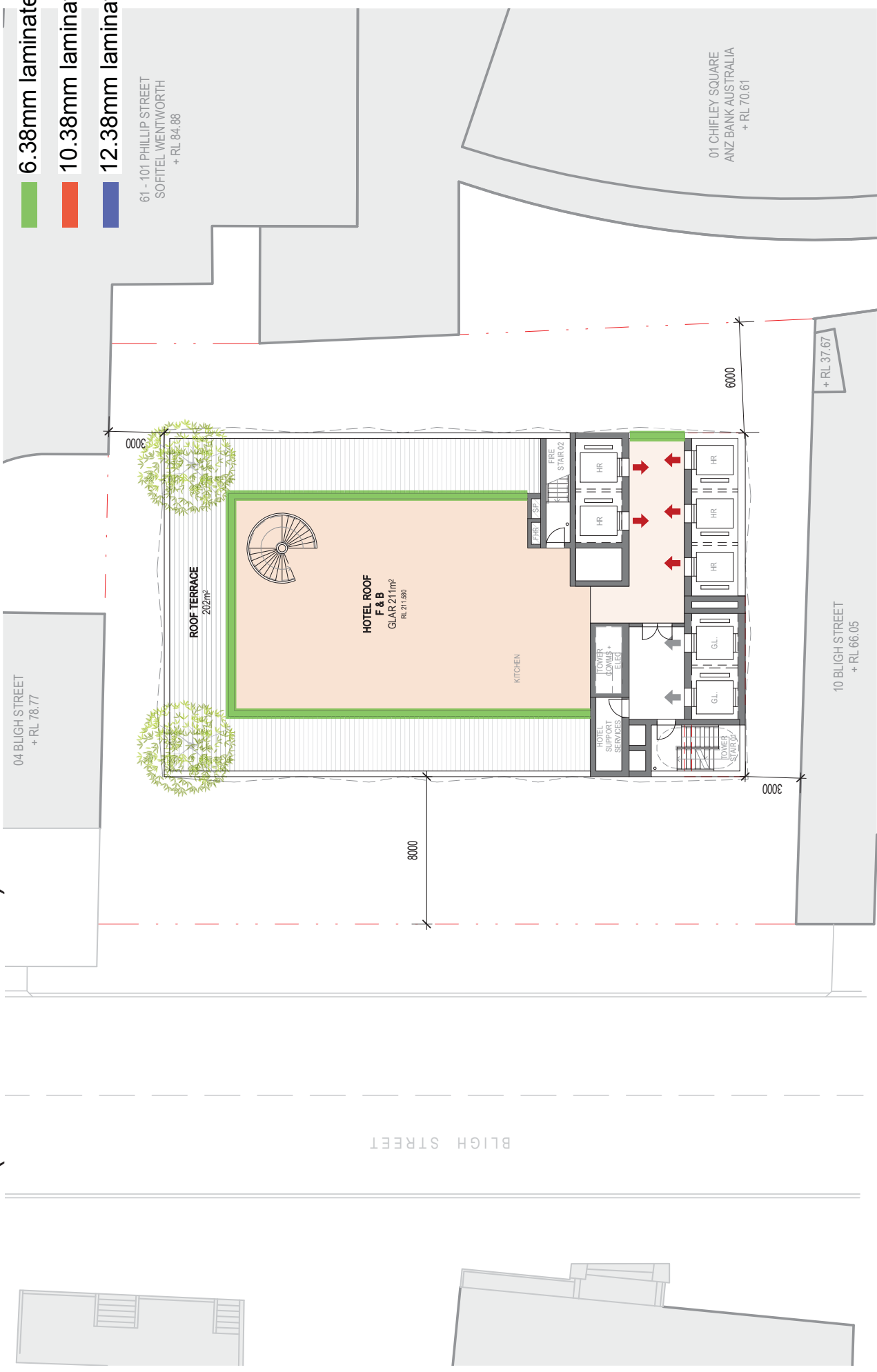
Level 51 Plan (Function)  
FD1016  
5  
1 : 200  
20/07/17



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Sydney NSW 2000  
sydney@architectus.com.au

4-6 Bligh Street, Sydney

# GA - Level 52 Plan (Hotel Roof Terrace)



Drawing:  
 Drawing no: RD1017  
 Issue: 6  
 Scale @ A3: 1 : 200  
 Date: 20/07/17

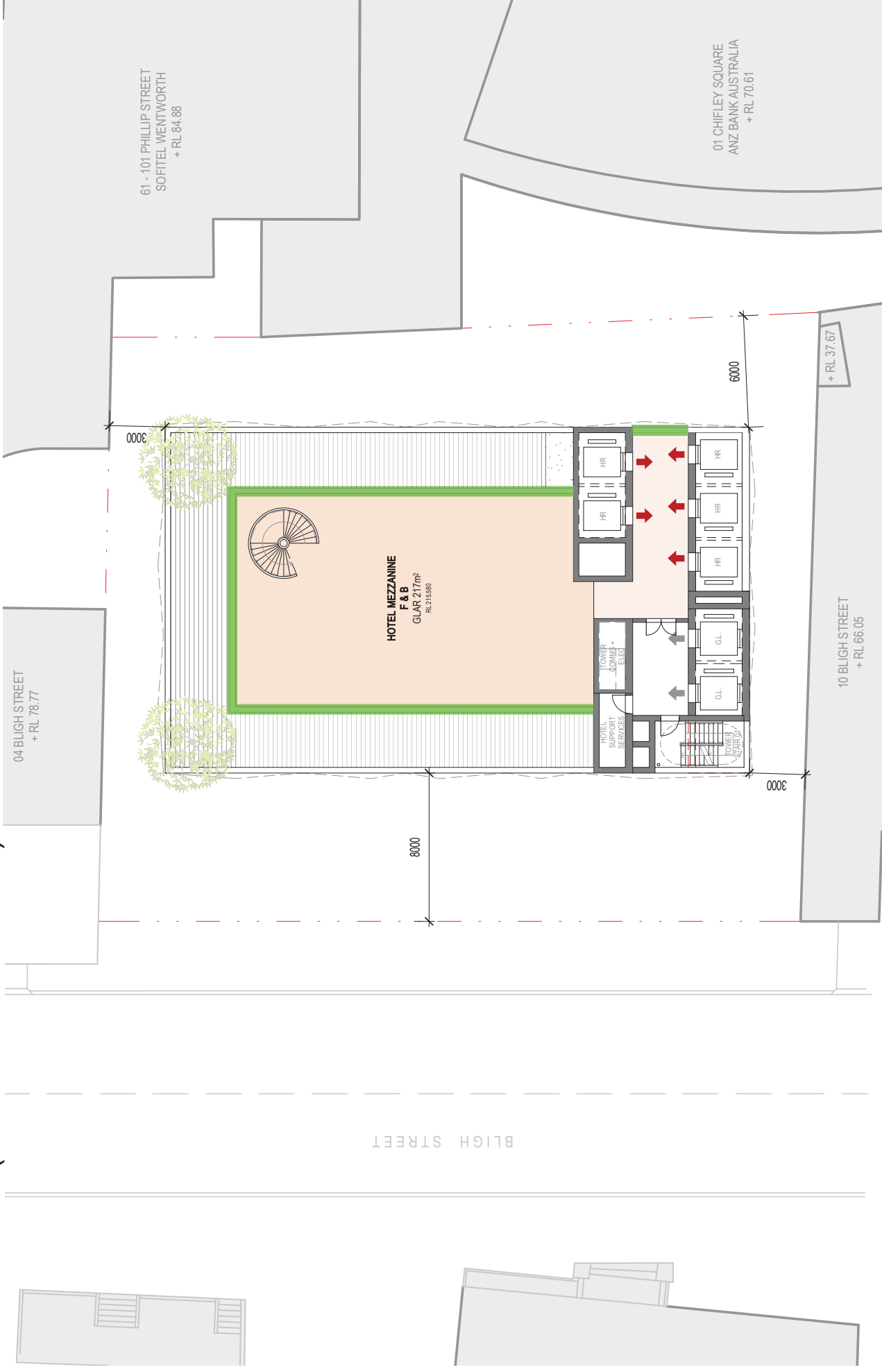
Level 52 Plan (Hotel Roof Terrace)  
 6



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 19 Martin Place  
 Sydney NSW 2000  
 sydney@architectus.com.au

4-6 Bligh Street, Sydney

# GA - Level 53 Plan (Hotel Roof Mezzanine)



4-6 Bligh Street, Sydney

Drawing:  
 Drawing no: FD1018  
 Issue: 6  
 Scale @ A3: 1 : 200  
 Date: 20/07/17

Level 53 Plan (Hotel Roof Mezzanine)  
 FD1018  
 6  
 1 : 200  
 20/07/17



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