

SOPA FERRY WHARF SITE

DA Acoustic Assessment

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Contents

1	Introduction	1
2	Description of site and proposal	2
2.1	Existing site	2
2.2	Future setting of site	2
2.3	Description of proposal	3
2.4	Acoustic considerations	5
3	Operational noise criteria	6
3.1	Policies and guidelines	6
3.1.1	SOPA Master Plan 2030	6
3.1.2	General operational criteria	6
3.1.3	Licensed premises	6
3.2	Project noise goals	7
3.3	Alternative criteria for retail uses	8
4	Noise intrusion criteria for residential premises	10
4.1	'Criteria related to background' and 'Fixed noise level' criteria	10
4.2	AS2107:2000	11
4.3	AAAC ratings	11
4.4	Project noise goals	11
5	Operational noise assessment	12
5.1	Noise sources	12
5.1.1	Ground floor restaurant/cafes	12
5.1.2	Site loading dock	12
5.1.3	Child care centre	13
5.1.4	UAP school	13
5.1.5	Mechanical plant and equipment	14
5.1.6	Operational noise source locations	14
5.2	Assessment locations	15
5.3	Noise predictions and discussion	15
5.3.1	Ground level retail (cafes/restaurants)	15
5.3.2	Loading dock	16
5.3.3	Childcare centre	17
5.3.4	UAP school outdoor play area	17
5.3.5	Mechanical plant	18
6	Residential noise intrusion assessment	19
7	Conclusion	20
APPENDIX A	Glossary of terminology	21

List of tables

Table 1:	AS1055.2-1997 Environmental Noise Part 2 - Appendix A	8
Table 2:	AAAC star ratings for residential internal noise levels	11
Table 3:	Project noise goals for residential internal noise levels	11
Table 4:	Commercial premises source noise levels - L_{eq}	12
Table 5:	Delivery vehicle source noise levels	12
Table 6:	Child care centre source noise levels	13
Table 7:	UAP school outdoor active play area noise levels	13
Table 8:	Cumulative predicted noise level assessment L_{Aeq}	16
Table 9:	Cumulative predicted noise level assessment L_{Aeq}	16
Table 10:	Child care predicted noise level assessment L_{Aeq}	17
Table 11:	UAP school predicted noise level assessment L_{Aeq}	18
Table 12:	Indicative residential façade acoustic treatment, external noise level L_{Aeq} 65-70dB(A)	19

List of figures

Figure 1:	Existing site location	2
Figure 2:	Future site setting	3
Figure 3:	Level 1 plan indicating noise source locations	14
Figure 4:	Residential assessment locations	15

1 Introduction

Renzo Tonin & Associates was engaged by Ionic Management Pty Ltd to review the acoustic aspects relating to the proposed mixed use development at the Sydney Olympic Park Authority (SOPA) Ferry Wharf site. The proposed development site is bound by Wentworth Point Urban Activation Precinct which has been identified for rezoning and urban development.

The purpose of this assessment is to outline the acoustic parameters, design aspects and criteria relevant to the development in regard to operational noise impact onto noise sensitive uses, as well as noise impact upon the proposed residential component of the development.

As an overview, the following objectives for the development have been identified:

- To provide acceptable acoustic amenity for the residential apartments, giving consideration to both internal and external (on balconies) areas. Assessment to include proposed retail uses and child care centre and other nearby noise sources, particularly the proposed adjacent school, and
- To not unduly restrict the operations of the ground floor commercial premises, either through onerous operating hours or capacity restrictions etc.

The work documented in this report was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001. Appendix A contains a glossary of acoustic terms used in this report.

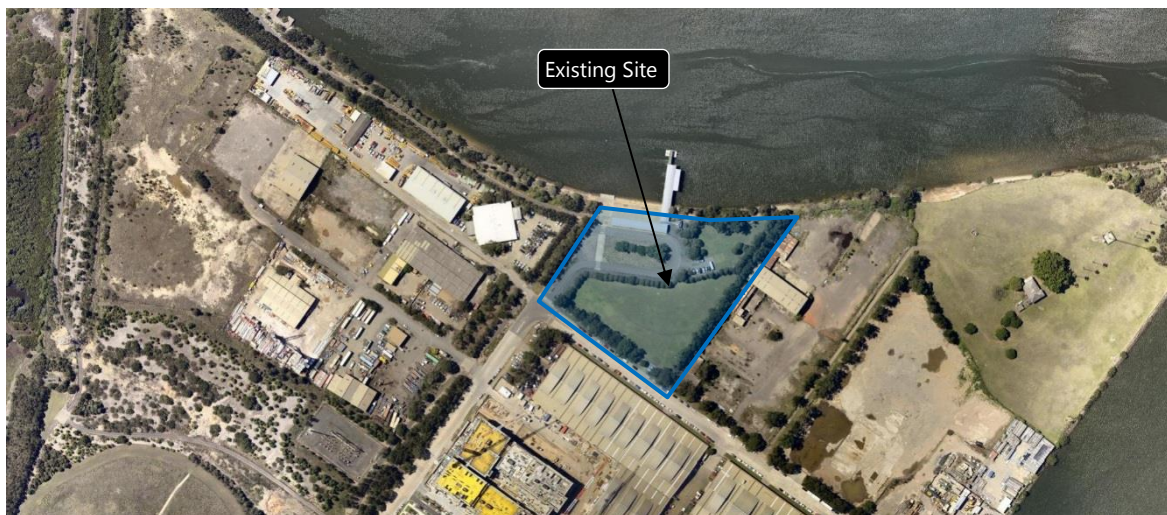
2 Description of site and proposal

The following section presents a description of the subject site and the proposed development.

2.1 Existing site

The proposed development is to be located at the SOPA Ferry Wharf site on Burroway Road, Wentworth Point, NSW. The site contains two road frontages with Hill Road to the west and Burroway Road to the south. The northern end of the site contains the Sydney Olympic Park Ferry Wharf which is used by various maritime and ferry services to transfer passengers between Circular Quay and Parramatta. The western boundary of the site is adjacent to a vacant industrial site.

Figure 1: Existing site location



2.2 Future setting of site

The NSW government is aiming to provide housing and employment for the expected increase of 1.3 million people predicted to reside in Sydney by 2031. On Saturday, 16 March 2013, the NSW government identified Wentworth Point as an Urban Activation Precinct (UAP) and it is proposed to rezone the existing industrial area into a new commercial and residential hub. The Wentworth Point UAP includes the land immediately surrounding the Ferry Wharf site to the northwest, southeast and south, but does not specifically include the subject site.

The UAP will include:

- A western neighbourhood that will predominantly accommodate high density housing
- A eastern neighbourhood that will include
 - High density housing
 - New school with 18 classrooms (scheduled to open in 2017)

- Community facilities
 - Maritime facilities that may include dry boat storage and rowing kayaking facility adjacent to the western side of Homebush Bay
 - Small scale supporting commercial uses such as shops, cafes and possibly a small supermarket to service the residents of the precinct
 - Open space distributed throughout the precinct, including peninsula park, foreshore paths and maritime plaza
- A new bridge across Homebush Bay to the Rhodes peninsula for pedestrians, cyclists, buses and emergency vehicles.

Figure 2 presents the subject SOPA Ferry Wharf site situated between the Wentworth Point UAP.

Figure 2: Future site setting



2.3 Description of proposal

The proposal for the SOPA Ferry Wharf site is for construction of a 10 storey mixed use premises containing three basement level car parks, ground floor retail/commercial premises including a child care centre and mini major, as well as nine levels of residential apartments. This assessment has been based on architectural drawings prepared by Rice Daubney. Details of the relevant drawings which have been referenced for the report are provided below:

Drawing no.	Issue	Drawing title
DA-0000	-	Cover Sheet
DA-0001	E	Location Plan

Drawing no.	Issue	Drawing title
DA-0002	E	The Concept
DA-0003	G	Site Analysis
DA-0004	E	Site Survey
DA-0005	G	Site Plan
DA-0006	E	GFA
DA-0008	E	Images Sheet 01
DA-0009	E	Images Sheet 02
DA-0010	E	Images Sheet 03
DA-0011	C	Exterior Finishes
DA-1001	F	Basement Level 3
DA-1002	F	Basement Level 2
DA-1003	F	Basement Level 1
DA-1201	H	Level 1
DA-1301	I	Level 2
DA-1302	H	Level 3
DA-1303	G	Level 4
DA-1304	G	Level 5
DA-1305	H	Level 6
DA-1306	G	Level 7
DA-1307	H	Level 8
DA-1308	G	Level 9
DA-1401	E	Level 10
DA-1500	G	Site Elevations
DA-1501	G	Elevations N and S
DA-1502	G	Elevations Bldg A E and W
DA-1503	G	Elevation Bldg B E and W
DA-1504	G	Elevation Bldg C E and W
DA-1550	G	Elevation Bldg A W and N
DA-1551	G	Elevation Bldg A E and S
DA-1552	G	Elevation Bldg B W and N
DA-1553	G	Elevation Bldg B E and S
DA-1554	G	Elevation Bldg C W and N
DA-1555	G	Elevation Bldg C E and S
DA-1556	G	Elevation Bldg C Cuts
DA-1601	B	Section
DA-3101	C	Accessible Units
DA-8001	E	Winter
DA-8002	E	Summer
DA-8003	E	Equinox

At this stage of the development specific uses of the ground floor commercial premises have not been determined however restaurants and cafes are expected. Furthermore, details of the child care centre including number of children and operating hours have not been determined.

2.4 Acoustic considerations

The acoustic aspects addressed in this report include:

- Operational noise emission from retail/commercial uses including patron and music noise, mechanical services equipment, loading dock operations to residential apartments above
- Operational noise from child care centre to residential apartments above, and
- Ambient noise intrusion study for the residential apartments, including local road traffic and proposed school.

3 Operational noise criteria

The following section presents a discussion regarding operational noise criteria.

3.1 Policies and guidelines

3.1.1 SOPA Master Plan 2030

A review of the SOPA Master Plan 2030 did not reveal any acoustic criteria or requirements applicable to the subject site or Wentworth Point Urban Activation Precinct. Detailed discussion regarding acoustic design principles and constraints was also not identified in the preliminary reports prepared for the planning of the UAP.

3.1.2 General operational criteria

In the absence of specific noise criteria stipulated by the consent authority, reference is made to the NSW *Noise Guide for Local Government* (NGLG). According to the NGLG, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The intrusiveness criterion is summarised as follows:

- $L_{Aeq,15minute} \leq \text{Rating Background Level (RBL) plus 5dB(A)}$

The allowable $L_{Aeq,15minute}$ noise emission from a site is therefore dependant on the background noise level in an area without the subject development in operation. The background noise levels at times which the development is to operate therefore need to be quantified.

3.1.3 Licensed premises

Noise emission from licensed premises in NSW, such as restaurants, bars and clubs, should aim to comply with the standard noise criteria set by the NSW Office of Liquor, Gaming and Racing (OLGR). The OLGR criteria apply to all noise emission associated with activities from the licensed area of the premises, including music and patron noise, but excludes mechanical services equipment.

The OLGR, through the Liquor Act 2007, is the regulatory authority that deals with noise pollution issues pertaining to licensed premises. The OLGR recommends the use of their standard noise criteria when assessing noise impact from licensed premises and when determining the occurrence of noise nuisance and annoyance. Noise emissions are assessed in terms of the noise limits set out in the OLGR's 'Standard Noise Condition' which states as follows:

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

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

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

Interior noise levels which still exceed safe hearing levels are in no way supported or condoned by the NSW Office of Liquor, Gaming and Racing.

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

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

For the assessment of inaudibility Renzo Tonin and Associates adopt a design criterion of 10dB below the background noise level in each octave band for intermittent noise sources such as patrons and music. For steady state sources such as mechanical plant, a design criterion of 5dB below the background level in each octave band is adopted.

Similar to the intrusiveness criteria, the OLGR criteria, requires the background noise levels to be quantified. In comparison to the intrusiveness criteria, the OLGR criteria is more stringent as it applies in each octave band and has more onerous requirements between 12 midnight and 7am.

3.2 Project noise goals

The noise environment to which the proposed development will be situated will differ once the site and surrounding area has been redeveloped. While marine activities may be similar, increased pedestrian activity, traffic, mechanical plant and retail activity are expected to alter the ambient noise levels and character of the area. The extent to which this future activity impacts the residential apartments is dependent upon the siting and design of the other noise generating development/sources and the patterns of pedestrian movement in the area. Noise levels are also expected to vary at the different facades of the residential apartments due to their orientation to these activities.

The acoustic amenity of occupants of residential apartments is genuinely dependant on the establishment of relevant noise goals which are determined by measurement of existing background noise levels. However, due to the expected change in the noise environment, determination of relevant noise goals cannot be determined through measurement.

Reference has therefore been made to Appendix A of AS1055.2-1997 'Environmental Noise Part 2', which provides average background noise levels categorised by the type of environment. The average background noise levels of AS1055.2-1997 have been reproduced Table 1.

Table 1: AS1055.2-1997 Environmental Noise Part 2 - Appendix A

Noise area category (Notes 1 and 2)	Description of neighbourhood	Average background A-weighted sound pressure level, $L_{A90,T}$					
		Monday to Saturday			Sundays and public holidays		
		0700-1800	1800-2200	2200-0700	0900-1800	1800-2200	2200-0900
R1	Areas with negligible transportation	40	35	30	40	35	30
R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R4	Areas with dense transportation or some commerce or industry	55	50	45	55	50	45
R5 (See Note 3)	Areas with very dense transportation or in commercial districts bordering industrial districts	60	55	50	50	55	50
R6 (See Note 3)	Areas with extremely dense transportation or within predominantly industrial districts	65	60	55	65	60	55

- Notes
1. The division into noise area categories is necessary in order to accommodate existing sound levels encountered at residential sites in predominantly commercial or industrial districts, or in areas located close to main land transport routes, i.e. road and rail
 2. The noise area category most appropriate should be selected irrespective of metropolitan or rural zoning and will vary from location to location.
 3. Some industrial and commercial sites are not predominant sources of high background sound levels.

Following completion of the SOPA development and surrounding developments in the area, it is expected that the acoustic environment of Wentworth Point UAP would be similar to Noise Area Category R3. The preliminary noise goals for this assessment have been based accordingly.

3.3 Alternative criteria for retail uses

As outlined, the standard operational noise criteria are relative to the existing background noise level at the sensitive receptor location. This is in contrast to road traffic noise intrusion, which is assessed against a fixed L_{Aeq} noise level criterion.

Standard noise policy and criteria applicable to retail type development places the onus of noise control and management upon the operator (noise emitter). With respect to the SOPA Ferry Wharf Site, it is understood that each retail tenancy will need to seek development approval and therefore unless

otherwise agreed, would be subject to the consent authorities standard conditions of consent, which may include requirements to mitigate noise impact upon sensitive receiver locations. Where retail uses are in close proximity to residential premises this can restrict the operational flexibility of the retail premises, such as:

- limiting operating hours,
- prohibiting or minimising the extent of outdoor seating
- prohibiting or minimising the extent openable facades,
- limiting music noise levels etc.

Further to the above, the control of noise at the commercial premises does not address noise from the public realm. The criteria do however protect both the internal and external amenity of residential premises without the need for any specific acoustic treatment to the residential building.

Where retail uses cannot practically achieve compliance with the standard noise criteria, consideration could be given to alternative noise criteria. The obvious alternative to applying controls at the source of noise is to apply the mitigation measures at the receptor location. In this case, the typical design response would be to design the residential building envelope to control noise intrusion. The following design and planning aspects however need to be considered:

- Windows and doors to residential apartments would typically be required to remain closed in order for the acceptable level of amenity to be achieved
- The closure of windows may affect the provision of ventilation
- External amenity of residential premises (balconies) is still affected by noise
- Residents may need to be advised of this design solution – expectations managed
- An acceptable internal noise level needs to be determined
- A design criterion for the façade system needs to be established and a noise limit for the retail sector is still required
- Requires a change to the standard conditioning of development and mechanisms for complaint. Retail consents would need to reflect any alternative noise criteria

Noise emission from the proposed operation of the retail sector has been assessed within this report. Where the assessment reveals the standard noise criteria are unlikely to be met without onerous controls, consideration of alternative noise criteria has been given. The noise intrusion criteria for residential premises have been discussed further in the following section of this report.

4 Noise intrusion criteria for residential premises

Noise intrusion assessment for residential premises is generally isolated to transportation noise sources such as road, rail and aircraft noise. However in the case of the subject site, other noise sources with the potential to affect the amenity of residents have been identified. These include the proposed retail (as discussed in the preceding section) and future school proposed to the east of the site as part of the UAP.

Regarding road traffic, the traffic report prepared for the subject site¹ indicates traffic on the local road network following the site and UAP development will be low (PM peak 407 veh/hr) and therefore road traffic noise is not deemed a design constraint for the residential development. Consideration should however be given to bus routes and stops when determining final design specification for the development. No further consideration has been given within this report.

As there are no statutory or regulative requirements applicable to the site in regard to noise intrusion, discussion has been provided regarding noise criteria that could be adopted for the site. It is expected that decision regarding the appropriate criteria may be determined following approval and, may also consider marketing requirements for the project. The following criteria and recommendations that follow may therefore be subject to review.

4.1 'Criteria related to background' and 'Fixed noise level' criteria

Regarding the adoption of alternative noise criteria for retail noise emissions, it is important to note the difference in noise criteria applicable to retail type operations, when compared with other sources such as road traffic, rail and aircraft. As outlined, the criteria for assessing noise from retail type development at residential receptors are compared against the prevailing background noise level. It is the emergence of noise above the background noise level that determines the how audible the noise may be.

By comparison, the noise criteria for road traffic, trains or aircraft are fixed noise levels relevant to the type of receptor location and are therefore independent of the prevailing background noise level inside the residential premises. These criteria do not necessarily address the audibility of noise, but rather set a fixed noise level at which the particular noise source is considered acceptable. In the case of fixed noise level criteria, the control of noise can be readily addressed by the building envelope, as the outside noise can be reduced down to the prescribed level.

However when the background noise level is relevant to the assessment, the blocking out of external noise by the building envelope can also reduce the internal background noise level within a noise sensitive premise. As a result, the more the external noise is reduced, so too can the background noise level. With this complexity, criteria related to the background noise level are not readily adopted for proposed sites. Fixed noise level criteria have therefore been adopted for the design of residential premises.

¹ Henson Consulting, Feb 2014, 'Proposed Development SOPA Site, Wentworth Point - Transport Impact Study',

4.2 AS2107:2000

Australian Standard 2107:2000 sets recommended internal noise levels for steady/quasi-steady state sounds such as road traffic noise. Noise from patrons and the public realm is not necessarily steady/quasi-steady state and therefore AS2017:2000 has not been relied upon for this project.

4.3 AAAC ratings

The Association of Australian Acoustical Consultants (AAAC) also provides guidance on internal noise levels within residential premises. The AAAC guideline outlines a star rating system which adopts an L_{Aeq} criteria for continuous noise sources and also includes an average L_{Amax} criteria for intermittent noises.

Table 2 presents the external noise intrusion criteria from the AAAC rating system.

Table 2: AAAC star ratings for residential internal noise levels

Descriptor	AAAC star rating and internal noise level				
	2 Star	3 Star	4 Star	5 Star	6 Star
Bedrooms					
Continuous noises $L_{Aeq} \leq$	36dB(A)	35dB(A)	32dB(A)	30dB(A)	27dB(A)
Intermittent noises ave $L_{Amax} \leq$	50dB(A)	50dB(A)	45dB(A)	40dB(A)	35dB(A)
Other habitable rooms including open kitchens					
Continuous noises $L_{Aeq} \leq$	41dB(A)	40 dB(A)	37 dB(A)	35 dB(A)	32dB(A)
Intermittent noises ave $L_{Amax} \leq$	55dB(A)	55 dB(A)	50 dB(A)	45 dB(A)	40dB(A)

Notes: Measurements are made in bedrooms and any nominated habitable rooms. Bedrooms are measured over a period between 2200hrs and 0700hrs. Noise measurements in other habitable rooms are undertaken between 0600 to 2400hrs. In any event the measurement period must be representative of the noise being measured. Measurements must include L_{Aeq} and L_{Amax} .

4.4 Project noise goals

The AAAC 3-star rating criteria have been adopted as the preliminary design criteria inside residential apartments.

Table 3: Project noise goals for residential internal noise levels

Area of residential premise	Continuous noises $L_{Aeq} \leq$	Intermittent noises ave $L_{Amax} \leq$
Bedrooms	35dB(A)	50dB(A)
Other habitable rooms including open kitchens	40 dB(A)	55 dB(A)

Notes: Measurements are made in bedrooms and any nominated habitable rooms. Bedrooms are measured over a period between 2200hrs and 0700hrs. Noise measurements in other habitable rooms are undertaken between 0600 to 2400hrs. In any event the measurement period must be representative of the noise being measured. Measurements must include L_{Aeq} and L_{Amax} .

5 Operational noise assessment

The following section provides an indicative assessment of expectant noise levels resulting from the operation of the various noise sources of the development and surrounding site. Further detailed acoustic assessment is recommended once detail operations of each commercial premise are determined.

5.1 Noise sources

5.1.1 Ground floor restaurant/cafes

At this early stage of the development, specific uses of the ground floor commercial premises have not been determined. As the ground floor commercial premises are expected to include cafes and restaurants, as worst case scenario, the acoustic assessment has been based on all retail uses being hospitality venues. Table 4 presents the source noise levels adopted for the assessment which have been determined from measurements previously conducted by Renzo Tonin & Associates.

Table 4: Commercial premises source noise levels - L_{eq}

Noise source	Overall dB(A)	Octave band centre frequency – Hz (dBZ) (for highest level)								
		31.5	63	125	250	500	1k	2k	4k	8k
Internal Patrons & Low Background Music (Lp)	84	70	72	72	73	81	81	77	40	68
Outdoor patrons without Music (Lw per person)	79	-	67	67	72	78	75	70	62	51

5.1.2 Site loading dock

A single loading dock is proposed off street level at the south west corner of the site, situated below residential apartments. Typical noise source activities associated with loading dock areas are likely to involve human voice, the loading and unloading of stock and deliveries, as well as noise from delivery vehicles. Based on previous experience, noise associated with delivery vehicles and unloading with pallet jacks and forklifts are likely to be the dominate noise sources associated within loading dock activities. The assumed source noise level of loading docks has been based on previous measurements conducted by Renzo Tonin and Associates. The source noise levels have been presented in Table 5.

Table 5: Delivery vehicle source noise levels

Description	Overall dB(A)	Octave band centre frequency – Hz (dBZ) (for highest level)								
		31.5	63	125	250	500	1k	2k	4k	8k
Loading Dock - Refrigerated Truck (L_{eq} Lw)	92	5	43	55	75	84	88	87	80	67

5.1.3 Child care centre

The assumed source noise levels for children playing and other activities in the centre have been based on previous measurements conducted by Renzo Tonin and Associates. The sound power levels recommended in the Association of Australian Acoustical Consultants (AAAC) Guideline for Child Care Centre Acoustic Assessment were used in the calculations for the external play area. The sound power levels obtained from the guideline are adjusted to take into consideration the number of children in each age group to enable prediction of noise levels to receiver locations. The source noise levels are based on the outdoor areas being used for active play (eg. children free play). Noise levels will be lower when the outdoor play areas are used for passive type activities (eg. learning activities such as story reading).

Table 6 presents the child care centre source noise levels used for the assessment. The highest noise levels for age group 3 to 5 years have been used for a conservative assessment due to the specific details of operation not being determined at this stage of the development.

Table 6: Child care centre source noise levels

Description	Overall dB(A)	Octave band centre frequency – Hz (dBZ) (for highest level)								
		31.5	63	125	250	500	1k	2k	4k	8k
Internal child care centre - L _{Aeq} sound pressure level										
Children	60 - 74	-	-	-	-	65	69	68	65	59
Outdoor play - sound power levels										
20 x 3 to 5 year olds	93	-	-	-	-	84	88	88	85	79

5.1.4 UAP school

It is understood that a school is proposed with the Wentworth Point UAP to the east of the subject site. Noise emission from the adjacent school may impact upon the residences of the site. While there is no specific noise criterion applicable to schools, predicted noise levels have been assessed against the intrusive criteria and project internal noise goals.

The primary activities potentially impacting the residential apartments is use of the outdoor playing fields, both during and outside school hours. The source noise levels for children playing in the outdoor area of the school have been based on previous measurements conducted by Renzo Tonin and Associates. Source noise levels are presented in Table 7 and are representative of active play. The sound power level is notated per square metre and has been distributed across the identified play area. The student capacity is unknown however the noise level is approximately equivalent to one student per $10m^2$.

Table 7: UAP school outdoor active play area noise levels

Description	Overall dB(A)	Octave band centre frequency – Hz (dBZ)								
		31.5	63	125	250	500	1k	2k	4k	8k
School Outdoor Area ($L_{eq} Lw/m^2$)	75	-	-	66	65	69	72	70	61	46

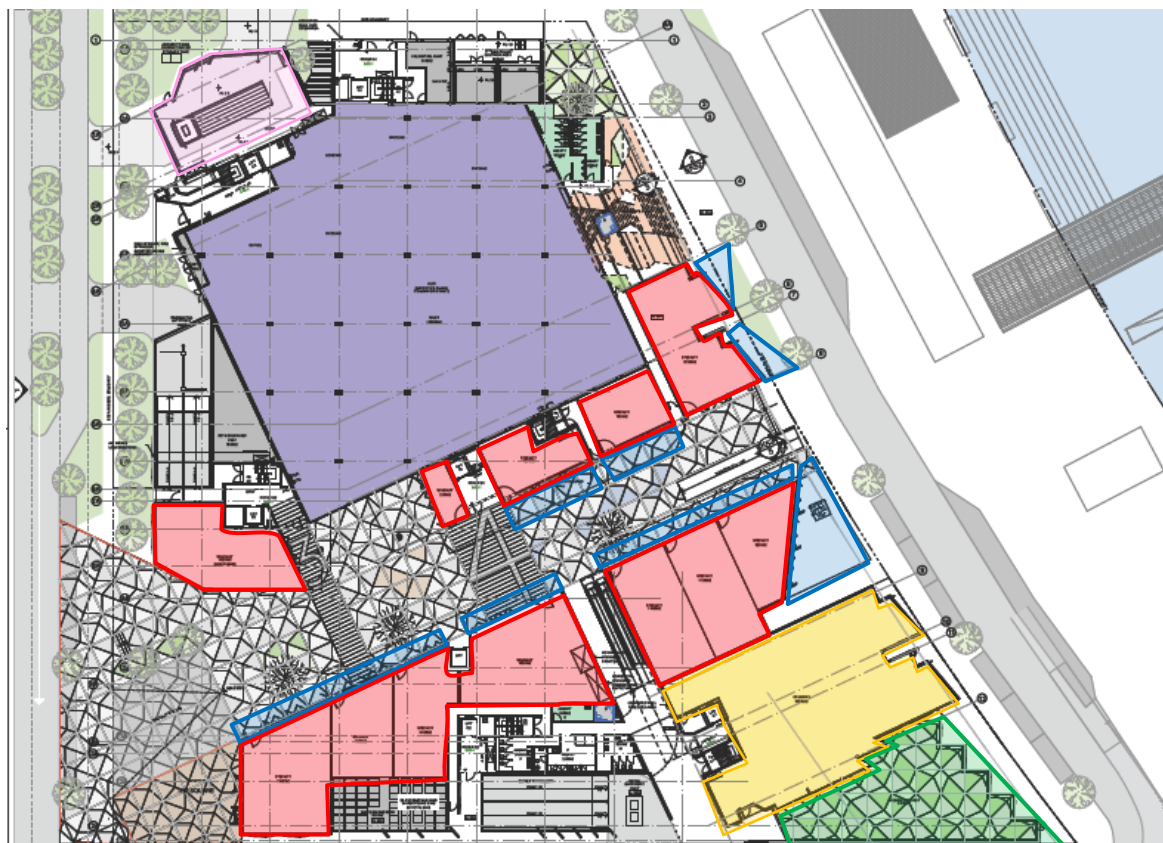
5.1.5 Mechanical plant and equipment

Detailed acoustic assessment of mechanical plant noise emission will occur at a later stage of the development, at a time when specifications and plant selection have been made. However, it is understood that mechanical plant and equipment is to be predominantly located within basement level 1 and rooftops of the residential towers. Positioning mechanical plant and equipment within underground and enclosed basement areas will significantly reduce the impact of mechanical noise emission on nearby sensitive receivers.

5.1.6 Operational noise source locations

Figure 3 presents the locations of the various noise sources associated with the development, including loading docks, child care centre, commercial premises and assumed locations of outdoor beer gardens associated with the commercial premises. It is advised that noise associated with the mini major is likely to be contained within the premises. It has been assumed that noise emission from patron egress associated with the mini major is likely to be well below noise levels from the various ground floor commercial premises.

Figure 3: Level 1 plan indicating noise source locations



LEGEND

- | | |
|--|---|
| Restaurant/Café Premises Internal Areas | Restaurant/Café Outdoor Seating |
| Child Care Centre Internal Area | Loading Dock |
| Child Care Centre Outdoor Play Area | |

5.2 Assessment locations

The nearest locations most potentially affected by the various noise sources outlined in **Figure 3**, have been identified and are presented in **Figure 4**. The nearest most affect locations are on Level 2 of the subject development.

Figure 4: Residential assessment locations



5.3 Noise predictions and discussion

Noise modelling has been undertaken to determine the external noise levels received at the assessment locations presented in **Figure 4**. While some locations may be affected by the cumulative impact of multiple sources, predicted noise levels and discussion regarding potential noise control have been separated to the identified activities.

5.3.1 Ground level retail (cafes/restaurants)

The calculated noise levels have assumed all retail spaces operating simultaneously at full capacity with full frontages of premises open (operable facades). One patron per square metre has been assumed for outdoor seating areas. At this stage, the operating hours of the premises are envisaged as 9am to 11pm.

Table 8: Cumulative predicted noise level assessment L_{Aeq}

Assessment location	Predicted overall $L_{Aeq\ 15minute}$ dB(A)	Intrusive noise criteria - R3 noise category area		
		Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)
A3	50	55	50	45
A4	58	55	50	45
A5	73	55	50	45
A6	69	55	50	45
A7	72	55	50	45
A8	71	55	50	45
A9	72	55	50	45
A10	70	55	50	45
A11	62	55	50	45
A12	62	55	50	45
A13	73	55	50	45

The prediction results reveal that the most impacted locations are those located directly over the outdoor areas, and where solid balconies/awnings are not provided. While the noise predictions may be considered conservative in terms of the number of hospitality venues, patron capacity and extent of open façade, they provide an indication of potential noise impact should noise controls and further design development not be considered. It is expected that these design parameters will be refined during the design development so as to ensure a balance between retail operations and residential façade design. For example, operation during the evening and night time period (10pm to 11pm) may be controlled through limiting the number of outdoor seating and extent of open retail facades. Furthermore, it is recommended that acoustic controls be incorporated into design of the retail tenancies, such as use of acoustically absorptive finishes to ceilings and awnings, and potentially internal walls.

The predicted noise levels have however been used for further assessment against the alternative noise criteria for the residential development (Section 6).

5.3.2 Loading dock

The calculated noise levels have assumed a refrigeration delivery truck entering the loading area, while loading operations would take place with the roller doors closed. It is noted that closure of roller doors will provide only marginal benefit as perforated doors are identified for ventilation.

Table 9: Cumulative predicted noise level assessment L_{Aeq}

Assessment location	Predicted Overall $L_{Aeq\ 15minute}$ dB(A)	Intrusive noise criteria - R3 noise category area		
		Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)
A1	56	55	50	45
A2	53	55	50	45

It is recommended that the use of loading dock areas is restricted to the hours of 7am to 10pm. It is noted that further detailed design of the loading area would be expected to achieve compliance with the evening noise goals.

Mitigation measures for the loading docks are expected to include:

- Minimise opening through access doors
- Acoustic upgrade to ceiling, such as a supplementary acoustically sealed ceiling, particularly for waste pipes and services that penetrate the floor slab,
- Acoustic absorptive finish to ceiling/soffit,
- Vibration/structural isolation of loading platforms from the supporting structure common with the residential apartments above,
- Impact noise control to load bearing walls for pallet jack and loading activities,
- Vibration isolation of mechanical equipment and door motors.

5.3.3 Childcare centre

The calculated noise levels are based upon 20 children at active play in the outdoor area. The current design has no provision for a solid awning/roof over the outdoor play area and therefore residential apartments currently overlook the play area. Assessment is made only against the daytime noise criteria.

Table 10: Child care predicted noise level assessment L_{Aeq}

Assessment location	Predicted overall $L_{Aeq\ 15\text{minute}}$ dB(A)	Intrusive noise criteria - R3 noise category area		
		Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)
A14	62	55	n/a	n/a

While noise impact from use of the outdoor play area will be limited to daytime hours, given that the apartments affected by the child care centre will also be affected by noise from the adjacent school, noise mitigation is recommended to be incorporated into the design of the child care centre. It is recommended that a solid roof be provided over the outdoor play area. The extent of roof would be dependent upon the detailed operations of the childcare centre; however provision should be made for its inclusion. The roof would need to be of a solid impervious material with sufficient mass to provide adequate noise reduction through the structure. Material selection and detailed specification should be determined during design development.

5.3.4 UAP school outdoor play area

The calculated noise levels have assumed all retail spaces operating simultaneously at full capacity with full frontages of premises open (operable facades). Assessment is made only against the daytime noise criteria.

Table 11: UAP school predicted noise level assessment L_{Aeq}

Assessment location	Predicted overall $L_{Aeq\ 15\text{minute}}$ dB(A)	Intrusive noise criteria - R3 noise category area		
		Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)
A14	65	55	n/a	n/a

As the Ferry Wharf development has no control of over the management and control of noise from the proposed school, it is recommended that the residential apartments be suitably designed to provide suitable acoustic amenity within apartments (windows and doors closed if required). Further discussion is provided in Section 6 of this report.

5.3.5 Mechanical plant

Mechanical plant associated with the development has the potential to impact on nearby noise sensitive properties. In order to carry out a quantitative assessment of mechanical equipment, a complete specification of equipment is required. At this stage of development appropriate detail for mechanical plant is not typically available. Therefore in-principle measures have been outlined only:

- Acoustic assessment of mechanical services equipment should be undertaken during the detail design phase of the development to ensure that the cumulative noise of all equipment does not exceed the applicable noise criteria.
- Noise control treatment can affect the operation of the mechanical services system. An acoustic engineer should be consulted during the initial design phase of mechanical services system to reduce potential redesign of the mechanical system.
- Mechanical plant noise emission can be controlled by appropriate mechanical system design and implementation of common engineering methods, which may include:
 - strategic positioning of plant away from sensitive neighbouring premises to maximise intervening acoustic shielding between the plant and sensitive neighbouring premises. It is understood that mechanical plant and equipment is predominantly going to be located within basement level 1. Positioning mechanical plant and equipment within underground and enclosed basement areas will significantly reduce the impact of mechanical noise emission on nearby sensitive receivers.
 - commercially available acoustic attenuators for air discharge and air intakes of plant
 - acoustically lined and lagged ductwork
 - acoustic barriers between plant and sensitive neighbouring premises
 - partial or complete acoustic enclosures over plant
- The specification and location of mechanical plant should be confirmed prior to installation on site, and
- Fans shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 '*Rotating and Reciprocating Machinery – Mechanical Vibration*'.

6 Residential noise intrusion assessment

A preliminary assessment has been undertaken for the Level 2 residential apartments affected by noise from the hospitality uses on Level 1 and the UAP school, as identified in the preceding section.

This assessment has been carried out in order to provide an indication of the potential acoustic mitigation measures and demonstrate that the noise objectives can be practically achieved. Acoustic treatment to apartments on higher floors and less exposed orientations would have reduced acoustic requirements.

Assuming external noise levels at the façade of Level 2 residential premises ('free field' level) to be between 65 and 70dB(A), the following in-principle building envelope treatments are likely to be required when considering the AAAC 3 Star internal noise level criteria. The acoustic recommendations focus on the window/door glazing as it is typically the weakest element of the building envelope in regard to noise intrusion.

Table 12: Indicative residential façade acoustic treatment, external noise level L_{Aeq} 65-70dB(A)

Room type	Internal criteria	Façade element	Acoustic Rating (Rw)	Indicative construction
Bedroom	L_{Aeq} 35	Glazing	35 – 42*	10.38mm laminated glazing with acoustic seals, up to Laminated double glazed, insulated glazing unit or Balcony operable glazing and secondary single glazing.
Living rooms and other habitable Areas	L_{Aeq} 40	Glazing	28 - 33	6.38mm laminated glazing with acoustic seals, up to 10.38mm laminated glazing with acoustic seals or Balcony operable glazing and secondary single glazing.

Notes: Bedroom - 12m² floor area, glazing area 5.5m²
 Living Room - 30m² floor area, glazing area 12m²
 Wall construction is recommended to have an acoustic performance 10-15dB greater than the specified glazing.
 * Higher Rw performance expected that is not directly relative to the dB difference in external noise level.

It is noted that the floor/ceiling construction of Level 2 apartments is also expected to require acoustic treatment, however will be dependent upon the nature of the Level 1 use. Given that the building construction will comprise a concrete slab separating the ground floor retail and first floor residential occupancies, acoustic upgrade is likely to be in the form of a supplementary acoustically sealed ceiling in the retail tenancies. As outline in the preceding section, it is also recommended that acoustically absorptive finishes to ceilings and awnings, and potentially internal walls, form part of the fit-out of the retail tenancies.

7 Conclusion

Renzo Tonin & Associates has completed an acoustic review and assessment of the proposed mixed use redevelopment at the Sydney Olympic Park Authority (SOPA) Ferry Wharf site. The purpose of the assessment was to outline the parameters, design aspects and relevant acoustic criteria in relation to operational noise emission and noise impact upon the development.

At this stage of the development, there is insufficient detail to carry out a detailed acoustic assessment of the proposed development, particularly with regarding to retail and commercial uses. However, we have considered the following acoustic aspects of the development:

- Operational noise emission from potential hospitality uses at Level 1, child care centre and min-major loading dock operations
- Ambient noise intrusion to residential apartments, considering both uses within the site and surrounding environment such as traffic and the proposed school within the UAP

The assessment made the following findings:

- Operational noise from the site can be management through a combination of physical noise controls and management measures. In-principle measures have been outlined; however detailed acoustic assessment should be undertaken once the operation of each commercial premises and child care centre has been determined. Detailed assessment to include mechanical plant and equipment noise emission.
- Consideration should be given to the design and implementation of roofs/awnings of outdoor areas, both of the proposed child care centre and outdoor seating areas.
- The acoustic amenity of residential premises can be provided through a combination of noise control and management of commercial operations, and through specification of the residential building envelope,

APPENDIX A Glossary of terminology

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

Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period	The period in a day over which assessments are made.
Assessment Point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background Noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L _{Max}	The maximum sound pressure level measured over a given period.
L _{Min}	The minimum sound pressure level measured over a given period.
L ₁	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L ₁₀	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.

L ₉₀	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L _{eq}	The “equivalent noise level” is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound Absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.