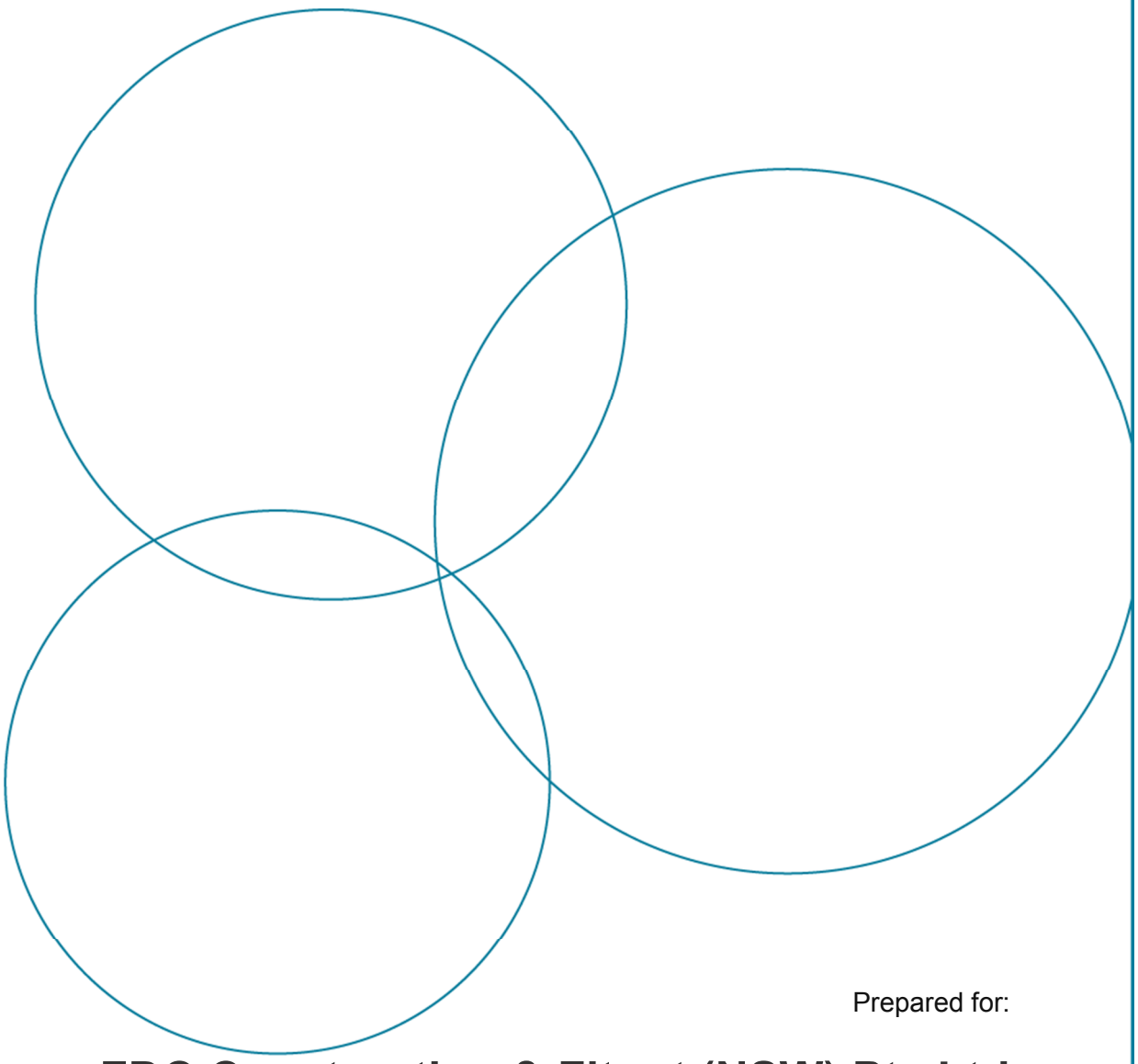
21 August 2017

Acoustic Report for DA Submission

1015558 – Sydney Olympic Park, Site YP



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-	First Issue for comment	26/07/2017
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The success and realisation of the proposed initiatives will be dependent upon the commitment of the design team, the development of the initiatives through the life of the design and also the implementation into the operation of the building. Without this undertaking the proposed targets may not be achieved.

Contents

Executive Summary

This report presents acoustic input to the DA submission for the proposed development at Site YP in Sydney Olympic Park.

The acoustic analysis has been undertaken based upon data from noise surveys at the site. Acoustic design targets have been determined, based on appropriate standards and guidelines to achieve acceptable noise levels for:

- Noise break-in to the development and internal noise levels;
- Noise break-out to the community.

Noise from the surroundings affecting the development, such as general road traffic, can be controlled by the selection of appropriate façade glazing, external construction, and ventilation strategy to meet the recommended internal noise levels.

As the development will include items of building services plant, appropriate noise limits when assessed at affected façades have been set. It is considered that typical external noise sources could be adequately controlled using standard acoustic treatment techniques.

The potential impact of activity noise has been assessed, based on values set out in the City of Sydney guidelines. Based on the distance to the nearest noise-sensitive façade and the performance of glazing elements, external and internal noise limits have been determined. Assessment has determined that typical activities associated with the development are unlikely to cause an adverse impact at the nearest noise-sensitive property.

1 Introduction

Cundall has been commissioned by FDC Construction & Fitout to carry out an assessment of noise levels affecting a proposed development in Sydney Olympic Park, and consider noise break-out affecting neighbouring properties.

1.1 The development

It is proposed to construct a new licenced premises within Sydney Olympic Park (SOP). Preliminary designs have been received and are based on the provision of a main bar, lounge, dining, and gaming areas primarily across the upper and lower ground floor, together with a roof-top terrace and other exterior areas. There is to be no on-site car parking.

The development will be located in the Cathy Freeman Park area of the SOP site, bounded by Grand Parade in the north, Showground Road in the east, Olympic Boulevard in the west and Dawn Fraser Avenue in the south. Neighbouring properties are commercial buildings and sports facilities.

1.2 Design criteria

In this report, acoustic design targets are established for:

- Noise impact of the surrounding community on the development, including internal noise levels;
- Noise impact of the development on the surrounding community.

The acoustic design targets and guidance have been derived from relevant Australian codes, standards, and guidance, including the following:

- Environmental Planning and Assessment Act 1979;
- Protection of the Environment Operations Act 1997 (POEO Act);
- EPA 'NSW Industrial Noise Policy' [INP] (January 2000);
- Australian Standard AS2107 'Acoustics – Recommended design sound levels and reverberation times for building interiors' (2016);
- Sydney Olympic Park Masterplan 2030 '2016 Review – Noise Management Guidelines' (Version E, July 2016);
- Sydney Olympic Park Authority Act 2001 No 57, Part 4 – Functions of the Authority (July 2001);
- Sydney Olympic Park Authority Act 2001 No 57, Division 5 – Environment Protection (July 2001);
- City of Sydney guidance 'Licensed venues and commercial premises' (2016);
- NSW Office of Liquor, Gaming & Racing (OLGR) 'Sound advice' (October 2009).

A glossary of acoustic terminology used in this report is included in Appendix A.

2 Site description

2.1 Existing site

The site is located within Sydney Olympic Park, approximately 16 km to the west of Sydney's CBD. Sydney Olympic Park is an official suburb of Sydney, but is managed by Sydney Olympic Park Authority (SOPA).

The development site is located opposite the ANZ Stadium site on Olympic Boulevard, adjacent to Cathy Freeman Park.

The figure below indicates the approximate site location and the immediate surrounds.

Figure 1 – Approximate site location and surrounds

The immediate vicinity comprises public open space, including Cathy Freeman Park and a number of boulevards. Beyond this area are predominantly commercial and retail properties, including a Novotel hotel to the south of the site across Dawn Fraser Avenue.

The Novotel is considered to be the nearest noise-sensitive property to the site as it contains guest bedrooms at upper levels. At ground floor, a number of retail/commercial operations were noted, including:

- Gloria Jean's Coffees;
- The Brewery Bar + Kitchen – with external seating area;
- Wok On Inn Thai restaurant – with external seating area;
- Cold Rock Olympic Park ice cream parlour.

Activities at these existing commercial uses will also have a noise impact on the hotel.

From site observations, other nearby properties are predominantly office spaces.

2.2 Proposed site

Proposals are for a new licenced premises to be constructed on the site. Preliminary designs have been received and are based on the provision of a main bar, lounge, dining, and gaming areas primarily across the upper and lower ground floor, together with a roof-top terrace and other exterior areas. There is to be no on-site car parking.

The figures below illustrate concept areas on each floor:

Figure 2 – Ground floor

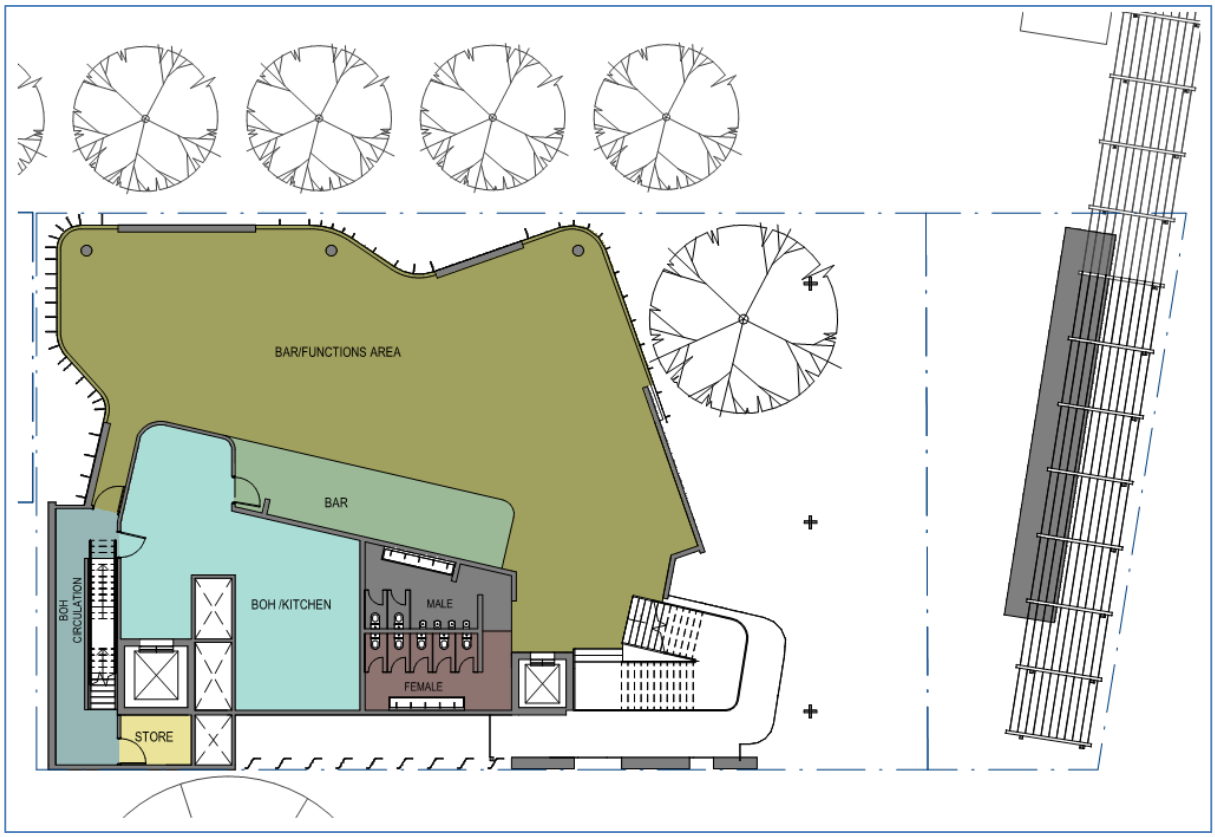

Figure 3 – First floor

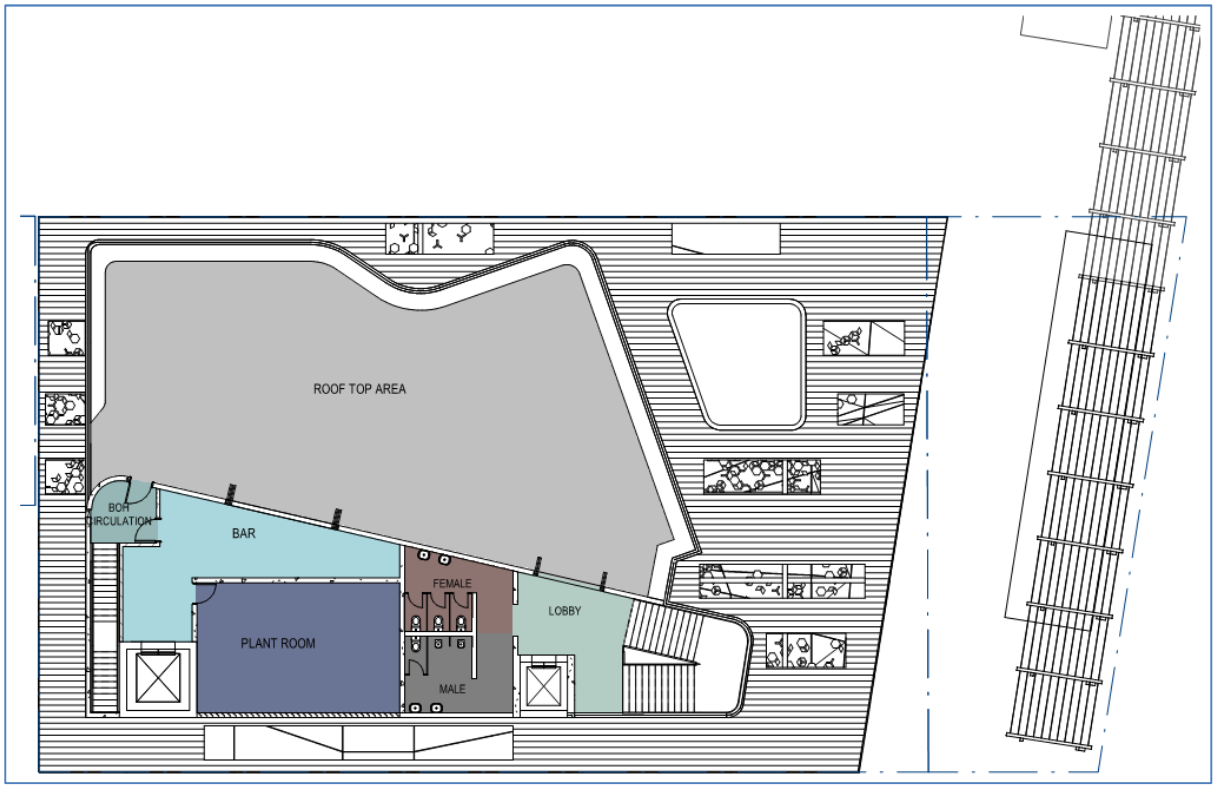

Figure 4 – Rooftop

It can be seen that the main rooftop plant compound is located to the north-west.

3 Noise survey

The purpose of the noise survey was primarily to:

- Identify sources of noise that are likely to affect the development and their expected levels;
- Quantify existing ambient noise levels, to assist in setting appropriate noise criteria to assess the impact of the proposed development on the surroundings;
- Identify potential noise sensitive receivers in the vicinity.

3.1 Methodology

The environmental noise survey was based on a long-term unattended monitoring position, located on the rooftop of the existing amenities building immediately to the north of the site. This location was considered representative of noise levels on the most exposed façade of the proposed development, and characteristic of the background noise levels at the nearest noise sensitive properties.

The logger recorded at variety of noise parameters at 15 minute intervals, including the prevailing noise level (L_{Aeq}), background noise level (L_{A90}), and maximum instantaneous noise level (L_{AFmax}). Measurements were made between 18 – 25 July 2017.

In addition to the long-term measurements, an attended survey was undertaken on 18 July 2017, set back from the north of Dawn Fraser Avenue and considered equivalent to the façade of the Novotel.

3.2 Conditions

Reported weather conditions at the nearest monitoring location[1] were generally fine over the unattended logging period, with the exception of few periods where windspeeds were slightly higher than the recommended maximum value for measurements of 18 m/s.

Conditions were nevertheless considered appropriate for representative noise data to be obtained.

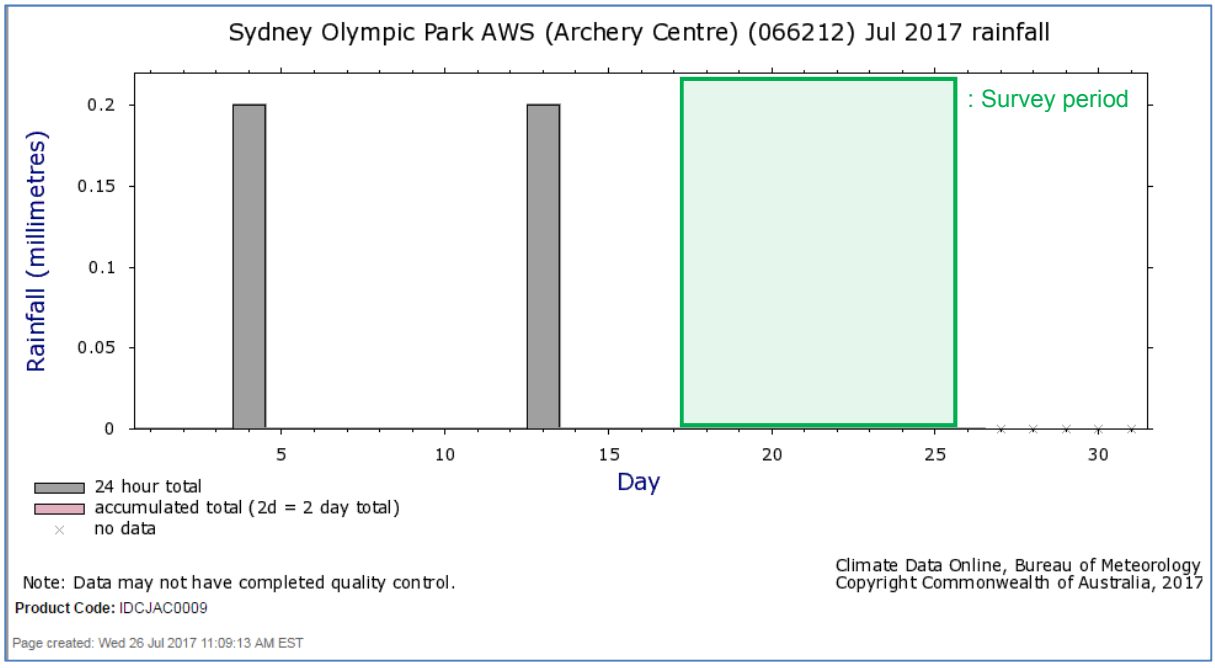

Figure 5 – July rainfall at the nearest monitoring location

[1] Ref: *http://www.bom.gov.au/climate/data/stations/*

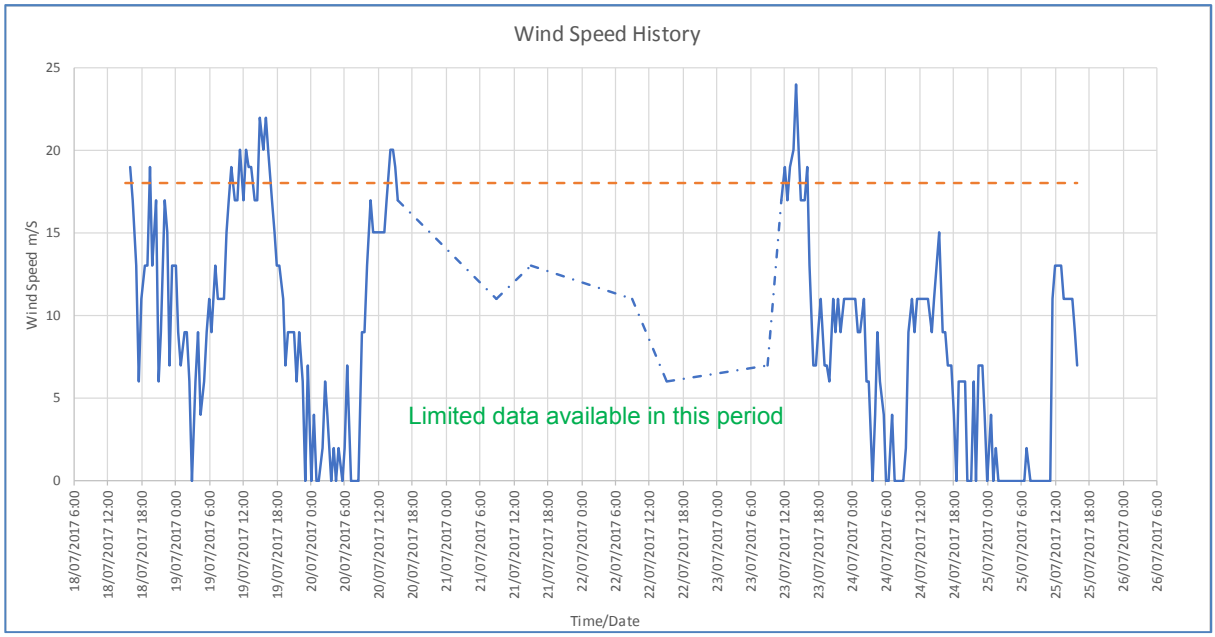

Figure 6 – July windspeed at the nearest monitoring location

It is considered that the survey generally meets recommendations given in relevant guidance documents.

3.3 Observations

From our site visits, the predominant noise source affecting the site and surrounding area was considered to be services plant associated with the ANZ Stadium and road traffic on Olympic Boulevard and Dawn Fraser Avenue. Traffic volumes were observed to be low during the attended survey periods but included regular buses on Dawn Fraser Avenue.

Additional noise sources observed were forklift trucks and other maintenance vehicles, patron noise from ground floor retail premises below the Novotel, and public address announcements from Olympic Park Station, to the east.

3.4 Results

The figure below illustrates the recorded L_{Aeq}, L_{A90}, and L_{max} noise levels over the long-term monitoring period, based on the 15 minute survey data.

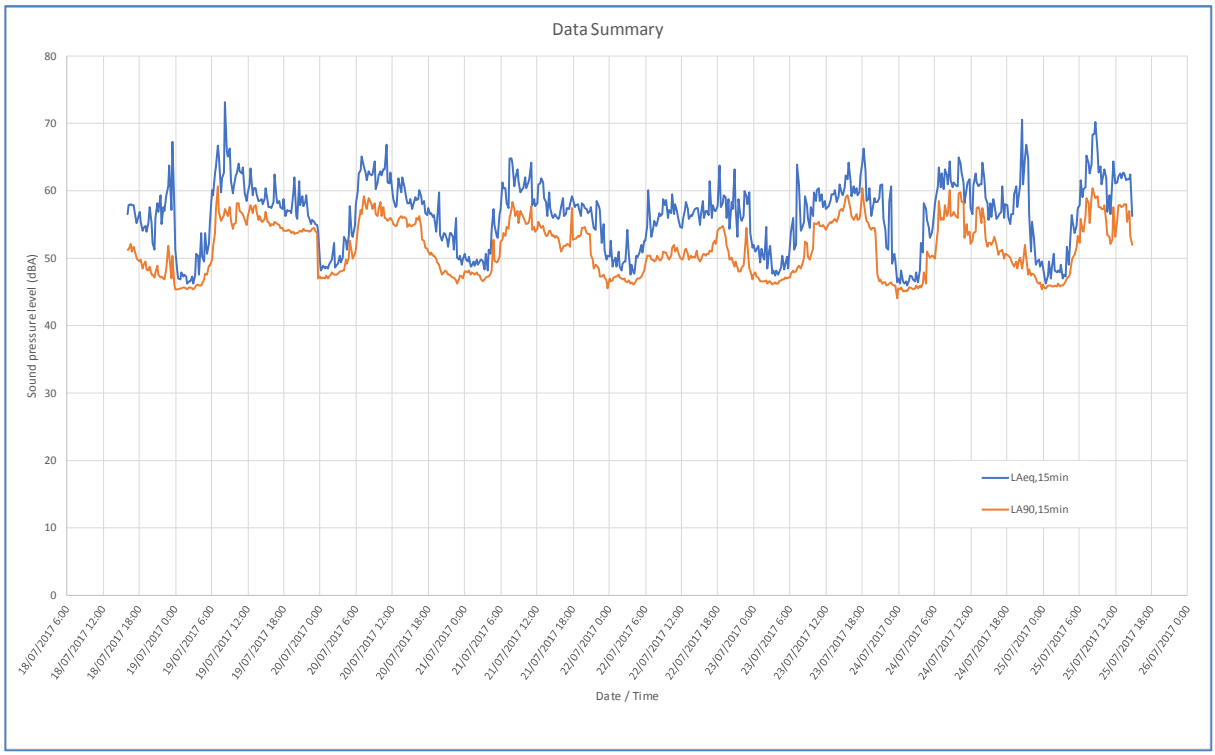

Figure 7 – Long-term noise level measurements

The Table below presents the logarithmically averaged 15 minute L_{Aeq} values and typical L_{A90} values recorded across the whole survey period[2].

Date	Averaged $L_{Aeq,15min}$ (dB)			Typical $L_{A90,15min}$ (dB)		
	Daytime	Evening	Night	Daytime	Evening	Night
18 Jun (Tue)	n/a	56	57	n/a	47	45
19 Jun (Wed)	63	59	55	55	54	47
20 Jun (Thu)	61	55	54	55	48	47
21 Jun (Fri)	60	57	53	52	49	46
22 Jun (Sat)	57	59	55	50	50	46
23 Jun (Sun)	60	61	55	50	46	45
24 Jun (Mon)	61	63	54	51	48	46
25 Jun (Tue)	62	n/a	n/a	53	n/a	n/a

Table 1 - Averaged 15 minute noise levels

The table below summarises the average “weekday” and “weekend” hourly L_{Aeq} values, based on the values given above.

[2] Refer to Table 7 for definition of time periods.

Date	Averaged $L_{Aeq,15min}$ (dB)			Typical $L_{A90,15min}$ (dB)		
	Daytime	Evening	Night	Daytime	Evening	Night
Weekday	61	59	55	53	49	46
Weekend	58	60	55	50	48	46

Table 2 – Averaged weekday and weekend noise levels

Attended measurements made at a position considered representative of the hotel façade are summarised in the table below.

Date	Averaged $L_{Aeq,5min}$ (dB)			Typical $L_{A90,5min}$ (dB)		
	Daytime	Evening	Night	Daytime	Evening	Night
Weekday	59	n/a	n/a	54	n/a	n/a

Table 3 – Attended noise survey measurements

With reference to the averaged values from the long-term data logger in Table 2, it is considered that the hotel façade will be exposed to a similar average noise environment as the development site.

4 Internal acoustic criteria

4.1 Internal noise level targets

The internal noise level within each space is the combination of any building services and intrusive external noise levels.

Recommended design levels for steady-state internal noise levels within hotels and other commercial/retail buildings are given in Australian Standard AS2107:2016. The table below gives requirements for typical spaces within the proposed development.

Room type	Design sound level range (dB $L_{Aeq,T}$)
Bars and Lounges	< 50
Foyers and Recreation areas	45 to 50
Washroom / WC	45 to 55
Function areas	40 to 45
Kitchens and Maintenance areas	< 55

Table 4 – Internal noise level requirements

4.2 Applicable project-specific noise levels

With reference to the above considerations, it is recommended that the building envelope (including glazed elements) and ventilation strategies (including any openings) be designed such that an internal noise level of ≤ 45 dB $L_{Aeq,T}$ can be achieved in all areas.

4.3 Acoustic design recommendations

Daytime noise levels monitored are objectively moderate at the proposed façades. To comply with the internal noise criteria given in Section 4.2, attention should be given to provide the necessary sound insulation performance of the façade and glazing and the selection of suitable ventilation systems.

Based on the worst-case façade noise levels of 63 dB $L_{Aeq,T}$ during the daytime/evening and 57 dB $L_{Aeq,T}$ at night (refer to Table 1), rooms will need to provide glazing attenuation as indicated in the table below.

Type of room	Worst-case façade noise level, dB $L_{Aeq,T}$	Internal noise level target, dB $L_{Aeq,T}$	Glazing attenuation, dB R_w+C_{tr}
Noise-sensitive	63 / 57	≤ 45	18 / 12

Table 5 – Glazing attenuation requirements (Day/Night)

Both levels of performance can be easily achieved by standard single or double-glazed units, such as the following constructions[3].

[3] Based on data within 'Sound reduction data for glass', Viridian Technical Note, dated 26/11/2009.

Glazing attenuation, dB R_w+C_{tr}	Single glazing	Double glazing
≤ 27	≥ 4 mm pane	4 mm pane / 12 mm / 4 mm pane

Table 6 – Example glazing performance

The acoustic performance of glazing systems should not be compromised by the framing system or seals. It is recommended that any selected systems be reviewed by a suitably qualified acoustic consultant.

5 External plant noise emissions

In accordance with the Sydney Olympic Park Master Plan 2030, any environmental emissions from the proposed development must be designed to comply with the requirements of the NSW Environment Protection Authority's Industrial Noise Policy [INP] dated January 2000.

The objective of the INP is to protect sensitive receivers from noise generated by commercial, industrial, or trade premises. Noise limits are set based on land use in the area and existing background noise levels. Compliance is achieved if the adjusted L_{Aeq} noise level at any residence affected by noise from the facility is below these noise limits. The adjusted L_{Aeq} is determined by applying corrections for such noise characteristics as duration, intermittency, tonality, and impulsiveness.

The INP separates the day into three different time periods – day, evening and night. These time periods are detailed below.

Period	Day of week	Time period
Day	Monday-Saturday Sunday, Public Holiday	07:00 – 18:00 hours 08:00 – 18:00 hours
Evening	Monday-Sunday	18:00 – 22:00 hours
Night	Monday-Saturday Sunday, Public Holiday	22:00 – 07:00 hours 22:00 – 08:00 hours

Table 7 – INP Time periods

The INP provides guidance on acceptable noise levels from the introduction of new industrial noise sources to an area. The assessment procedure for industrial noise sources has two components:

- Controlling intrusive noise impacts in the short term for residences; and
- Protecting noise level amenity for particular land uses such as commercial offices etc.

Both of these components suggest noise criteria that should not be exceeded in order to minimise adverse noise impacts on the affected areas. Both criteria should be taken into account when assessing the noise impact of industrial source(s) associated with the proposed development, and where the intrusiveness and the amenity criterion differ, the lower of the noise criteria should be adopted as the project-specific noise criterion.

It should be noted that the assessment is based on industrial noise sources, which in this case would relate to mechanical services plant etc.

5.1 Selection of noise sensitive receivers

The existing receptor most affected by potential noise from the development is considered to be hotel bedrooms within the Novotel across Dawn Fraser Avenue, approximately 50 metres to the south.

5.2 Intrusiveness criteria

A 15-minute sampling period is typically used when measuring the level of intrusive noise. This is taken to be a reasonable estimate of the period over which annoyance may occur. The intrusiveness criterion is summarised as follows:

$$L_{Aeq,15min} \leq L_{A90,15min} \text{ (i.e. background level) } + 5 \text{ dB.}$$

Because of the variable nature of background noise levels, the INP specifies single number background noise levels for use in setting the intrusiveness noise criterion. The Assessment Background Level [ABL] for each time period is the level exceeded by 90% of the $L_{A90,15min}$ measurements. The Rating Background Level [RBL] for a particular time period is the median of the ABL values for that time period for each day of the measurement period.

The applicable intrusiveness criteria for the development based on operation of adjacent noise sensitive receptors and site measurement data from the noise logger are provided below.

Location	Time Period	RBL	Intrusiveness Criterion
		dBA	RBL + 5 dB
Noise sensitive receptor	Daytime	52	57
	Evening	48	53
	Night	46	51

Table 8 – Derivation of Intrusiveness Criteria

5.3 Amenity criteria

Criteria for the protection of amenity are given for various types of receiver and different times of day. The amenity criterion is set so that the L_{Aeq} noise level from the industrial noise source does not increase the total industrial noise levels at the receiver above the acceptable noise level [ANL] for that receiver.

The amenity criterion is set based on how close the existing average L_{Aeq} industrial noise levels are to the ANL, using the adjustment factors given in Table 2.2 of the INP.

In cases where the existing L_{Aeq}, average noise levels exceed the ANL by more than 2 dB, and the existing noise levels are unlikely to decrease in future, then the amenity criterion is set to be 10 dB lower than the existing noise levels at the receiver.

A summary of the amenity criteria using data from the noise logger is presented below.

Location	Time Period	Existing noise level dB L_{Aeq} [4]	ANL[5] dB L_{Aeq}	Modification factor [6] dB	Amenity Criterion dB L_{Aeq}
Residence (Urban)	Daytime	58	60	ANL – 4	56
	Evening	59	50	L_{Aeq} – 10	49
	Night	55	45	L_{Aeq} – 10	45
Nearest commercial properties (when in use)	Daytime	58	65	ANL	65
	Evening	59	65	ANL	65
	Night	55	65	ANL	65

Table 6 – Derivation of Amenity Criteria

[4] Ref: Lowest values recorded in Table 2 above.
[5] Ref: Acceptable Noise Level for commercial properties, according to Table 2.1 of NSW INP, 2000.
[6] Ref: According to Table 2.2 of NSW INP, 2000.

5.4 Applicable project-specific noise levels

The most stringent of the intrusiveness and the amenity criteria should be set as the limiting project-specific noise level to be met by the development. The Table below compares the intrusiveness and the amenity criteria, and identifies the limiting criterion for each time period.

Location	Time Period	Intrusiveness Criterion	Amenity Criterion	Project-specific Criterion dB $L_{Aeq,15min}$
Residence (Urban)	Day	57	56	**56**
	Evening	53	49	**49**
	Night	51	45	**45**

Table 9 – Project-specific noise levels

5.5 Plant items

Specific plant items and locations are not defined at this stage of the project; however it is noted that the rooftop plant compound is to be located at the northern end of the proposed building, facing away from the hotel development.

5.6 Acoustic design recommendations

The cumulative noise from any mechanical plant should be controlled to meet the project-specific criteria given in Table 9, when assessed at the nearest affected noise-sensitive location(s).

Care should be taken to see that noise emissions from new services plant is not tonal in nature.

Typical noise mitigation strategies include selection of low noise outdoor equipment, locating plant to take advantage of shielding from building elements, and the use of plant enclosures or screens if necessary.

5.6.1 Additional guidelines

Noise generated by waste collection or other service vehicles should be controlled by management of the collection/delivery times to ensure that undue disturbance to nearby noise-sensitive properties is avoided.

6 Activity noise

It is understood that the bar areas will include facilities for reproduced music, although typically at low volume levels. The first floor bar area may be used for functions, and therefore consideration needs to be given to the potential for such activity noise breakout to nearby noise-sensitive areas.

At this stage of the design, internal layouts are not finalised, however it is understood that the first floor area may be divided with moveable partitions to form a number of private function spaces. To meet operational requirements, the acoustic performance of such partitions will be considered within the design stage of the project, however for the Development Application stage, the potential impact of associated function noise breakout will be considered here.

6.1 Sydney Olympic Park Authority

We understand that the Authority, in relation to Sydney Olympic Park, may exercise the functions of a council under Part 6 of the Environmental Planning and Assessment Act 1979[7].

Reference has been made to the Sydney Olympic Park Master Plan 2030, however no specific noise emission criteria for activity noise from new developments have been identified.

Maximum noise criteria for within residential and hotel developments are provided, but we understand that these relate to general environmental noise impact:

Internal Space	Noise Criterion	Time Period	Noise Measure
Living Rooms	45dBA	Day & Evening (7am to 10pm)	LAeq, 15 min
Working Areas			
Sleeping Rooms	40dBA	Night Time (10pm to 7am)	

Figure 8 - Maximum noise criteria (source: SOPA Master Plan 2030)

These values will be taken into account; however we consider that music and patron noise from a licenced venue may need to be considered in more detail.

6.2 Guidance on noise from licensed premises and commercial premises

Whilst the development site is not within City of Sydney boundaries, guidance provided for licenced premises within this area is considered equally applicable to the Olympic Park site.

Music and patron noise from licenced premises can sometimes reach high levels, and a balance is required based on the existing noise environment of the area. The City's standard conditions of consent for controlling such events are technical in nature and limit the overall level of noise, its frequency characteristics, and its effect on both residential and noise-sensitive commercial operations.

A non-technical summary of the typical conditions of consent for noise from licensed premises (within the City of Sydney area) at neighbouring residential locations is provided below:

- Background noise is determined from the environmental noise levels at the affected property in the absence of any licensed premises noise;

[7] Ref: SOPA Act 2001 No 57, Part 4, Division 2, Clause 25

- Between 7 am and midnight, noise from a licensed venue, as measured at the edge of a residential property, should not exceed the background noise level by 5 decibels (dB);
- Between midnight and 7 am, noise from a licensed venue, as measured at the edge of a residential property, should not exceed the background noise level. Additionally, noise should not be audible within any habitable room of the residential premises;
- Entertainment noise, particularly music can be tonal in nature, therefore applicable limits apply to the frequencies of noise from the licensed premises in relation to those which characterise the background noise of an area.

Whilst not clarified within the guidance, it is assumed that 'noise from a licenced venue' refers to the $L_{Aeq,T}$ value. It is considered that these guidelines could reasonably be adopted for the proposed development within Sydney Olympic Park.

6.3 Determination of activity noise emission limits

As presented in Section 3.4, representative background ($L_{A90,T}$) noise levels at a position considered applicable for the Novotel development are as follows.

Date	Typical $L_{A90,15min}$ (dB)		
	Daytime	Evening	Night
Weekday	53	49	46
Weekend	50	48	46

Table 10 – Typical weekday and weekend background noise levels

To meet the adopted criteria set out above, activity noise should not exceed these values by more than 5 dB during the daytime and evening period, and should not exceed the night-time value from midnight to 7 am.

Activity noise from the proposed development will be attenuated due to the distance to the hotel façade, therefore the maximum external noise level at source whilst meeting the limits set out above can be determined. In addition, internal activity noise will be attenuated by the performance of the glazing, therefore the maximum internal noise level can also be established.

The table below summarises the calculation process for the periods with the most stringent noise limits:

Criterion	Time period		
	Daytime	Evening	Night
Background noise level (dB $L_{A90,15min}$)	50	48	46
External noise level limit at residential property (dB $L_{Aeq,15min}$)	55	53	46
Distance attenuation [50 m] (dB)	- 34		
External activity noise limit at development (dB $L_{Aeq,15min}$)	89	87	78
Glazing attenuation (dB R_w+C_{tr}) *	- 25		
Permissible internal activity noise limit in development (dB $L_{Aeq,T}$)	114	112	103

Table 11 – Determination of activity noise limits

* Note: The C_{tr} correction applied to glazing performance takes into account the reduced attenuation offered at low frequencies, and is therefore considered an appropriate metric to assess glazing attenuation for amplified music sources.

6.4 Assessment of activity noise emissions

With reference to the permissible activity noise limits identified above, such levels are higher than would be anticipated within the proposed development for patron and music noise.

Therefore, impact from activities associated within the licenced premises would be within the adopted design criteria set out above.

7 Construction noise

Assessment of demolition and construction noise is outside the scope of this DA report, however it should be noted that all work, including demolition, excavation, and building work should comply with Australian Standard 2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*.

8 Conclusions

This report presents acoustic input to the DA submission for the proposed licenced premises development at Site YP, Sydney Olympic Park.

Based on appropriate standards and guidance, noise impact on the development from the surroundings has been assessed. It has been determined that standard glazing solutions should provide an acceptable environment within the proposed development.

Noise limits on the cumulative emissions from plant items have been set to see that any noise impact of the development on surrounding noise-sensitive receivers is acceptable.

The potential impact of activity noise has been assessed, based on values set out in the City of Sydney guidelines. Based on the distance to the nearest noise-sensitive façade and the performance of glazing elements, external and internal noise limits have been determined. The permissible internal noise levels determined indicate that typical activities associated with the development are unlikely to cause an adverse impact at the nearest noise-sensitive property.

Appendices

Appendix A Acoustic Terms

ASSESSMENT BACKGROUND LEVEL (ABL)

A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening or night time period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background L_{A90} noise levels – i.e. the measured background noise is above the ABL 90% of the time.

'A'-WEIGHTED SOUND LEVEL dBA

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dBA. An A-weighting network can be built into a sound level measuring instrument such that sound levels in dBA can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. An increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise. A change of 2 to 3 dB is subjectively barely perceptible.

DECIBEL

The ratio of sound pressures which we can hear is a ratio of one million to one. For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound level' (L) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

EQUIVALENT CONTINUOUS SOUND LEVEL (L_{Aeq})

Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level, which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

FREQUENCY

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kilohertz (kHz), eg 2 kHz = 2000 Hz. Human hearing ranges from approximately 20 Hz to 20 kHz. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used.

For more detailed analysis, each octave band may be split into three one-third octave bands or, in some cases, narrower frequency bands.

RATING BACKGROUND LEVEL (RBL)

A single-number figure used to characterise the background noise levels from a complete noise survey.

The RBL for a day, evening or night time period for the overall survey is calculated from the individual Assessment Background Levels (ABL) for each day of the measurement period, and is numerically equal to the median (middle value) of the ABL values for the days in the noise survey.

SOUND POWER AND SOUND PRESSURE

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source.

The sound pressure level (L_p) varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its mass), which is not affected by the environment within which the source is located.

STATISTICAL NOISE LEVELS

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index that allows for this variation. 'A'-weighted statistical noise levels are denoted L_{A10}, dB L_{A90} etc. The reference time period (T) is normally included, e.g. dB $L_{A10\ 5min}$ or dB $L_{A90,8hr}$.

$L_{A90\ (T)}$

Refers to the sound pressure level measured in dBA, exceeded for 90% of the time interval (T) – i.e. measured noise levels were greater than this value for 90% of the time interval. This is also often referred to the background noise level.

$L_{A10\ (T)}$

Refers to the sound pressure level measured in dBA, exceeded for 10% of the time interval (T). This is often referred to as the average maximum noise level and is frequently used to describe traffic noise.

$L_{A1\ (T)}$

Refers to the sound pressure level measured in dBA, exceeded for 1% of the time interval (T). This is often used to represent the maximum noise level from a period of measurement.