APPENDIX D: ROAD TRAFFIC NOISE ASSESSMENT PREPARED BY RENZO TONIN

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

296-298 BOTANY RD & 284 WYNDHAM ST

Road Traffic Noise Assessment

1 December 2015

City of Sydney Council

TH772-01F02 (r2) 296-298 Botany Rd

Sydney Melbourne Brisbane Kuwait
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1 Introduction

Renzo Tonin & Associates was engaged to conduct a road traffic noise impact assessment for a proposed residential development site located at 296-298 Botany Rd and 284 Wyndham St, Alexandria. The assessment is required to determine the impact of future road traffic noise (year 2036) on two built form scenarios under consideration by the City of Sydney Council.

The assessment will be used to establish which areas of the future buildings, if any, are unable to comply with the ADG requirement for all habitable rooms to be naturally ventilated, while also satisfying the provisions of the SEPP (Infrastructure) 2007.

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 Project description

2.1 Site location

The subject site located at 296-298 Botany Rd and 284 Wyndham St, Alexandria, contains three road frontages, with Wyndham St to the west, Bourke St to the south and Botany Rd to the east. These roads currently carry high vehicle volumes and as redevelopment in Alexandria and Green Square continues, it is anticipated that these vehicle volumes and the resultant noise impact on the site will increase significantly.

Figure 1 presents an aerial photograph of the subject site and surrounding area.

Figure 1: Aerial photograph of subject site

2.2 Development proposal

The City of Sydney Council is currently considering two built form scenarios at the site. Both of the scenarios contain various multi story commercial tenancies and residential apartment buildings. The scenarios under consideration have been developed by:

- Option 1 - City of Sydney Council, and
- Option 2 - SJB.

3 Road traffic noise criteria

3.1 State Environmental Planning Policy (Infrastructure) 2007 (ISEPP)

The NSW State Environmental Planning Policy (Infrastructure) 2007 (known as 'ISEPP') came into force in NSW on 1 January 2008 to facilitate the effective delivery of infrastructure across the State. The aim of the policy includes identifying the environmental assessment category into which different types of infrastructure and services development fall and identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure.

Pertinent to noise assessment, the ISEPP includes the following clauses:

> *102 Impact of road noise or vibration on non-road development*
>
> *1. This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*
>
> *a. a building for residential use,*
>
> *b. a place of public worship,*
>
> *c. a hospital,*
>
> *d. an educational establishment or child care centre.*
>
> *2. Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*
>
> *3. If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
>
> *a. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,*
>
> *b. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.*
>
> *4. In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the Roads Act 1993*

3.2 Department of Planning publication 'Development near rail corridors and busy roads – Interim guideline'

To support the Infrastructure SEPP, the NSW Department of Planning released the *Development in Rail Corridors and Busy Roads – Interim Guideline* (December 2008). The Guideline assists in the planning,

design and assessment of developments in, or adjacent to, major transport corridors in terms of noise, vibration and air quality.

3.3 Clarification of ISEPP noise limits

The Guideline clarifies the time period of measurement and assessment. Section 3.4 '*What Noise and Vibration Concepts are Relevant*' and Table 3.1 of Section 3.6.1 confirms that noise assessment is based over the following time periods:

- Daytime 7:00am - 10:00pm $L_{Aeq(15hr)}$
- Night-time 10:00pm - 7:00am $L_{Aeq(9hr)}$

The noise criteria nominated in the ISEPP apply to internal noise levels with windows and doors closed. However as the preliminary noise assessment is based on predictions at external locations, equivalent external noise criteria has been established. The equivalent external noise criterion is used to determine which areas of the development may require acoustic treatment in order to meet the internal noise requirements of the ISEPP. The equivalent external goals have been determined on the following basis:

- *The ISEPP states: "If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia." The internal criteria with windows open is therefore 10dB(A) above the criteria explicitly outlined in the ISEPP.*
- The generally accepted noise reduction through an open window from a free-field external position is 10dB(A). Windows/doors are assumed to be open no more than 5% of room floor area, in accordance with the Building Code of Australia (BCA) ventilation requirements.

Table 1 presents the ISEPP internal noise criteria along with the equivalent external noise criteria for residential premises.

Table 1: ISEPP noise criteria for new residential development

Room	Location	$L_{Aeq, 15hr}$ Day 7am – 10pm	$L_{Aeq\ 9hr}$ Night 10pm – 7am
Living rooms*	Internal, windows closed	40	40
	Internal, windows open	50	50
	External free-field (allowing windows to remain open)^	60	60
Bedrooms*	Internal, windows closed	40	35
	Internal, windows open	50	45
	External free-field (allowing windows to remain open)^	60	55

Notes: * Requisite for 40,000AADT Roads only under ISEPP 2007.

^ ISEPP Guideline states that where internal noise criteria are exceeded by more than 10dB(A) with windows open mechanical ventilation is required. External goals have been calculated on the basis of nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the BCA 2011 requirements.

4 Road traffic noise assessment

4.1 Road design and traffic flow

Roads and Maritime Services (RMS) Strategic Model traffic data (2 hour peak hour traffic volumes) for the year 2036 have been obtained and have been utilised for the assessment. The Strategic Model traffic data is presented in Appendix B. The following calculations and assumptions were used for the road traffic noise modelling:

- The AADT is 6.5 times the average of the 2 hour peaks,
- The 15hr daytime volume is 85% of the 24hr volume,
- The 9hr night time volume is 15% of the 24hr volume, and
- The heavy vehicle percentage has been based on existing traffic counts.

The traffic volumes used for the assessment are presented in Table 2.

Table 2: 2036 future road traffic volumes

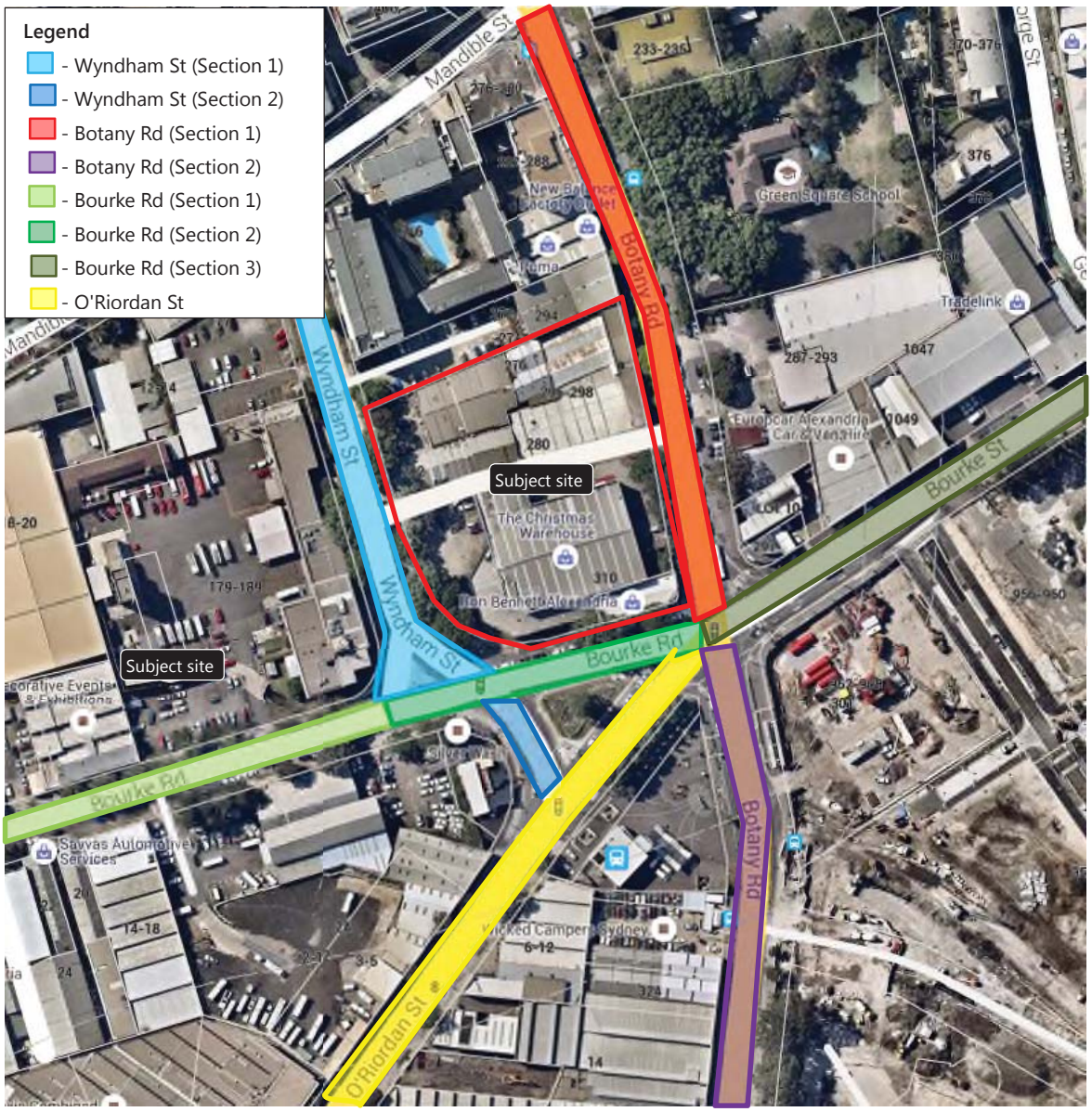
Road	Approach	2hr Predicted Traffic Volume		Calculated Traffic Volumes			% Heavy Vehicles
		AM Peak	PM Peak	AADT	15hr Day	9hr Night	
Wyndham St (Section 1)	North bound	1818	1742	11570	9835	1736	11
	South bound	1076	1161	7270	6180	1091	11
Wyndham St (Section 2)	North bound	837	951	5811	4939	872	11
	South bound	927	804	5626	4782	844	11
Botany Rd (Section 1)	North bound	1723	1446	10299	8754	1545	11
	South bound	1548	1479	9838	8362	1476	11
Botany Rd (Section 2)	North bound	2289	2046	14089	11975	2113	11
	South bound	2080	1856	12792	10873	1919	11
Bourke Rd (Section 1)	North bound	1186	1058	7293	6199	1094	8
	South bound	861	964	5931	5042	890	8
Bourke Rd (Section 2)	North bound	1294	1399	8752	7439	1313	8
	South bound	1801	1479	10660	9061	1599	8
Bourke Rd (Section 3)	North bound	3441	3273	21821	18547	3273	8
	South bound	3381	3240	21518	18291	3228	8
O'Riordan St	North bound	2643	2234	15850	13473	2378	10
	South bound	2200	2027	13738	11677	2061	7

Note is made that the modelled roads all contain an AADT lower than 40, 000 vehicles. While the ISEPP applies only to roads with an AADT greater than 40,000 vehicles, the guideline is also recommended for other road traffic noise affected sites.

Although there are both 'day' and 'night' traffic noise goals to be satisfied, based on the difference in traffic volumes between day and night, daytime was established as the worst case period for road traffic noise impacts.

The roads modelled in the assessment are indicated in Figure 2.

Figure 2: Modelled roads



4.2 Prediction methodology

Noise predictions are based on CoRTN, having been adapted to Australian conditions and extensively tested by the Australian Road Research Board. As a result it is recognised and accepted by the NSW Environmental Protection Authority (EPA). The model predicts noise levels for steady flowing traffic and noise from high truck exhausts is taken into account. The CoRTN algorithms are contained within the 'CadnaA' noise modelling software which has been used to calculate road traffic noise levels.

The noise prediction software takes into account the following:

Table 3: Summary of modelling inputs

Input Parameters	Input used
Traffic volumes and mix	As described in Section 4.1
Vehicle speed	50km/h
Gradient of roadways	Topographic data provided by RMS
Source height	0.5m for car exhaust, 1.5m for car and truck engines and 3.6m for truck exhaust.
Ground topography at receiver and road	2m Ground Contours obtained from the NSW Land & Property Information (LPI)
Angles of view from receiver	Calculated within CoRTN
Reflections from existing barriers, structures and cuttings on opposite side of road	Calculated within CoRTN
Air and ground absorption - Values vary between 0 (hard surface) to 1 (100% absorptive)	0 has been used in this study It is noted that where screening is calculated CoRTN uses hard surface correction.
Receiver Heights	1.5m above floor level of the identified floor
Free Field Noise Levels	Free Field noise levels were used in this assessment as it is directly relevant to assessment against ISEPP criteria
Australian conditions correction	-1.7dB(A)
Acoustic properties of road surfaces	Assumed dense graded asphalt (DGA) (+0dB)
Roadside mounds / barriers	None were considered in this assessment

4.3 Road traffic noise results

The results of the road traffic noise impact assessment are presented graphically in Appendix C.

5 Conclusion

Renzo Tonin & Associates as completed a road traffic noise assessment for a proposed residential development site located at 296-298 Botany Rd and 284 Wyndham St, Alexandria.

The assessment was required to determine the impact of future road traffic noise (year 2036) on two built form scenarios under consideration by the City of Sydney Council, and to establish which areas of the future buildings, if any, are unable to comply with the ADG requirement for all habitable rooms to be naturally ventilated, while also satisfying the provisions of the Infrastructure SEPP 2007 for maximum repeatable noise levels.

The results of the road traffic noise impact assessment are presented graphically in Appendix C.

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.

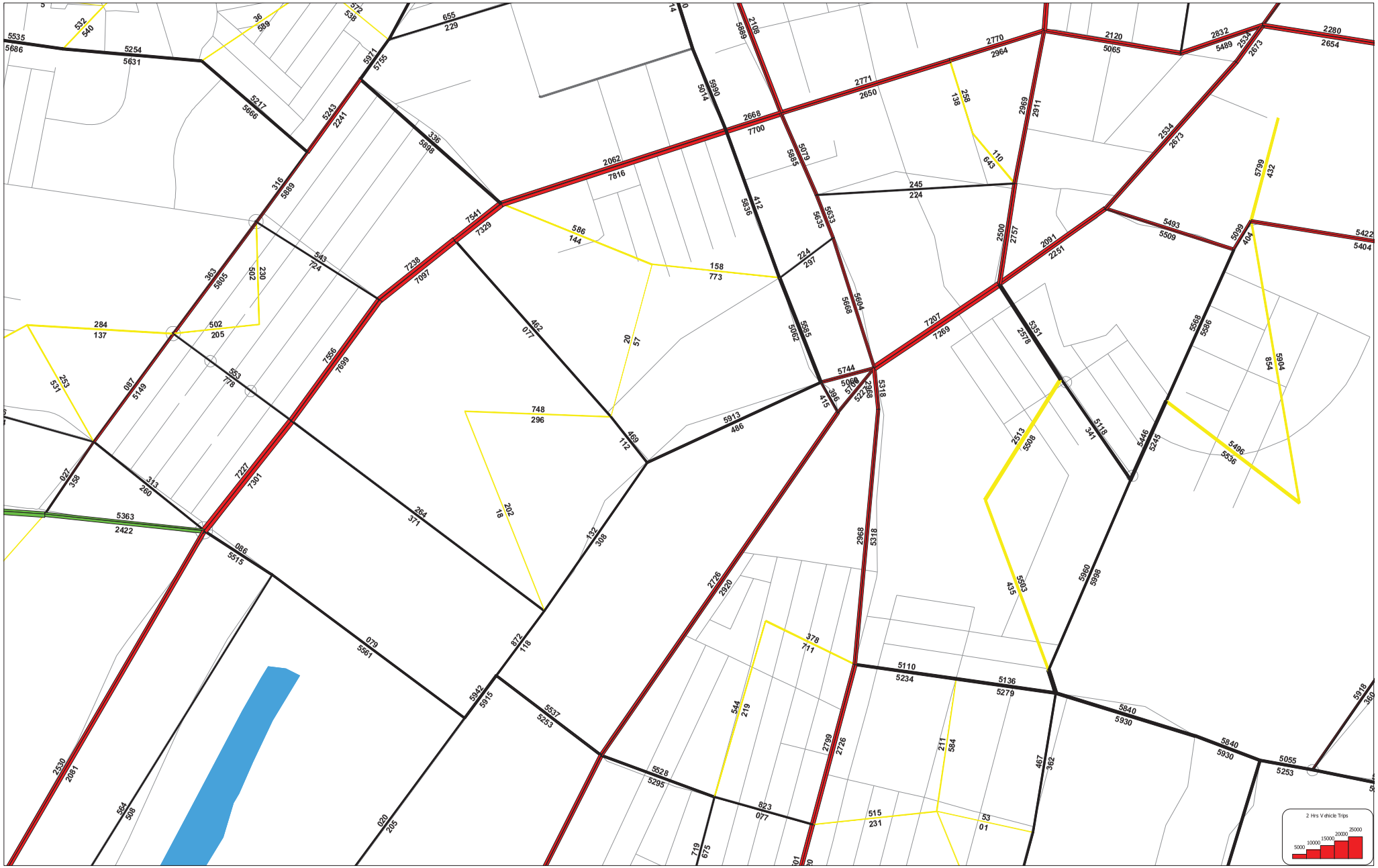
Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights 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 A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in 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.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
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.

APPENDIX B RMS Strategic Model Traffic Data

TRAFFIC VOLUMES__

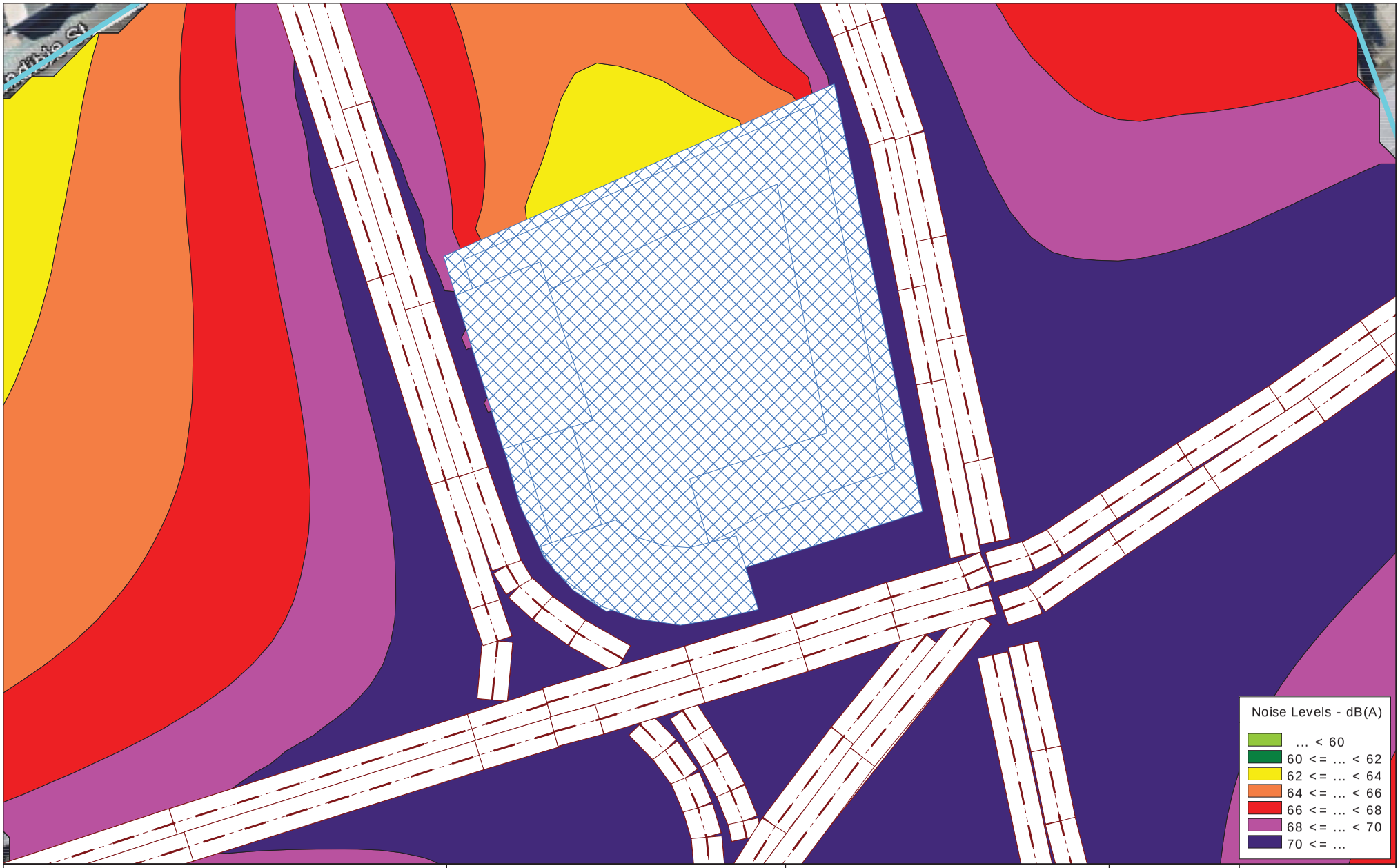
2006TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
Scenario 31127: 2036 SYDNEY ROAD NETWORK (INTDELAY)-7-9AM(mf15)
2015-03-20 14:25



2006TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
Scenario 1118: 2036 SYDNEY ROAD NETWORK (INTDELAY)-4-6PM(mf20)
2015-03-20 14:24

APPENDIX C Road traffic noise impact results

Façade noise levels indicated in vertical contours are approximate only. Reference should be made to horizontal contours for precise noise levels.



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Project:
296-298 Botany Rd & 284 Wyndham St

Description:
LAeq (15hr) Daytime at 13m (AGL) height
Design Year - 2036
Option 1

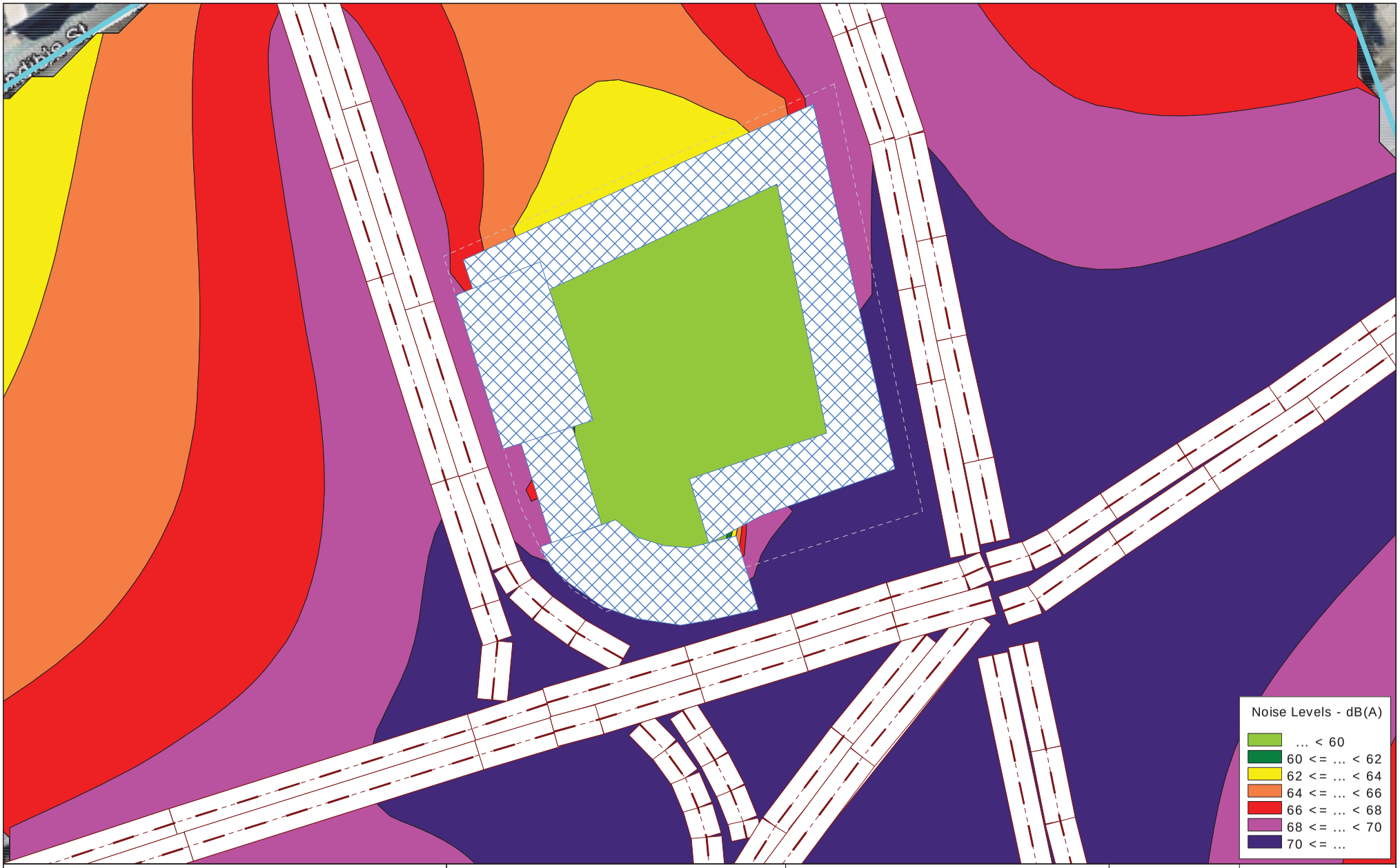
legend:
Road
Building
Contour Line
Receiver
Calculation Area

Reference: TH772-01 (rev 0) Option 1 - COS

Client: City of Sydney Council

Date: 25/11/2015

Scale: 1: 1200 A3



RENZO TONIN & ASSOCIATES
inspired to achieve

Project:
296-298 Botany Rd & 284 Wyndham St

Description:
LAeq (15hr) Daytime at 20m (AGL) height
Design Year - 2036
Option 1

legend:
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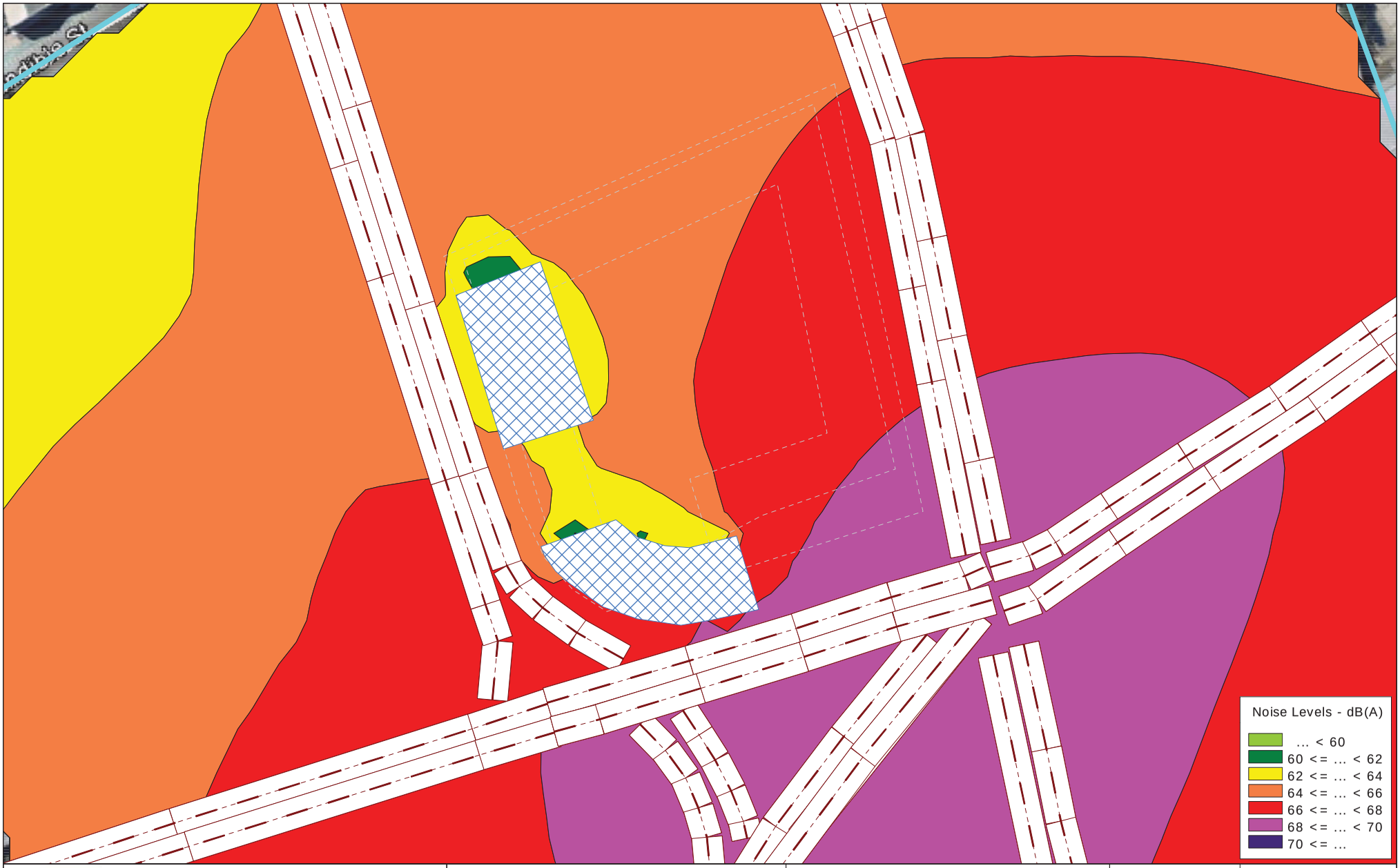
Building
Contour Line
Receiver
Calculation Area

Reference: TH772-01 (rev 0) Option 1 - COS

Client: City of Sydney Council

Date: 25/11/2015

Scale: 1: 1200 A3



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Project:
296-298 Botany Rd &
284 Wyndham St

Description:
LAeq (15hr) Daytime at 70m (AGL) height
Design Year - 2036
Option 1

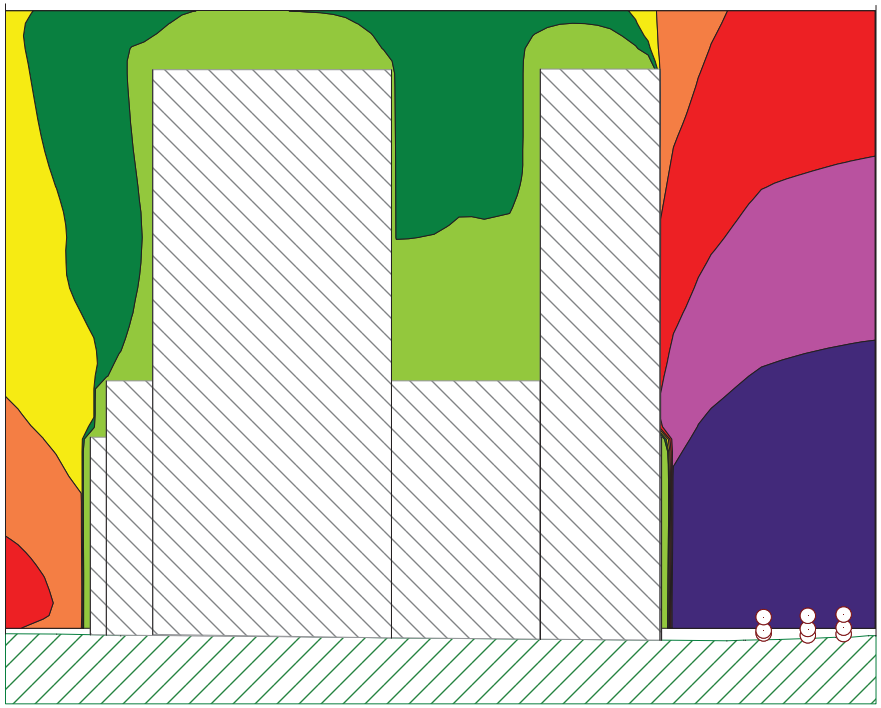
legend:
Road
Building
Contour Line
Receiver
Calculation Area

Reference: TH772-01 (rev 0) Option 1 - COS

Client: City of Sydney Council

Date: 25/11/2015

Scale: 1: 1200 A3



Noise Levels - dB(A)

- ... < 60
- 60 <= ... < 62
- 62 <= ... < 64
- 64 <= ... < 66
- 66 <= ... < 68
- 68 <= ... < 70
- 70 <= ...

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Project:
296-298 Botany Rd &
284 Wyndham St

Description:
LAeq (15hr) Daytime
Design Year - 2036
Option 1 - Easten side looking west

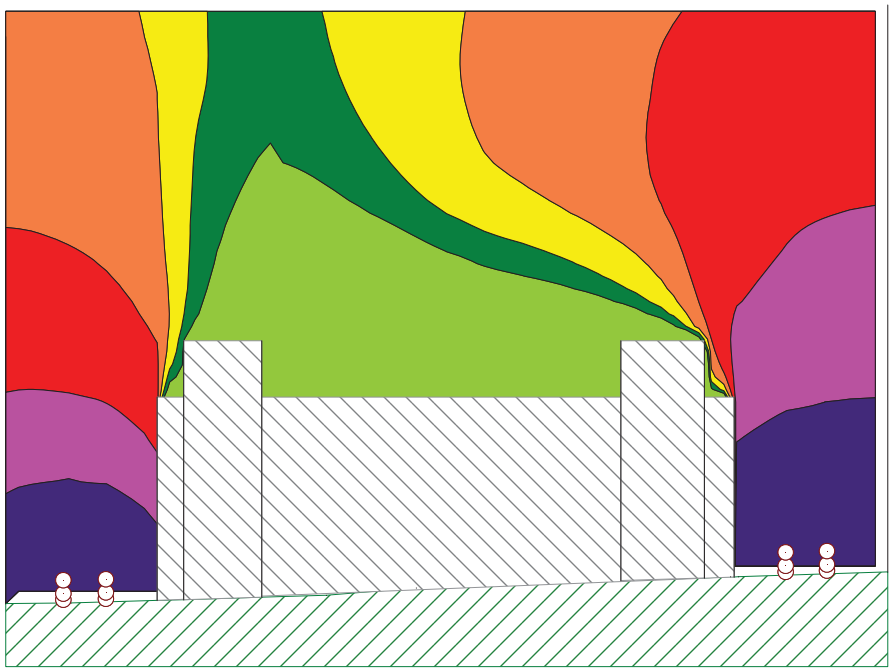
legend:
- Road
- Building
- Contour Line
- Vertical Grid

Reference: TH772-01 (rev 0) Option 1 - COS

Client: City of Sydney Council

Date: 01/12/2015

Scale: 1: 1200 A3



Noise Levels - dB(A)

- ... < 60
- 60 <= ... < 62
- 62 <= ... < 64
- 64 <= ... < 66
- 66 <= ... < 68
- 68 <= ... < 70
- 70 <= ...

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Project:
296-298 Botany Rd &
284 Wyndham St

Description:
LAeq (15hr) Daytime
Design Year - 2036
Option 1 - Southern side looking north

legend:
- Road
- Building
- Contour Line
- Vertical Grid

Reference: TH772-01 (rev 0) Option 1 - COS

Client: City of Sydney Council

Date: 01/12/2015

Scale: 1: 1200 A3

RENZO TONIN & ASSOCIATES
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Project:
296-298 Botany Rd & 284 Wyndham St

Description:
LAeq (15hr) Daytime at 13m (AGL) height
Design Year - 2036
Option 2

legend:
Road
Building
Contour Line
Calculation Area

Reference: TH772-01 (rev 0) Option 2 - SJB

Client: City of Sydney Council

Date: 25/11/2015

Scale: 1: 1200 A3

RENZO TONIN & ASSOCIATES
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Project:
296-298 Botany Rd & 284 Wyndham St

Description:
LAeq (15hr) Daytime at 40m (AGL) height
Design Year - 2036
Option 2

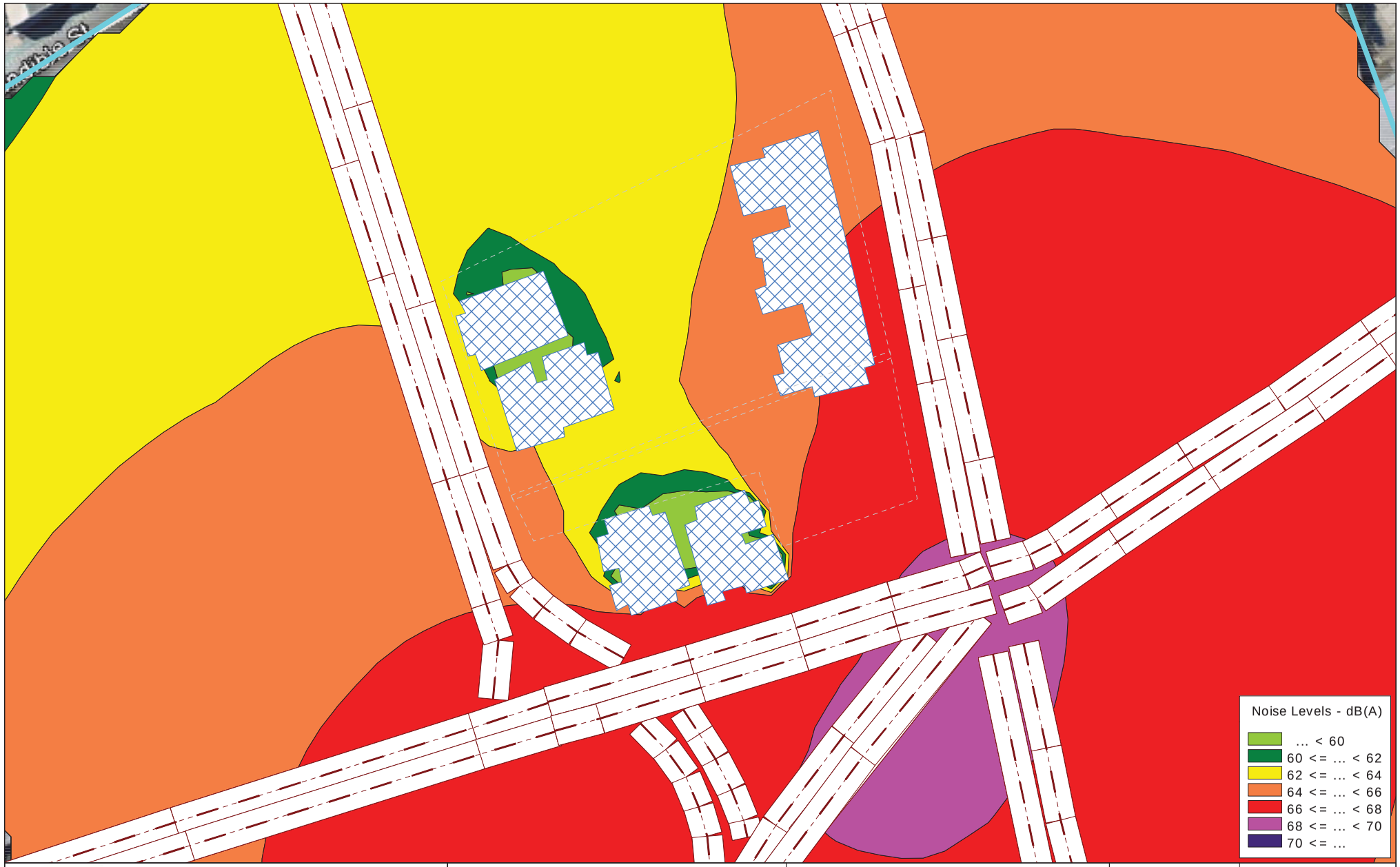
legend:
Road
Building
Contour Line
Calculation Area

Reference: TH772-01 (rev 0) Option 2 - SJB

Client: City of Sydney Council

Date: 25/11/2015

Scale: 1: 1200 A3



RENZO TONIN & ASSOCIATES
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Project:
296-298 Botany Rd &
284 Wyndham St

Description:
LAeq (15hr) Daytime at 83m (AGL) height
Design Year - 2036
Option 2

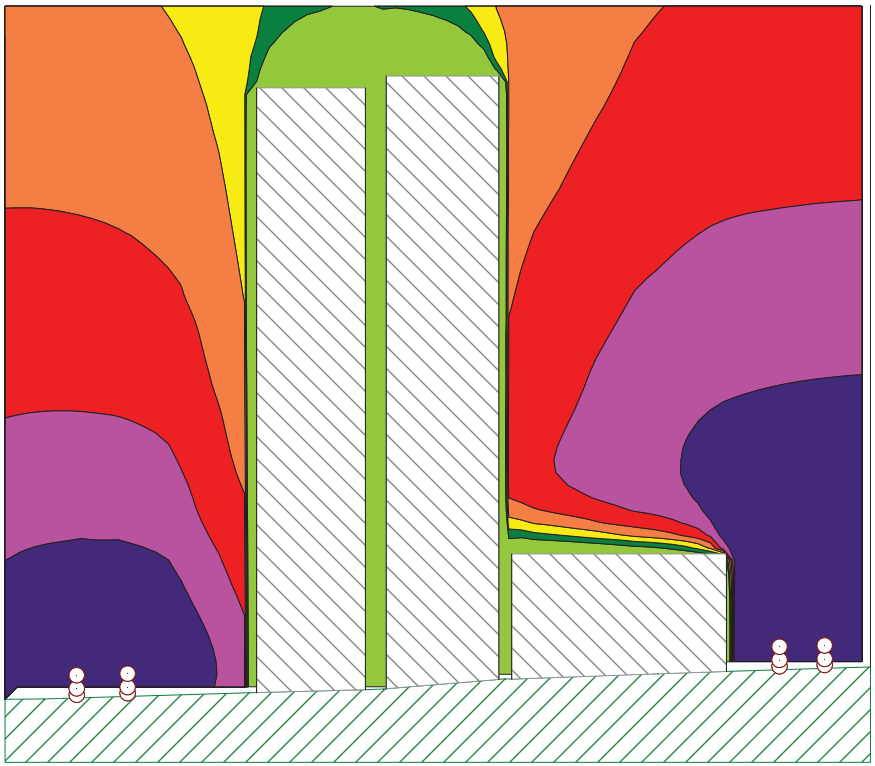
legend:
Road
Building
Contour Line
Calculation Area

Reference: TH772-01 (rev 0) Option 2 - SJB

Client: City of Sydney Council

Date: 25/11/2015

Scale: 1: 1200 A3



Noise Levels - dB(A)

- ... < 60
- 60 <= ... < 62
- 62 <= ... < 64
- 64 <= ... < 66
- 66 <= ... < 68
- 68 <= ... < 70
- 70 <= ...

RENZO TONIN & ASSOCIATES
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Project:
296-298 Botany Rd &
284 Wyndham St

Description:
LAeq (15hr) Daytime
Design Year - 2036
Option 2 - Southern side looking north

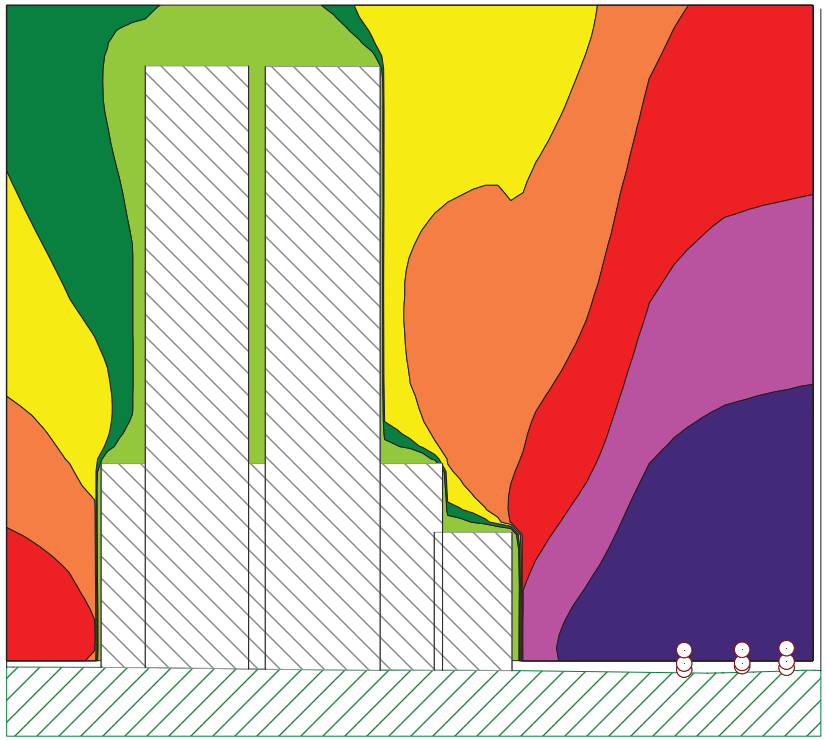
legend:
- Road
- Building
- Contour Line
- Calculation Area
- Vertical Grid

Reference: TH772-01 (rev 0) Option 2 - SJB

Client: City of Sydney Council

Date: 01/12/2015

Scale: 1: 1200 A3



Noise Levels - dB(A)

- ... < 60
- 60 <= ... < 62
- 62 <= ... < 64
- 64 <= ... < 66
- 66 <= ... < 68
- 68 <= ... < 70
- 70 <= ...

RENZO TONIN & ASSOCIATES
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Project:
296-298 Botany Rd &
284 Wyndham St

Description:
LAeq (15hr) Daytime
Design Year - 2036
Option 2 - Western side looking east

legend:
- Road
- Building
- Contour Line
- Calculation Area
- Vertical Grid

Reference: TH772-01 (rev 0) Option 2 - SJB

Client: City of Sydney Council

Date: 01/12/2015

Scale: 1: 1200 A3

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Acoustics
Vibration
Structural Dynamics

296-298 BOTANY RD & 284 WYNDHAM ST

Road Traffic Noise Assessment

8 March 2016

SJB Architects

TH772-02F02 (r3) 296-298 Botany Rd

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Renzo Tonin & Associates was engaged to conduct a road traffic noise impact assessment for a proposed residential development site located at 296-298 Botany Rd and 284 Wyndham St, Alexandria. The assessment is required to determine the impact of future road traffic noise (year 2036) on a built form scenario under consideration by SJB Architects.

The assessment will be used to establish which areas of the future buildings, if any, are unable to comply with the ADG requirement for all habitable rooms to be naturally ventilated, while also satisfying the provisions of the SEPP (Infrastructure) 2007.

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 Project description

2.1 Site location

The subject site located at 296-298 Botany Rd and 284 Wyndham St, Alexandria, contains three road frontages, with Wyndham St to the west, Bourke St to the south and Botany Rd to the east. These roads currently carry high vehicle volumes and as redevelopment in Alexandria and Green Square continues, it is anticipated that these vehicle volumes and the resultant noise impact on the site will increase significantly.

Figure 1 presents an aerial photograph of the subject site and surrounding area.

Figure 1: Aerial photograph of subject site

2.2 Development proposal

SJB Architects is currently considering a built form scenario at the site which contains various multi story commercial tenancies and residential apartment buildings.

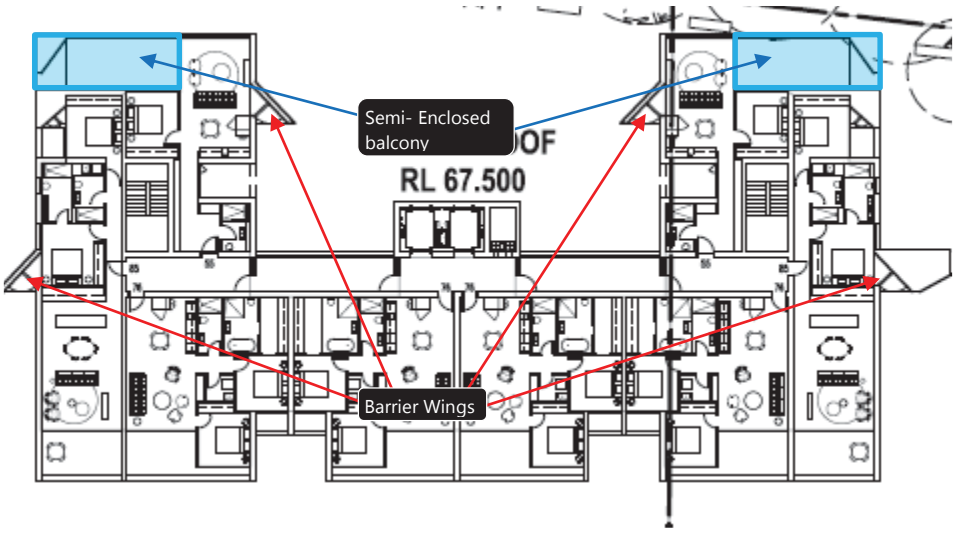
The design features various barrier wings along the external facades of the building as well various balcony areas which are largely enclosed, with small openings on the short side. The intent of the barrier wings and enclosed balconies is to allow habitable rooms to be naturally ventilated with windows open, while also satisfying the provisions of the SEPP (Infrastructure) 2007.

The barrier wings are understood to be of durable material with a minimum mass of 10kg/m^3 and are to extend from ground level to the top of roof level. Windows associated with the habitable rooms are located behind the barrier wings, along the external façades of the building and within the balcony areas. The acoustic assessment specifically seeks to determine the effectiveness in noise reduction provided by the barrier wings and the enclosed balconies.

A podium is also included into the design which extends to the edge of the site and is approximately 15m above ground level towards the Wyndham St side of the site and 11m above ground level towards the Botany Rd side of the site.

Figure 2 presents an example of some of the barrier wings and enclosed balcony areas.

Figure 2: Barrier wings and enclosed balcony areas



3 Road traffic noise criteria

3.1 State Environmental Planning Policy (Infrastructure) 2007 (ISEPP)

The NSW State Environmental Planning Policy (Infrastructure) 2007 (known as 'ISEPP') came into force in NSW on 1 January 2008 to facilitate the effective delivery of infrastructure across the State. The aim of the policy includes identifying the environmental assessment category into which different types of infrastructure and services development fall and identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure.

Pertinent to noise assessment, the ISEPP includes the following clauses:

> *102 Impact of road noise or vibration on non-road development*
>
> *1. This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:*
>
> *a. a building for residential use,*
>
> *b. a place of public worship,*
>
> *c. a hospital,*
>
> *d. an educational establishment or child care centre.*
>
> *2. Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Director-General for the purposes of this clause and published in the Gazette.*
>
> *3. If the development is for the purposes of a building for residential use, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:*
>
> *a. in any bedroom in the building - 35 dB(A) at any time between 10 pm and 7am,*
>
> *b. anywhere else in the building (other than a garage, kitchen, bathroom or hallway) - 40 dB(A) at any time.*
>
> *4. In this clause, "freeway", "tollway" and "transitway" have the same meanings as they have in the Roads Act 1993*

3.2 Department of Planning publication 'Development near rail corridors and busy roads – Interim guideline'

To support the Infrastructure SEPP, the NSW Department of Planning released the *Development in Rail Corridors and Busy Roads – Interim Guideline* (December 2008). The Guideline assists in the planning,

design and assessment of developments in, or adjacent to, major transport corridors in terms of noise, vibration and air quality.

3.3 Clarification of ISEPP noise limits

The Guideline clarifies the time period of measurement and assessment. Section 3.4 '*What Noise and Vibration Concepts are Relevant*' and Table 3.1 of Section 3.6.1 confirms that noise assessment is based over the following time periods:

- Daytime 7:00am - 10:00pm $L_{Aeq(15hr)}$
- Night-time 10:00pm - 7:00am $L_{Aeq(9hr)}$

The noise criteria nominated in the ISEPP apply to internal noise levels with windows and doors closed. However as the preliminary noise assessment is based on predictions at external locations, equivalent external noise criteria has been established. The equivalent external noise criterion is used to determine which areas of the development may require acoustic treatment in order to meet the internal noise requirements of the ISEPP. The equivalent external goals have been determined on the following basis:

- *The ISEPP states: "If internal noise levels with windows or doors open exceed the criteria by more than 10dBA, the design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire, and also to meet the ventilation requirements of the Building Code of Australia." The internal criteria with windows open is therefore 10dB(A) above the criteria explicitly outlined in the ISEPP.*
- The generally accepted noise reduction through an open window from a free-field external position is 10dB(A). Windows/doors are assumed to be open no more than 5% of room floor area, in accordance with the Building Code of Australia (BCA) ventilation requirements.

Table 1 presents the ISEPP internal noise criteria along with the equivalent external noise criteria for residential premises.

Table 1: ISEPP noise criteria for new residential development

Room	Location	$L_{Aeq,\ 15hr}$ Day 7am – 10pm	$L_{Aeq\ 9hr}$ Night 10pm – 7am
Living rooms*	Internal, windows closed	40	40
	Internal, windows open	50	50
	External free-field (allowing windows to remain open)^	60	60
Bedrooms*	Internal, windows closed	40	35
	Internal, windows open	50	45
	External free-field (allowing windows to remain open)^	60	55

Notes: * Requisite for 40,000AADT Roads only under ISEPP 2007.

^ ISEPP Guideline states that where internal noise criteria are exceeded by more than 10dB(A) with windows open mechanical ventilation is required. External goals have been calculated on the basis of nominal 10dB(A) reduction through an open window to a free-field position. Windows open to 5% of floor area in accordance with the BCA 2011 requirements.

4 Road traffic noise assessment

4.1 Road design and traffic flow

Roads and Maritime Services (RMS) Strategic Model traffic data (2 hour peak hour traffic volumes) for the year 2036 have been obtained and have been utilised for the assessment. The Strategic Model traffic data is presented in Appendix B. The following calculations and assumptions were used for the road traffic noise modelling:

- The AADT is 6.5 times the average of the 2 hour peaks,
- The 15hr daytime volume is 85% of the 24hr volume,
- The 9hr night time volume is 15% of the 24hr volume, and
- The heavy vehicle percentage has been based on existing traffic counts.

The traffic volumes used for the assessment are presented in Table 2.

Table 2: 2036 future road traffic volumes

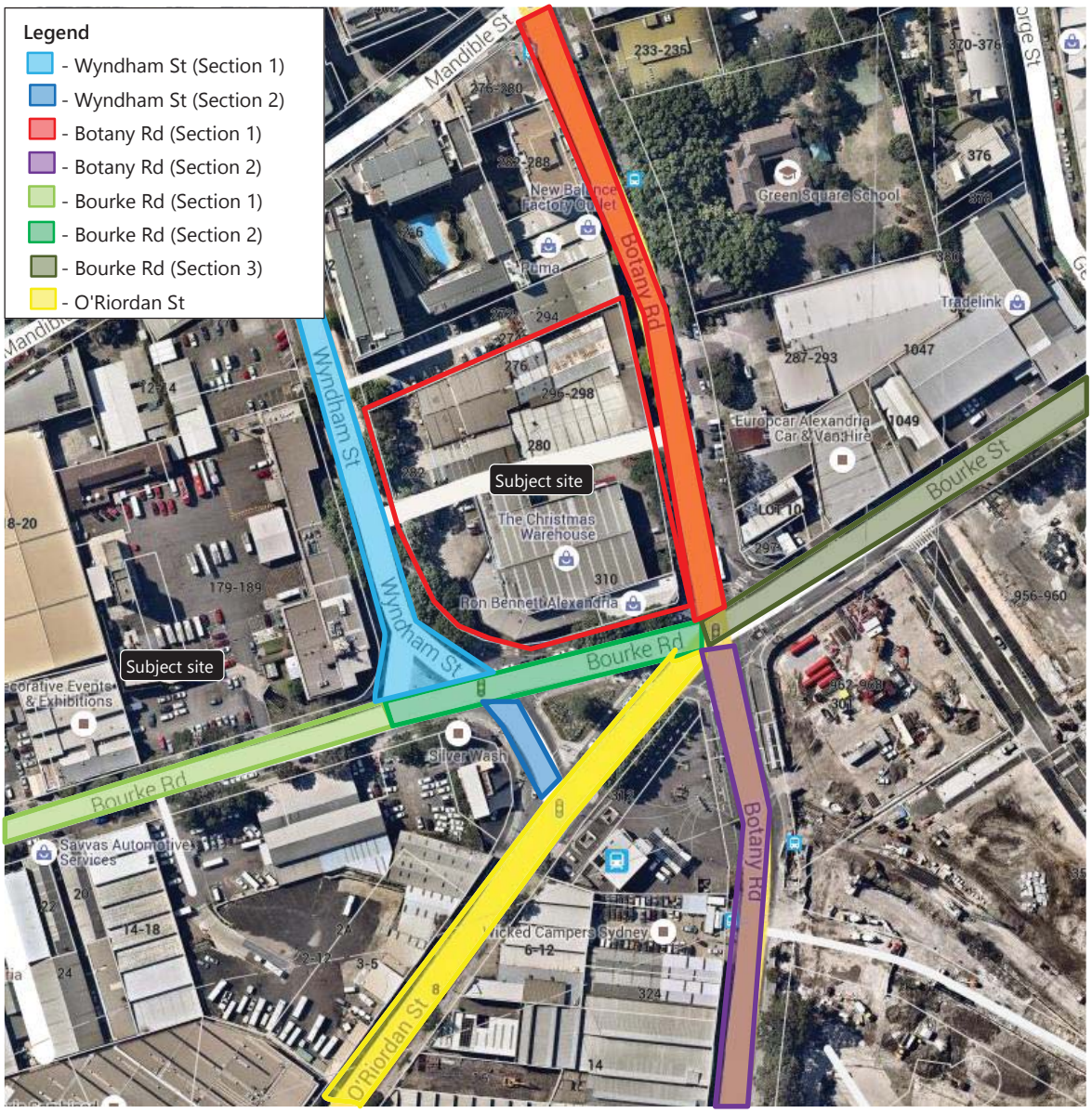
Road	Approach	2hr Predicted Traffic Volume		Calculated Traffic Volumes			% Heavy Vehicles
		AM Peak	PM Peak	AADT	15hr Day	9hr Night	
Wyndham St (Section 1)	North bound	1818	1742	11570	9835	1736	11
	South bound	1076	1161	7270	6180	1091	11
Wyndham St (Section 2)	North bound	837	951	5811	4939	872	11
	South bound	927	804	5626	4782	844	11
Botany Rd (Section 1)	North bound	1723	1446	10299	8754	1545	11
	South bound	1548	1479	9838	8362	1476	11
Botany Rd (Section 2)	North bound	2289	2046	14089	11975	2113	11
	South bound	2080	1856	12792	10873	1919	11
Bourke Rd (Section 1)	North bound	1186	1058	7293	6199	1094	8
	South bound	861	964	5931	5042	890	8
Bourke Rd (Section 2)	North bound	1294	1399	8752	7439	1313	8
	South bound	1801	1479	10660	9061	1599	8
Bourke Rd (Section 3)	North bound	3441	3273	21821	18547	3273	8
	South bound	3381	3240	21518	18291	3228	8
O'Riordan St	North bound	2643	2234	15850	13473	2378	10
	South bound	2200	2027	13738	11677	2061	7

Note is made that the modelled roads all contain an AADT lower than 40, 000 vehicles. While the ISEPP applies only to roads with an AADT greater than 40,000 vehicles, the guideline is also recommended for other road traffic noise affected sites.

Although there are both 'day' and 'night' traffic noise goals to be satisfied, based on the difference in traffic volumes between day and night, daytime was established as the worst case period for road traffic noise impacts.

The roads modelled in the assessment are indicated in Figure 3.

Figure 3: Modelled roads



4.2 Prediction methodology

Noise predictions are based on CoRTN, having been adapted to Australian conditions and extensively tested by the Australian Road Research Board. Additionally, barrier noise improvement calculations are based on ISO9613. As a result it is recognised and accepted by the NSW Environmental Protection Authority (EPA). The model predicts noise levels for steady flowing traffic and noise from high truck

exhausts is taken into account. The CoRTN algorithms are contained within the 'CadnaA' noise modelling software which has been used to calculate road traffic noise levels.

The noise prediction software takes into account the following:

Table 3: Summary of modelling inputs

Input Parameters	Input used
Traffic volumes and mix	As described in Section 4.1
Vehicle speed	50km/h
Gradient of roadways	Topographic data provided by RMS
Source height	0.5m for car exhaust, 1.5m for car and truck engines and 3.6m for truck exhaust.
Ground topography at receiver and road	2m Ground Contours obtained from the NSW Land & Property Information (LPI)
Angles of view from receiver	Calculated within CoRTN
Reflections from existing barriers, structures and cuttings on opposite side of road	Calculated within CoRTN
Air and ground absorption - Values vary between 0 (hard surface) to 1 (100% absorptive)	0 has been used in this study It is noted that where screening is calculated CoRTN uses hard surface correction.
Receiver Heights	1.5m above floor level of the identified floor
Free Field Noise Levels	Free Field noise levels were used in this assessment as it is directly relevant to assessment against ISEPP criteria
Australian conditions correction	-1.7dB(A)
Acoustic properties of road surfaces	Assumed dense graded asphalt (DGA) (+0dB)
Roadside mounds / barriers	None were considered in this assessment

The predicted road traffic noise levels have been calculated to specific points behind the barrier wings, along the external façade of the building. Additionally, desktop calculations have been undertaken to determine the effectiveness in noise reduction provided by the enclosed balconies.

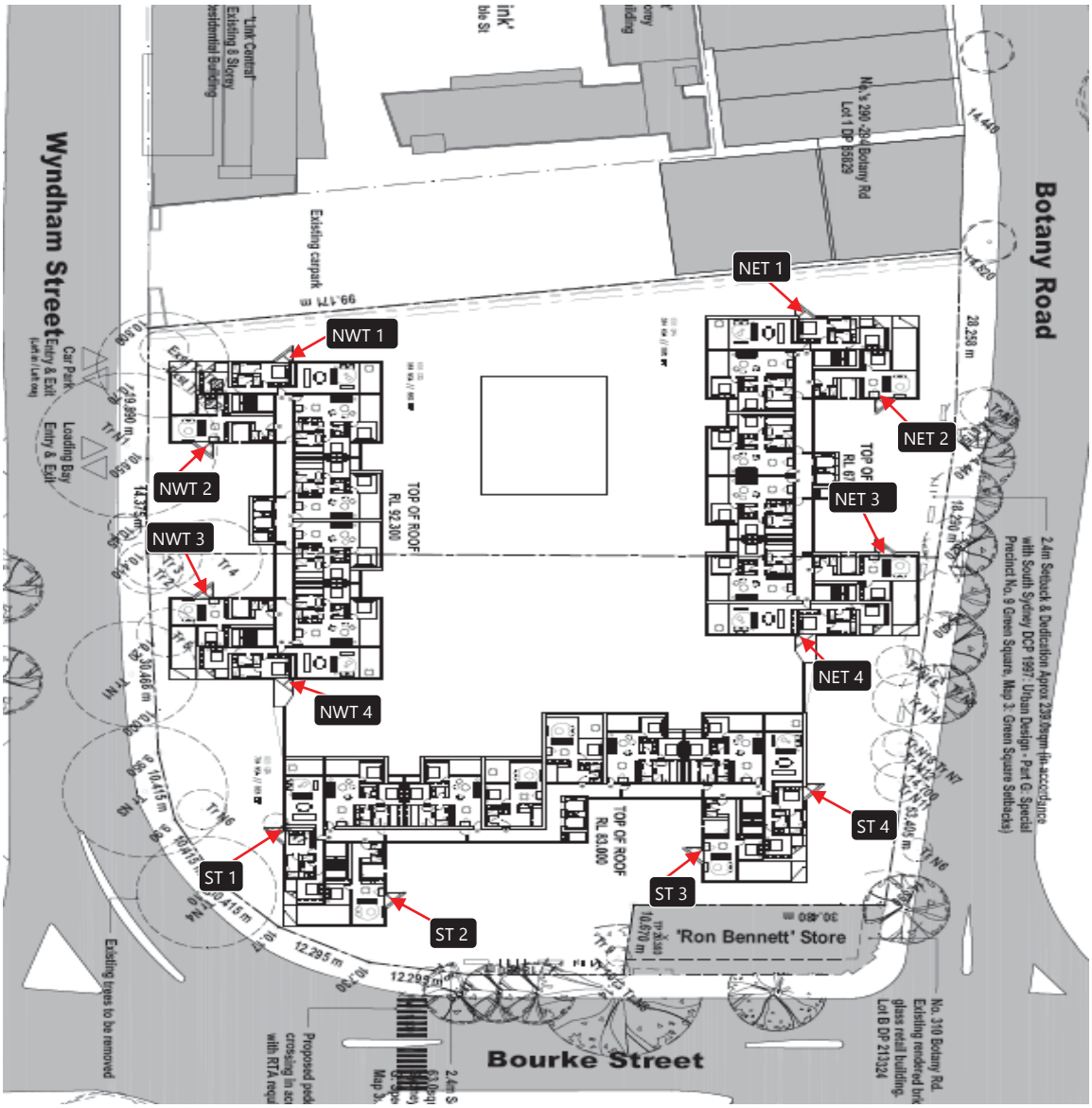
The specific points behind the barrier wings are presented in Table 4 and Figure 4.

Table 4: Barrier wing calculation points

ID	Name	Description	Calculation heights
NWT 1	North-West Tower - Point 1	Calculation point located along the northern façade of the north-western tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
NWT 2	North-West Tower - Point 2	Calculation point located along the north-western façade of the north-western tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
NWT 3	North-West Tower - Point 3	Calculation point located along the south-western façade of the north-western tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
NWT4	North-West Tower - Point 4	Calculation point located along the southern façade of the north-western tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m

ID	Name	Description	Calculation heights
NET 1	North-East Tower - Point 1	Calculation point located along the northern façade of the north-eastern tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
NET 2	North-East Tower - Point 2	Calculation point located along the north-eastern façade of the north-eastern tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
NET 3	North-East Tower - Point 3	Calculation point located along the south-eastern façade of the north-eastern tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
NET4	North-East Tower - Point 4	Calculation point located along the southern façade of the north-eastern tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
ST 1	South Tower - Point 1	Calculation point located along the western façade of the southern tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
ST 2	South Tower - Point 2	Calculation point located along the south-western façade of the southern tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
ST 3	South Tower - Point 2	Calculation point located along the south-eastern façade of the southern tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m
ST 4	South Tower - Point 4	Calculation point located along the eastern façade of the southern tower, positioned in between the façade and angled barrier wing.	16m, 45m and 60m

Figure 4: Barrier wing calculation points



4.3 Road traffic noise results

The results of the road traffic noise calculations at barrier wing locations, including indicative internal noise levels and assessment criteria, are presented in Table 5. The noise reduction provided by the barriers varied between 1-17dB(A). The locations with the greatest reduction were determined to be within the enclosed courtyard, which were all found to satisfy the external and internal noise criteria.

Table 5: Road traffic noise level predictions (barrier wings), dB

ID	$L_{Aeq\ 15\ hr}$ external noise levels			$L_{Aeq\ 15\ hr}$ internal noise levels			$L_{Aeq\ 15\ hr}$ noise criteria	
	16m	45m	60m	16m	45m	60m	External	Internal
NET 1	58	58	58	48	49	48	60	50
NET 2	57	59	58	47	49	48	60	50

ID	$L_{Aeq\ 15\ hr}$ external noise levels			$L_{Aeq\ 15\ hr}$ internal noise levels			$L_{Aeq\ 15\ hr}$ noise criteria	
	16m	45m	60m	16m	45m	60m	External	Internal
NET 3	47	57	56	37	47	46	60	50
NET 4	59	56	56	49	46	46	60	50
NWT 1	54	58	58	44	48	48	60	50
NWT 2	54	55	56	44	45	46	60	50
NWT 3	48	53	54	38	43	44	60	50
NWT 4	52	54	53	42	44	43	60	50
ST 1	57	50	50	47	40	40	60	50
ST 2	59	64	64	49	54	54	60	50
ST 3	58	59	61	48	49	41	60	50
ST 4	61	50	50	51	40	40	60	50

Notes: Red indicates exceedance of external and internal noise criteria

Calculations were also undertaken to determine the effectiveness in noise reduction provided by the semi-enclosed balconies. Following analysis of the noise model results, it was determined that the balconies on the lower levels of the southern tower, fronting Bourke St were the most exposed to road traffic noise. Typical noise reduction provided through short side balcony openings would be in the range of 5-8dB. For the purposes of the assessment, 5dB has conservatively been assumed.

The results of the road traffic noise calculations at balcony locations, including indicative internal noise levels and assessment criteria, are presented in Table 6. For the assessment it has been assumed that hard reflective surfaces are throughout the balcony space. However, if absorptive finishes were applied to the soffit and walls, further noise reductions up to approximately 5dB(A) could be achieved dependent on the extent and type of treatment.

Table 6: Road traffic noise level predictions (balconies), dB

Location	$L_{Aeq\ 15\ hr}$ external façade noise levels	$L_{Aeq\ 15\ hr}$ internal balcony noise levels	$L_{Aeq\ 15\ hr}$ internal apartment noise levels	$L_{Aeq\ 15\ hr}$ noise criteria	
				External	Internal
ST balconies	72	70	57	60	50

Notes: Red indicates exceedance of external and internal noise criteria
Windows open 5% of floor area

5 Conclusion

Renzo Tonin & Associates as completed a road traffic noise assessment for a proposed residential development site located at 296-298 Botany Rd and 284 Wyndham St, Alexandria.

The assessment was required to determine the impact of future road traffic noise (year 2036) a built form scenario under consideration by SJB Architects and to establish which areas of the future buildings, if any, are unable to comply with the ADG requirement for all habitable rooms to be naturally ventilated, while also satisfying the provisions of the Infrastructure SEPP 2007 for maximum repeatable noise levels.

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.

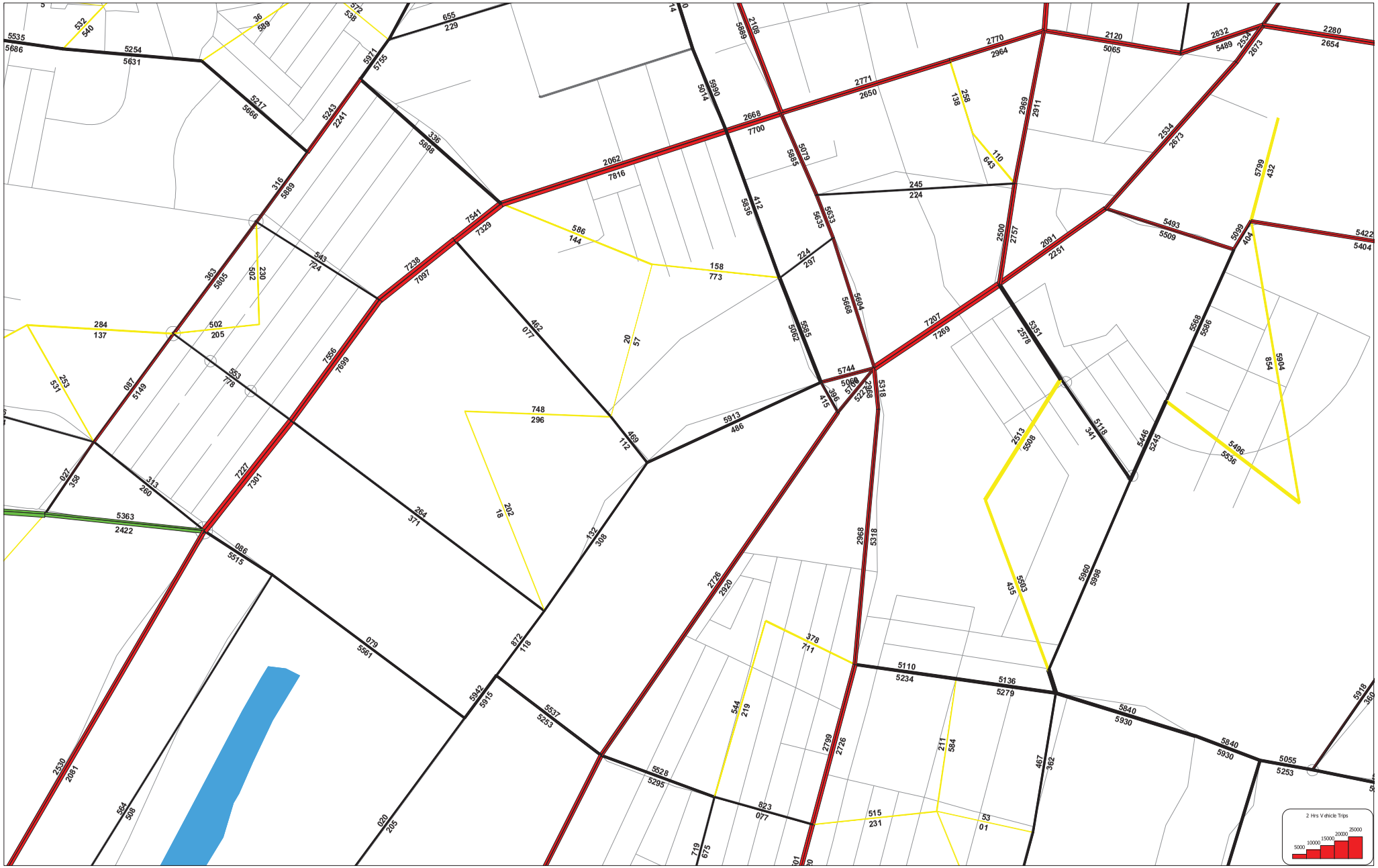
Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights 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 A- weighting noise filter simulates the response of the human ear at relatively low levels, where the ear is not as effective in hearing low frequency sounds as it is in 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.
dB(C)	C-weighted decibels. The C-weighting noise filter simulates the response of the human ear at relatively high levels, where the human ear is nearly equally effective at hearing from mid-low frequency (63Hz) to mid-high frequency (4kHz), but is less effective outside these frequencies.
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.

APPENDIX B RMS Strategic Model Traffic Data

TRAFFIC VOLUMES__

2006TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
Scenario 31127: 2036 SYDNEY ROAD NETWORK (INTDELAY)-7-9AM(mf15)
2015-03-20 14:25



2006TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
Scenario 1118: 2036 SYDNEY ROAD NETWORK (INTDELAY)-4-6PM(mf20)
2015-03-20 14:24

APPENDIX E: PRELIMINARY AERONAUTICAL IMPACT ASSESSMENT PREPARED BY STRATEGIC AIRSPACE

Preliminary Aeronautical Impact Assessment to Support Planning Approval Application

Airports (Protection of Airspace) Regulations

for

296-298 Botany Rd, Alexandria: Preliminary Aeronautical Assessment for Planning

Doc v1.0 FINAL

09 Feb 2015

by

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Document Control

Document Number: **15.003-01-001** *Version:* **Doc v1.0 FINAL**

Document Title: 296-298 Botany Rd, Alexandria: Preliminary Aeronautical Assessment for Planning

Purpose / Abstract: *This brief report assesses the potential aeronautical impact of the proposed development at 296-298 Botany Rd, the site also being bounded by Bourke Rd and Wyndham Street. The purpose of this assessment to support the application for Planning Approval*

Contract: - *StratAir Ref:* 15.003

Change History

Version	*Versn Date*	*Version By*	*QA By*	*Version / Change Description*
1.0 DRAFT	06-Feb-15	C. Pak-Poy	J. McCarthy	Initial version for review & comment
1.0 FINAL	09-Feb-15	C. Pak-Poy	J. McCarthy	Minor typographical amendments

Distribution Control

Legend:				
	Uncont	Uncontrolled Document	SACL	Sydney Airport Limited
	Client	Gazcorp	*StratAir*	Strategic Airspace
	APT	–	*AsA*	Airservices (formerly Airservices Australia)
	CASA	Civil Aviation Safety Authority	*Infrastructure*	Department of Infrastructure

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1.0 DRAFT	06-Feb-15	Distribution to client	Uncont	StratAir, Gazcorp
1.0 FINAL	09-Feb-15	Distribution to client	Uncont	StratAir, Gazcorp

Contents

APPENDICES

1. Introduction & Executive Summary

Gazcorp has engaged Strategic Airspace to prepare a preliminary aeronautical assessment in relation to proposed development at **296-298 Botany Rd, Alexandria NSW**, adjacent to the Green Square precinct of southern Sydney.

The proposed development is approximately 5.1km (2.77NM) at 027°T from the Aerodrome Reference Point (ARP) at Sydney Airport. Thus, due to proximity to the airport and the proposed maximum building height of the development, the proposal is subject to the Airports (Protection of Airspace) Regulations 1996. The two fundamental factors of the Airports Regulations that are used for assessment of development heights are the Obstacle Limitation Surfaces (OLS) and the PANS-OPS Surfaces. Various other factors that come under the catch-all of "assuring the safety, efficiency or regularity of existing or future air transport operations into or out of airports" are also considered.

The development site comprises three tower complexes, of **proposed maximum heights** of **66.2m**, **91.0m and** the tallest at **100.3m AHD**.

All of the proposed towers would penetrate Sydney Airport's OLS. Specifically, it will penetrate the **OLS Inner Horizontal Surface** (IHS), which has an elevation of **51m AHD** above the site; **the tallest tower would penetrate the OLS IHS by 49.2m**. However there are precedents for approved penetrations of such extents in the area adjacent to the development — namely the Green Square Town Centre (GSTC) site — and this may help support the case for approval of the development (subject to timing of the construction of buildings in the GSTC and the likely requirement for a safety case).

In addition to the OLS, the other critical aspect of the Airports Regulations is the absolutely restrictive height of the PANS-OPS "surfaces". These surfaces are complex in nature and protect aircraft operations in all weather. The limiting height of the **lowest PANS-OPS surface** (based on this preliminary analysis of PANS-OPS procedures currently published) is **126.4m AHD** above the site. Note also that this height would most likely be stipulated as the height restriction for cranes to be used for construction as part of any airspace height approval for the development itself.

Other factors that would be assessed as part of the overall safety and operational efficiency and regularity evaluation have also been considered as part of this preliminary assessment. A key factor in this regard is the ability of airlines to perform their contingency procedures in the event of an engine-out instance on or after take-off. Based on similar assessment for the nearby and already approved GSTC site, this is not anticipated to be problematic for this development.

In conclusion, based on the preliminary assessment, we believe that there is no technical impediment to approval of the development as proposed and described herein under the Regulations, and that an application supported by a full aeronautical assessment and safety case would be approved by the Department of Infrastructure.

This preliminary report is for the purpose of supporting further planning and exploring a maximum development height at the site that may be considered as technically and probably approvable under the Airports (Protection of Airspace) Regulations 1996 (APARs). The results and opinions are based on preliminary data only and would be subject to confirmation in a a complete aeronautical impact study.

2. Methodology

The preliminary version of this report includes only the technical analysis of PANS-OPS and OLS surfaces. More complete assessment of the potential impact upon operations at Sydney Airport would need to be included in the report presented for the application for approval by the aviation authorities.

2.1 Methodology as Basis of Study

The report considers the existing Sydney International Airport facilities only.

In respect to the influence on the proposed development, the prescribed airspace surrounding the Airport comprises two components:

- the Obstacle Limitation Surfaces (OLS); and
- the Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) surfaces.

In this instance the OLS plans produced by Sydney Airport were referenced. In addition to Airservices Australia Departure & Approach Plates (charts) effective at 6-March-2014 as published on the Airservices AIP (Aeronautical Information Publication) website.

The aeronautical assessment was undertaken in phases, as described below:

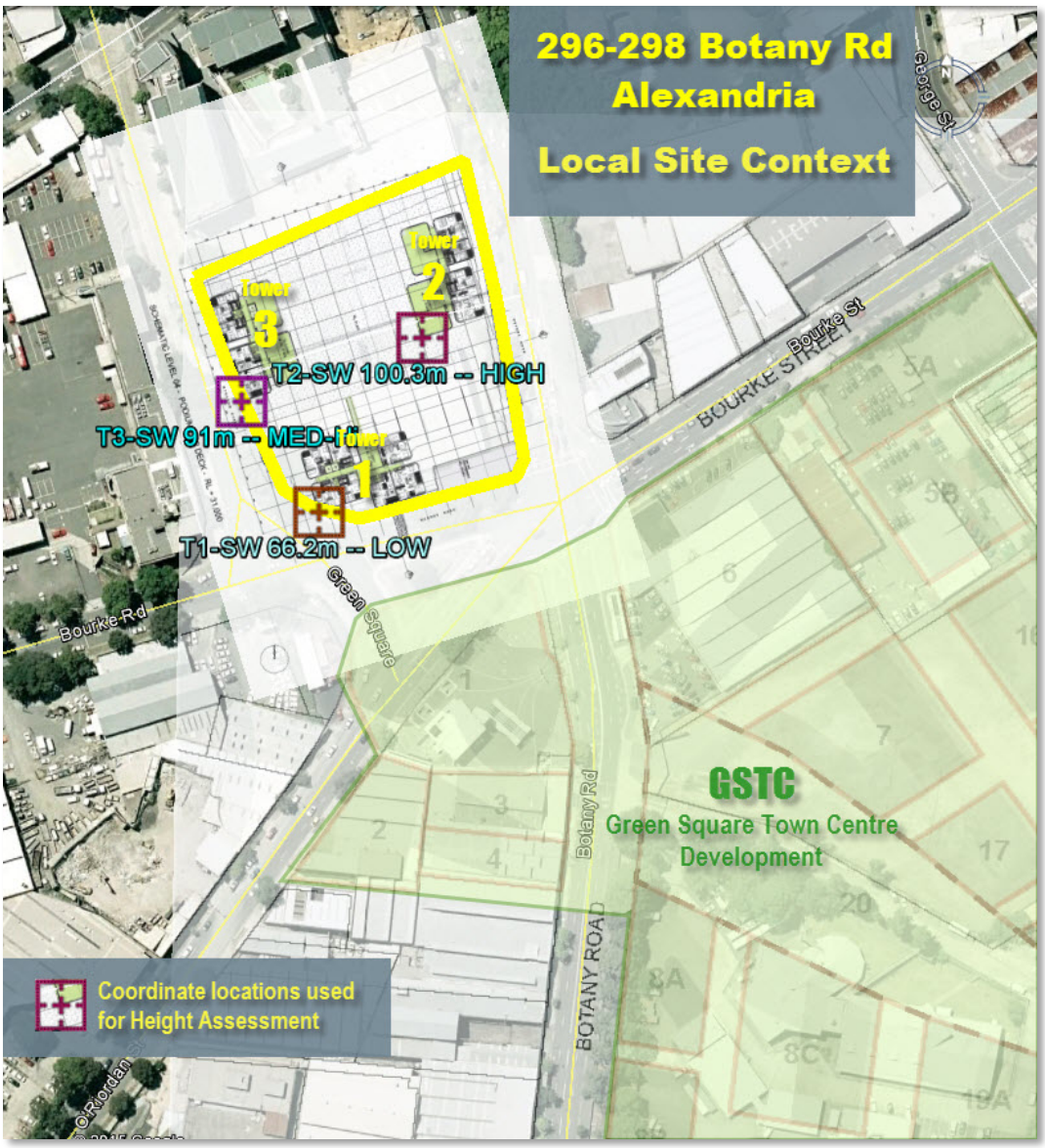
Table 2-1 Methodology

#	*Phase*	*Description*
1	**Obstacle Limitation Surfaces**	The extent of penetration of the Obstacle Limitation Surfaces by the proposed developments was determined accurately based on the siting (building zone footprint) and height data provided by the client. See section 3 below.
2	**Instrument Approach Procedures**	The relevant instrument approach procedures were examined to determine whether the development would impose any restriction on those procedures. Based on the requirement of the Airports (Protection of Airspace) Regulations any restriction on the instrument approach procedures would preclude further consideration of the application. See section 4 below.
3	**Other Assessment Factors**	Comments regarding other factors that would be assessed in a future detailed aeronautical impact study, the results of which will impact on the opinion concerning future approvability of the development. Some preliminary opinions are offered for guidance. See section 5 below.
4	**Summary & Conclusions**	A concise summary of findings and conclusion as to the likely approvability of the proposal. See section 6 below.

2.2 Location of the Proposed Development

For the purpose of the analysis, the site plan was geo-referenced against data in GoogleEarth™, and the most conservative coordinates for each tower were digitised. (as shown by the 'grid cursor' style marks depicted in the image below.

Figure 2-1: Site Plan in Local Context



3. Analysis of Obstacle Limitation Surfaces (OLS) & Shielding by Existing Obstacles

The analysis of the proposed building envelope in relation to the Obstacle Limitation Surfaces (OLS) and any relief that may be provided by shielding of the development by existing obstacles has been done with reference to the CASA Standards for Obstacle Restriction and Limitation[1] — known as MOS Part 139.

3.1 OLS Analysis

The prevailing OLS restriction on building heights over the development site is the OLS Inner Horizontal Surface (IHS). The site is some 250-350m inside the outer edge of the Inner Horizontal Surface.

The proposed heights penetrate the restrictive surface, as shown in the table below.

Table 3-1 Proposed Building Elevations & Penetrations of OLS Surfaces

Proposed Site / Feature	***Max Development Elevation*** *Metres AHD*	***OLS Surface Height at Location*** *Metres AHD*	***Penetration **** *Metres*	***Clearance***** *Metres*
Tower 1 (SW corner of site, southern-most tower)	**66.2**	**51.0**	**15.2**	**—**
Tower 2 (North-East corner)	**100.3**	**51.0**	**49.2**	**—**
Tower 3 (North-West corner)	**91.0**	**51.0**	**40.0**	**—**

* **Penetration**: rounded *up* to nearest 0.1m
** **Clearance**: rounded *down* to nearest 0.1m

3.2 Shielding

Preliminary analysis indicates that at least one of the taller GSTC buildings (Site 5A) that is closest to this proposed development may offer "shielding" of Tower 2 (at 100.3m AHD, the tallest in this proposal). Shielding is a provision permitted under the regulations, but requires that the structure providing the shielding actually exists. Hence the possibility of using this particular option as an easier and faster path to assessment and approval of the proposed development is dependent on the relative timing of the airspace height application for this development and the construction status (and confirmed maximum height plans) of the GSTC building.

If this particular possibility is not available at the time of the application to the Department, the application will have to be supported by a safety case to demonstrate that the development would not adversely impact the safety, efficiency or regularity of existing or future air transport operations into and out of Sydney Airport.

1 CASA RPA, and Manual of Standards Part 139 — Aerodromes, Chapter 7 Obstacle Restriction and Limitation, http://www.casa.gov.au/rules/1998casr/139/139m07.pdf

4. Analysis of PANS-OPS Surfaces

Assessment of impact by the proposed building envelope was undertaken with respect to:-

- The Circling Minima for existing PANS-OPS procedures
- The discrete minima for the Instrument Approach Procedures for Sydney International Airport, as published in the Departure and Approach Procedures (DAP), up to Amendment 141 (effective 13-Nov-2014 to 04-Mar-2015).
- Missed Approaches — as part of the evaluation of Approach Procedures
- The existing Standard Instrument Departure Procedures (SIDs)

The proposal was assessed as being laterally outside the protected airspace for all other procedures.

The aeronautical assessment was undertaken in phases with the results summarised as follows:

Table 4-1 Impact Summary

Procedure	*NO Impact*	*Impact*	*Issues & Coments*
MSA	✓	**Nil**	Below protection surface
Circling Minima (Cat A,B,C&D)	✓	**Nil** **Most limit-ing**	Below the **restrictive height of 126.4m AHD** (applicable to Cat A & B aircraft). This is the **most restrictive of the PANS-OPS surfaces** above the development site.
Approach Procedures & Missed Approaches			
All Approaches, Missed Approaches & Arrival Procedures	✓	**Nil**	The most restrictive surface related to approaches and arrival procedures is higher than the limit imposed by the Cat A&B Circling. The most restrictive of these procedures relates to the missed approach of the RNAV-Z (GNSS) approach to RWY 34L.
Departures			
➢ **Radar Departure**	✓	**Nil**	The most restrictive radar departure surface height above the proposed development is higher than the limit imposed by the Cat A&B Circling. The most restrictive is the RWY34R departure.
➢ **Other SIDS**	✓	**Nil**	As for the radar SIDs above, or outside protection area surfaces.

4.1 Minimum Sector Altitudes (MSAs)

In the location of the proposed development, the circling minimum is more restrictive than the MSA: thus, there is no impact on the MSA.

4.2 Circling Minima

The proposed development lies inside the permitted circling area to the north of the airport, and is most restricted by the minima applicable to the Category A and B aircraft.

The restrictive height due to Circling is 126.4m AHD — and the assessment has determined that this is the most restrictive PANS-OPS surface height overhead the development site.

4.3 Instrument Approaches, Missed Approaches & Arrivals

All instrument approach procedures were considered. The detailed results of these considerations are shown in Appendix 2.

The proposed development was assessed as being outside the tolerance areas for, or below the restrictive heights imposed by, all approach segments of the procedures.

In addition, the missed approaches were considered for all approach procedures, as well as the arrival procedures. In all cases the development was either outside the protection areas or below the critical heights.

The most restrictive height of the approach procedures relates to the RWY34L RNAV-Z (GNSS) procedure, where the development site is below the secondary protection area of the missed approach. The height limitation is greater than 102.4m — which means that the highest of the proposed towers will be below the limiting PANS-OPS surface height.

4.4 Departures

All published Standard Instrument Departures (SID) are based on the Radar SID. The proposed development is beneath the obstacle clearance surfaces for all Radar SIDs. The most limiting height of the departure procedures, based on the preliminary analysis calculations, is 152.4m AHD.

5. Other Assessment Factors

At the site location, other factors that would require assessment as part of any full aeronautical impact analysis may include:

- ✈ Navaid impact — no adverse impact anticipated
- ✈ Surveillance (eg, radar) — no adverse impact anticipated
- ✈ Airline contingency procedures (eg, engine out performance) — no adverse impact anticipated due to location and heights, especially in consideration of previously approved building elevations for the adjacent Green Square Town Centre (GSTC) development.

The opinions in this section are preliminary in nature only and are subject to confirmation by detailed analysis.

6. Conclusion

This preliminary study concludes that:

- **All** of the **three proposed towers on the 296-298 Botany Rd Alexandria** development site **penetrate the OLS** (the Inner Horizontal Surface, by amounts ranging from 15.2 to 49.2 metres).
  - This means that an "airspace height application" pursuant to the Airports (Protection of Airspace) Regulations will need to be submitted to the Department of Infrastructure (via Sydney Airport) for approval prior to development.
  - Penetration of the OLS also means that an approval of the airspace height application would most likely include conditions requiring obstacle lighting.
- **The three towers, at proposed elevations 66.2m, 91.0m and 100.3m AHD, would NOT infringe any PANS-OPS surface**, and thus the development may be considered approvable under the Airports (Protection of Airspace) Regulations.
  - The **most restrictive height of all PANS-OPS surfaces** overhead the development site is **126.4m AHD**.
  - It is highly likely that **this (or a slightly lower height) will be the maximum height cap stipulated for cranes** that would be required for construction of the development.
- As part of the safety, efficiency and regularity factors to be assessed when evaluating an airspace height application, aircraft contingency procedures are also considered. As these have already been demonstrated to be clear of the buildings already approved for the GSTC developments, it is also is anticipated that the proposed development will not adversely affect the aircraft contingency procedures — and thus not prevent approval on this basis.
- Further, preliminary analysis indicates that **at least one of the taller GSTC buildings** (Site 5A) closest to this development **would offer shielding (and therefore an easier path to airspace height approval) to the 100.3m Tower 2 building** of the proposed development. This will be dependent on the relative timing of the airspace height application for this development and the construction status of the GSTC building.
  Nevertheless, despite the proximity to the already approved Green Square Town Centre (GSTC) site, which already has buildings approved at higher elevations, it is highly probable that a safety case, as part of the Airspace Height application in order to support the case for approval, will be required by CASA. The safety case would also include any benefits from shielding by the nearby GSTC.

This preliminary report is for the purpose of supporting further planning and exploring a maximum development height at the site that may be considered as technically and probably approvable under the Airports (Protection of Airspace) Regulations 1996 (APARs). The results and opinions are based on preliminary data only and would be subject to confirmation in a complete aeronautical impact study.

APPENDIX 1 — ABBREVIATIONS

Abbreviations used in this report and/or associated reference documents, and the meanings assigned to them for the purposes of this report are detailed in the following table:

Abbreviation	Meaning
AC	Advisory Circular (document supporting CAR 1998)
ACFT	Aircraft
AD	Aerodrome
AGL	Above Ground Level (Height)
AHD	Australian Height Datum
AHT	Aircraft Height
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Services
ALARP	As Low As Reasonably Practicable
ALC	Airport Lease Company
Alt	Altitude
AMAC	Australian Mayoral Aviation Council
AMSL	Above Minimum Sea Level
ANEF	Australian Noise Exposure Forecast
ANSP	Airspace and Navigation Service Provider
APACL	Australia Pacific Airports Corporation Limited, owner of Melbourne and Launceston Airports
APARs, or A(PofA)R	Airports (Protection of Airspace) Regulations, 1996 as amended
ARP	Aerodrome Reference Point
AsA	Airservices Australia
ASDA	Accelerated Stop Distance Available
ATC	Air Traffic Control(ler)
ATM	Air Traffic Management
BAC	Brisbane Airport Corporation
BCC	Brisbane City Council
CAO	Civil Aviation Order
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
Cat	Category
CBD	Central Business District
CNS/ATM	Communications, Navigation, Surveillance / Air Traffic Management
CPA	Cairns Port Authority, Operators Of Cairns Airport
DAP	Departure and Approach Procedures (published by AsA)
DER	Departure End (of the) Runway
DEVELMT	Development
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DoD	Department of Defence
DODPROPS	Dependent Opposite Direction Parallel Runway OPerations
DOI&T	Department of Infrastructure and Transport (sometimes also abbreviated as Infrastructure)
EIS	Environmental Impact Study
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	EnRoute Supplement Australia

Abbreviation	Meaning
FAF	Final Approach Fix
FAP	Final Approach Point
Ft	Feet
GBAS	Ground-Based Augmentation System, a GNSS augmentation system to provide vertical guidance and additional precision to non-precision approaches
GLS	GNSS Landing System
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IHS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System
IAS	Indicated Air Speed
IPA	Integrated Planning Act 1997, Queensland State Government
ISA	International Standard Atmosphere
IVA	Independent Visual Approach
Km	Kilometres
Kt	Knot (one nautical mile per hour)
LAT	Latitude
LDA	Landing Distance Available
LLZ	Localizer
LONG	Longitude
LSALT	Lowest Safe ALTitude
M	Metres
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MDP	Major Development Plan
MGA94	Map Grid Australia 1994
MOC	Minimum Obstacle Clearance
MOS	Manual Of Standards, published by CASA
MP	Master Plan
MVA	Minimum Vector Altitude
NDB	Non-Directional Beacon
NE	North East
NM	Nautical Mile (= 1.852 km)
nnDME	Distance from the DME (in Nautical Miles)
NNE	North North East
NOTAM	NOTice to AirMen
NPR	New Parallel Runway (Project, Brisbane Airport)
OAR	Office of Airspace Regulation
OCA	Obstacle Clearance Altitude (in this case, in AMSL)
OCH	Obstacle Clearance Height
ODPROPS	Opposite Direction Parallel Runway OPerations
OHS	Outer Horizontal Surface, an Obstacle Limitation Surface
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation – Operations, ICAO Doc 8168
RAAF	Royal Australian Air Force
PRM	Precision Runway Monitor
RAPAC	Regional AirsPace users Advisory Committee
REF	Reference
RL	Relative Level

Abbreviation	Meaning
RNAV	aRea NAVigation
RNP	Required Navigation Performance
RPA	Rules and Practices for Aerodromes — replaced by the MOS Part 139 — Aerodromes
RPT	Regular Public Transport
RTCC	Radar Terrain Clearance Chart
RWY	Runway
SACL	Sydney Airport Corporation Limited
SID	Standard Instrument Departure
SODPROPS	(Independent) Simultaneous Opposite Direction Parallel Runway OPerations
SPP	State Planning Policy, Queensland (specifically SPP 1/02: Development in the Vicinity of Certain Airports and Aviation Facilities)
SSR	Secondary Surveillance Radar
STAR	STandard Arrival
TAR	Terminal Approach Radar
TAS	True Airspeed
THR	THReshold (of Runway)
TMA	TerMinal Area
TNA	Turn Altitude
TODA	Take-off Distance Available
TORA	Take-Off Runway Available
V_n	Aircraft critical velocity reference
VOR	Very high frequency Omni-directional Range
WAC	Westralia Airports Corporation, operators of Perth Airport
WAM	Wide-Area Multilateration

APPENDIX 2 — PANS-OPS ANALYSIS

Calculations for the procedures are shown in the table below.

Procedures are as per Airservices Australia AIP DAP 141 (effective 13-Nov-2014 to 04-Mar-2015).

CIRCLING

Table 6-1 Circling Procedures, including Calculations

Procedure	*Impact*	*Max Perm-issible Obstacl Elev (mAHD)*	*Comment*
Cat A & B	None – below limiting height	126.4	Inside permitted circling area north of the airport between RWY 16R/34L and RWY 07/25. Circling elevation = 710ft = 216.4m – 90m MOC = 126.4m

APPROACHES & ARRIVALS

Table 6-2 Approach Procedure Obstacle Clearance, including Calculations

Procedure	*Impact*	*Max Perm-issible Obstacl Elev (mAHD)*	*Comment*
STARs			
All	None – outside protection areas or too high over development precinct to affect building heights	N/A	BOREE 6, CALGA 1, MARLN 1, ODALE 5, RIVET 2
Approaches			
ILS Approaches			
RWY 07 ILS-Y OR LOC-Y ILS-Z OR LOC-Z GLS	Nil – outside extent of surfaces	N/A	The whole of the development is outside the extent of the Basic ILS surfaces, OAS surfaces and Localizer Only protection areas.
RWY 25 ILS OR LOC GLS	Nil – outside extent of surfaces	N/A	The whole of the development is outside the extent of the Basic ILS surfaces, OAS surfaces and Localizer Only protection areas.
RWY 16R ILS-Y OR LOC-Y ILS-Y PRM ILS-Z OR LOC-Z ILS-Z PRM ILS-Z (CAT I & II) OR LOC-Z ILS-Z (CAT I & II) PRM GLS	Nil – outside extent of surfaces	N/A	The whole of the development is outside the extent of the Basic ILS surfaces, OAS surfaces and Localizer Only protection areas.

Procedure	*Impact*	*Max Perm-issible Obstacl Elev (mAHD)*	*Comment*
RWY 34L ILS-Y OR LOC-Y ILS-Y PRM ILS-Z OR LOC-Z ILS-Z PRM ILS-Z (CAT I & II) OR LOC-Z ILS-Z (CAT I & II) PRM GLS	Nil – outside extent of surfaces	N/A	The whole of the development is outside the extent of the Basic ILS surfaces, OAS surfaces and Localizer Only protection areas.
RWY 16L ILS-Y OR LOC-Y ILS-Y PRM ILS-Z OR LOC-Z ILS-Z PRM GLS	Nil – Outside the extent of the Basic ILS, OAS and Localizer Only surfaces	N/A	The whole of the development is outside the extent of the Basic ILS surfaces, standard OAS surfaces and Localizer Only protection areas.
RWY 34R ILS-Y OR LOC-Y ILS-Y PRM ILS-Z OR LOC-Z ILS-Z PRM GLS	Nil - beneath the outer edge of the Basic ILS surfaces	> 132.9m	Development is in the turn area of missed approach with both 2.5% and 3.3% climb gradients. Turn is required when aircraft achieves altitude of 600ft = 182.9m. 50m clearance is required in the turn area, therefore maximum building height > 182.9 – 50m = 132.9m. Additional height margin due to location in secondary area not calculated.
RNAV (GNSS) Approaches			
RNAV-Z (GNSS) RWY 07	Nil – outside extent of protection surfaces	N/A	
RNAV-Z (GNSS) RWY 16L	Nil – outside extent of protection surfaces	N/A	
RNAV-Z (GNSS) RWY 16R	Nil – outside extent of protection surfaces	N/A	
RNAV-Z (GNSS) RWY 25	Nil – Clear of protection areas	N/A	
RNAV-Z (GNSS) RWY 34L	Nil – Beneath the outer portion of the secondary protection area of the missed approach	~ 139m	Development near outer edge of secondary area of missed approach turn area. Turn altitude = 500ft = 152.4m, therefore altitude of primary at turning point = 152.4m – 50m = 102.4m. Approximately 25% in from the outer edge of protection area, thus limiting height approximately 139m AHD. Additional height margin due to location in secondary area not calculated in detail.

Procedure	*Impact*	*Max Perm-issible Obstacl Elev (mAHD)*	*Comment*
RNAV-Z (GNSS) RWY 34R	Nil – In primary area of missed approach (after turn at altitude)	> 132.9m	Development near outer edge of secondary area of missed approach turn area. Turn altitude = 600ft = 182.9m, therefore altitude of primary at turning point = 182.9m – 50m = 132.9m. Additional height margin due to location in secondary area not calculated.

DEPARTURES

Table 6-3 Departure Procedure Obstacle Clearance, including Calculations

Procedure	*Impact*	*Max Perm-issible Obst Elev (mAHD)*	*Comment*
SIDS			
SYDNEY SIX DEPARTURE (RADAR)			
➢ RWY 07	Nil – beneath protection area	Approx 200.9m	Turn Alt = 182.9m Approx Dist from Turn Init Area to Site = 2297m Max Obst Height = 182.9m + 2297m*0.047 – 90m = 182.9m + 108m - 90m = 200.9m
➢ RWY 16R	Nil	N/A	Aircraft prohibited from turning towards development on take-off.
➢ RWY 16L	Nil – beneath protection area	323.9m	Turn Alt = 152.4m Approx Dist from Turn Init Area to Site = 5563m Max Obst Height = 152.4m + 5563m*0.047 – 90m = 152.4m + 261.5m - 90m = 323.9m
➢ RWY 25	Nil – beneath protection area	>153.4m	Turn Alt = 243.8m Turn Alt – 90m = 153.8m So aircraft must have adequate clearance when they start the turn.
➢ RWY 34R	Nil – beneath protection area	152.5m	Turn Alt = 152.4m Approx Dist from Turn Init Area to Site = 1893m Max Obst Height = 152.4m + 1893m*0.048 – 90m = 152.4m + 90.1m - 90m = 152.5m
➢ RWY 34L	Nil	N/A	Aircraft prohibited from turning towards development on take-off.

Procedure	*Impact*	*Max Perm-issible Obst Elev (mAHD)*	*Comment*
Other SIDs			
All	Nil	N/A	All other SIDs are based upon the Radar SIDs so none should have any greater effect upon the proposed development

21st June 2016

Gazcorp
PO Box A2577
Sydney South NSW 1235

Email: Nicholas@gazcorp.com

Attn: Nicholas Gazal

Dear Nicholas,

Re: Preliminary Aeronautical Impact Statement for Planning Application, for Development at 296-298 Botany Rd, Alexandria NSW — 2016/06 SUPPLEMENT to Feb-2015 Report

Regarding the **proposed change of layout of the proposed development (Feb-2016) at 296-298 Botany Rd, Alexandria NSW**, we have been requested to assess the changes and provided an updated opinion on the likely "building airspace height" approvability of the amended proposal should an application for the development be submitted under the Airports (Protection of Airspace) regulations.

Having evaluated the amended proposal against the Preliminary Aeronautical Impact Assessment report of Feb-2015, and our knowledge of the current and planned airspace and flight procedures for Sydney Airport, we confirm that:

- ❑ All three towers would penetrate Sydney Airport's OLS, and thus a building airspace height application would need to be submitted to the Department of Infrastructure, via Sydney Airport, prior to construction.
- ❑ The proposed development is lower than (and would not infringe) the maximum permissible heights of Sydney Airport's prescribed airspace.
- ❑ The maximum height of the development overall is 3.7m lower than that previously proposed — which means that **the amended development provides 3.7m more clearance** from the maximum permissible height limit than was available in the original proposal (as per the Feb-2015 report), **and an additional safety margin**.
- ❑ In our opinion, based on the applicable height restrictions, the heights of existing and approved nearby developments, and the location of this and other developments in relation to Sydney Airport, **the development as currently proposed would gain airspace height approval.**

KEY POINTS OF EVALUATION

The basis of the evaluation was the amended plan in the Botany Rd Response to Council report of Feb-2016[1].

The overall extent of site has not changed. The footprints of the various towers have changed and the maximum height of each of the three towers has changed, as indicated in Table 1 below. The maximum height of the development overall is 3.7m lower than that previously proposed.

1 *SJB Architects,* Council Response: 296-298 Botany Road, 294-300 Wyndham Street, Alexandria. *February 2016 Version 01*

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OLS ANALYSIS

The tallest of the towers in the amended proposal is 3.7m lower than in the original proposal, and so the maximum penetration of the limiting OLS surface is 3.7m less than before.

Table 1: Proposed (Original & Amended) Building Elevations & Penetrations of OLS Surfaces

***OLS Surface Height at Location: 51.0** m AHD*

Proposed Site / Feature	*ORIGINAL Max Development Elevation Metres AHD*	*Penetration * Metres*	***AMENDED Max Development Elevation*** *Metres AHD*	***Penetration *** *Metres*
Tower 1	66.2	15.2	**96.5**	**45.5**
Tower 2	100.3	49.2	**77.9**	**26.9**
Tower 3	91.0	40.0	**96.5**	**45.5**

* **Penetration**: rounded *up* to nearest 0.1m
** **Clearance**: rounded *down* to nearest 0.1m

PANS-OPS ANALYSIS

The current amendment provides 3.7m more clearance than was available in the original proposal. The total clearance from the most limiting surface — that related to the Cat A&B Circling procedure — is now almost 30m (almost 100 ft).

Table 2: Proposed (Original & Amended) Maximum Building Elevation in relation to Most Limiting PANS-OPS Surfaces

***Cat A&B Circling Procedure Surface Height at Location: 126.4** m AHD*

Proposed Site / Feature	*ORIGINAL Max Development Elevation Metres AHD*	***Clearance ** Metres***	***AMENDED Max Development Elevation*** *Metres AHD*	***Clearance ** Metres***
Tallest of Towers	100.3	26.1	**96.5**	**29.9**

* **Penetration**: rounded *up* to nearest 0.1m
** **Clearance**: rounded *down* to nearest 0.1m

OTHER FACTORS

No adverse change in relation to the Feb-2015 report.

Should you require clarification on any aspects of our evaluation or wish to discuss our final opinion, please do not hesitate to contact me directly via phone (M: 0411 389 317) or email (Cathy.PakPoy@StrategicAirspace.com).

Yours sincerely,
STRATEGIC AIRSPACE

Cathy Pak-Poy
Joint CEO