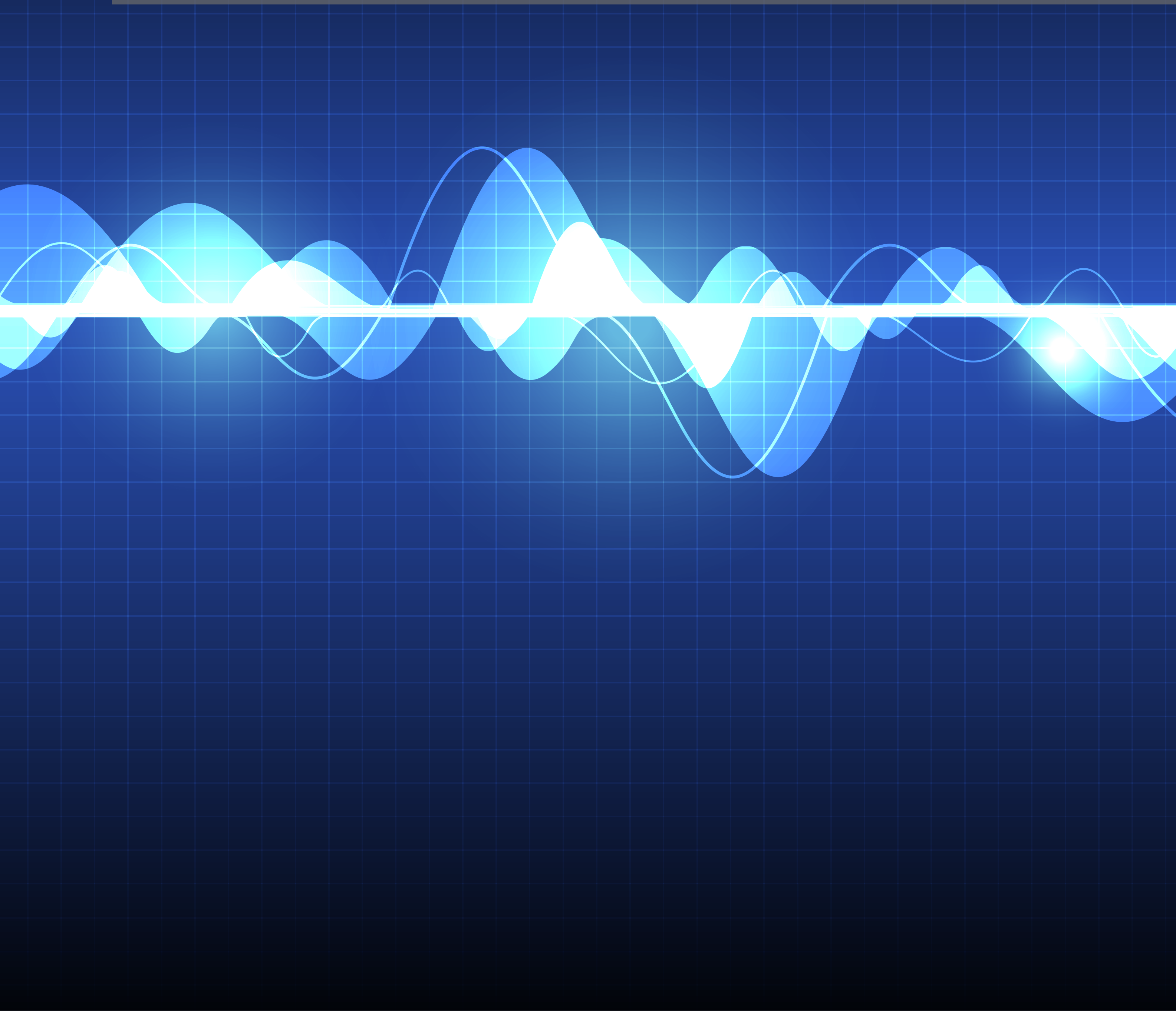
75 Mary Street, St Peters

Aircraft noise impact assessment

Prepared for Precinct 75
June 2019



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75 Mary Street, St Peters

Aircraft Noise Impact Assessment

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Prepared by

James Small
Associate
07/06/2019

Approved by

Najah Ishac
Director
07/06/2019

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Table of Contents

Appendices

Tables

Figures

1 Introduction

EMM Consulting Pty limited (EMM) has been engaged by JVMC Pty Ltd to conduct an acoustic assessment of aircraft noise impacts on the proposed mixed-use development at 67, 73-78 Mary Street, 50-52 Edith Street and 43 Roberts Street, St Peters NSW.

Noise impacts have been addressed for aircraft utilising the Sydney Airport in accordance with the following:

- AS 2021 - 2015 Acoustics - Aircraft noise intrusion – Building, siting and construction; and
- Sydney Airport ANEF 2033.

The planning proposal application for the subject site was made at a time when the 2033 Master Plan for Sydney Airport was current. Hence, the airport's ANEF 2033 contour map has been retained for this assessment consistent with correspondence received from Sydney Airport in May 2019. The Sydney Airport Master Plan 2039 and accompanying ANEF 2039 were approved in April 2019. It is important to note that the adoption of the 2033 Master Plan rather than the 2039 Master Plan, has no influence on the final design noise levels at the site from aircraft fly overs and subsequently has no implications on building planning or construction.

Acoustic treatments have been recommended to ensure compliance with the requirements of AS2021-2015 and the planning authority.

1.1 Site Description

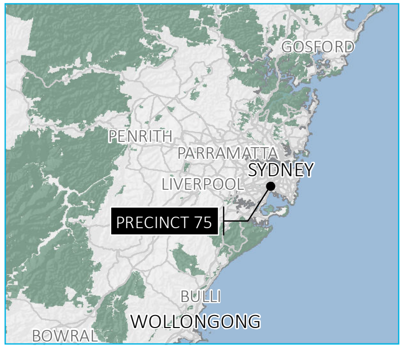
The site comprises 67, 73-83 Mary Street, 50-52 Edith Street and 43 Roberts Street, St Peters and is known as Precinct 75 (the site) with frontages to Mary Street (south) and Edith Street (north) and is located within the Marrickville local government area (LGA) within the Inner West Council.

The site has a combined area of approximately 1.333 hectares (13,300 m^2) and currently accommodates a number of commercial, retail and artistic uses such as The Rice Pantry, iConnect Systems, Smithys PA and Stage Gear, Willie the Boatman, Inartisan, Crank Furniture Co., Andiamo and others.

The site is currently zoned IN2 Industrial and bordered by R2 Low Density Residential on all sides. A single row of residential zoned land and dwelling separates the site from IN1 and IN2 Industrial lands and SP2 Rail Infrastructure Facilities to the west, north-west and north respectively. Significant expanses of industrial zoned land are also located to the east, south-east and south of the site.

The site is exposed to Sydney (Kingsford-Smith) Airport (SYD) flight operations and is the principal acoustic consideration for potential redevelopment of the site. The main exposure will be aircraft approaches on runway ends 16R and departure events on runway end 34L comprising the main north-south runway.

The site layout and surrounding site context is shown in Figure 1.1.



KEY

- Precinct 75
- Rail line
- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary
- Waterbody

Source: EMM (2018); Air Services Australia (2018); DFSI (2017); GA (2015)

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Site location

Strategic acoustic advice –
75 Mary Street, St Peters (Precinct 75)

Figure 1.1

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2 Regulatory context

2.1 Australian Standard AS 2021-2015

The fundamental tool used for building site acoustic planning purposes around aerodromes is Australian Standard *AS 2021 - 2015 Acoustics - Aircraft noise intrusion - Building siting and construction*. This is the fifth edition in this standard with the original published in 1977 and it replaces the prior edition which was published in 2000. The fundamental principles for land use planning did not change between the 2000 and 2015 versions. AS2021 states:

> The aircraft Noise Exposure Forecast (NEF) technique was first developed in the United States of America in the late 1960s. It was subsequently redefined in Australia in 1982. The NEF system is a scientifically based computational procedure for determining aircraft noise exposure levels around aerodromes. It can be used for assessing average community response to aircraft noise and for land use planning around aerodromes. In the Australian NEF system, noise exposure levels are calculated in Australian Noise Exposure Forecast (ANEF) units, which take into account the following features of aircraft noise:
>
> (a) The intensity, duration, tonal content and spectrum of audible frequencies of the noise of aircraft take offs, approaches to landing, and reverse thrust after landing (for practical reasons, noise generated on the aerodrome from aircraft taxiing and engine running during ground maintenance is not included).
>
> (b) The forecast frequency of aircraft types and movements on the various flight paths, including flight paths used for circuit training.
>
> (c) The average daily distribution of aircraft arrivals and departures in both daytime and night-time (daytime defined as 0700 hours to 1900 hours, and night-time defined as 1900 hours to 0700 hours).
>
> ANEF charts are provided for most aerodromes throughout Australia. The charts are simply plans of the aerodrome and the surrounding localities on which noise exposure contours of 20, 25, 30, 35 and 40 ANEF units have been drawn. These contours indicate land areas around an aerodrome which are exposed to aircraft noise of certain levels as defined by Clause 1.5.6; the higher the ANEF value the greater the noise exposure.
>
> In the areas outside 20 ANEF, noise from sources other than aircraft tends to predominate over aircraft noise, although individual reactions to aircraft noise may differ markedly. Within the area from 20 ANEF to 25 ANEF, aircraft noise exposure starts to emerge as an environmental problem, while above 25 ANEF the noise exposure becomes progressively more severe.
>
> The land use compatibility recommendations made in this Standard relate to the above ANEF contours.

Other useful context from AS2021-2015 includes:

> Prior to 1982, Australian land use recommendations were essentially similar to the criteria used in the U.S. NEF system. However, with the availability of an Australian dose/response function derived from the NAL social survey, the U.S. criteria were revised to take into account the general reaction of Australian communities to aircraft noise.
>
> In essence, this revision was limited to a firmer definition of the criterion for residential land use compatibility. In the NEF system as originally adopted in Australia, the U.S. criterion of 30 NEF was adhered to, but, in accordance with a recommendation of the House of Representatives Select Committee on Aircraft Noise made in 1970, cautious restraint was urged to be applied by land zoning authorities when applying the system to Australian conditions. Where possible, the 25 NEF contour was used rather than the 30 NEF as a conservative safeguard until the system was validated in Australia.

The NAL Report provided substantial evidence to support the use of 25 ANEF as the appropriate criterion for residential land usage. The 25 ANEF as a residential land usage criterion was recommended in 1985 by the House of Representatives Select Committee on Aircraft Noise, and subsequently adopted as policy by the Commonwealth Government. The only qualification which arises from the findings of the NAL Report is that some people will find that the noise exposure at 25 ANEF is still unacceptable (refer to Figure A1 for the percentage of people affected in the 20 ANEF to 25 ANEF zone). Accordingly, the issuing authorities enter the 20 ANEF contour on all ANEF charts. It is to be stressed, however, that the actual location of the 20 ANEF contour is difficult to define accurately, because of variations in aircraft flight paths, pilot operating techniques, and the effect of meteorological conditions on noise propagation. For that reason, the 20 ANEF contour is shown as a broken line on ANEF charts.

2.1.1 Site acceptability

The Standard considers whether a building site is 'acceptable', 'conditionally acceptable' or 'unacceptable' on acoustic grounds. To do this, an Australian Noise Exposure Forecast (ANEF) noise contour map is needed, which shows the aerodrome's noise footprint on the surrounding environment. The ANEF map is a function of noise levels from various aircraft that are forecast to use the airport and the number of aircraft movements. The ANEF values are used for land use planning around Airports in Australia. Most councils around the airport adopt this approach, and in the absence of such guidance in local or state policies, advice in AS 2021 is the most authoritative available.

The Australian Standard recommends an initial screening approach to determine the acceptability of a site for nominated land uses. Table 2.1 provides a reproduction of Table 2.1 from AS 2021 and the associated notes that follow the table.

Table 2.1 Building site acceptability based on ANEF zones (AS 2021)

Building Type	ANEF Zone of site		
	Acceptable	**Conditionally Acceptable**	**Unacceptable**
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Notes: 1. The actual location of the 20 ANEF contour is difficult to define accurately, mainly because of variation in aircraft flight paths. Because of this, the procedure of Clause 2.3.2 may be followed for building sites outside but near to the 20 ANEF contour.
2. Within 20 ANEF to 25 ANEF, some people may find that the land is not compatible with residential or educational uses. Land use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate (see also Figure A1 of Appendix A).
3. There will be cases where a building of a particular type will contain spaces used for activities which would generally be found in a different type of building (e.g. an office in an industrial building). In these cases, Table 2.1 should be used to determine site acceptability, but internal design noise levels within the specific spaces should be determined by Table 3.3.
4. This Standard does not recommend development in unacceptable areas. However, where the relevant planning authority determines that any development may be necessary within existing built-up areas designated as unacceptable, it is recommended that such development should achieve the required ANR determined according to Clause 3.2. For residences, schools, etc., the effect of aircraft noise on outdoor areas associated with the buildings should be considered.
5. In no case should new development take place in green field sites deemed unacceptable because such development may impact airport operations.

AS 2021 defines the terms in Table 2.1 as follows:

Acceptable

> *If from Table 2.1, the building site is classified as 'acceptable', there is usually no need for the building construction to provide protection specifically against aircraft noise. However, it should not be inferred that aircraft noise will be unnoticeable in areas outside the ANEF 20 contour. (See Notes 1, 2 and 3 of Table 2.1).*

Conditionally acceptable

> *If from Table 2.1, the building site is classified as 'conditionally acceptable', the maximum aircraft noise levels for the relevant aircraft and the required noise reduction should be determined from the procedure of Clauses 3.1 and 3.2, and the aircraft noise attenuation to be expected from the proposed construction should be determined in accordance with Clause 3.3 (See Notes 1 and 3 of Table 2.1).*

If an area is found to be 'conditionally acceptable' this typically means that any proposed buildings could require an improved level of building fabric above standard or light-weight materials to achieve internal noise goals set by AS 2021.

Unacceptable

> *If, from Table 2.1 the building site is classified as 'unacceptable', construction of the proposed building should not normally be considered. Where in the community interest redevelopment is to occur in such areas, e.g. a hotel in the immediate vicinity of an aerodrome, refer to the notes to Table 2.1.*

2.1.2 Requirements for construction

If buildings are constructed in 'conditionally acceptable' areas, AS 2021 sets out required internal noise levels, based on L_{Smax} values from the loudest operating aircraft type.

A procedure is described in AS 2021 for determining the required performance of building elements to meet these levels, but this is not a requirement of the Standard and in this study is replaced with a more accurate method – measurements to determine external noise levels, and accurate frequency-based calculations to determine resulting internal levels.

2.1.3 Maximum noise levels

For this site there are areas which are located within contours equal to or exceeding ANEF 25. As such, it is necessary to quantify the typical L_{Smax} noise level from aircraft. The representativeness of noise data should reflect typical events at the aerodrome, which can be ambiguous in some cases, particularly when trying to estimate future operations and associated impacts. For Sydney Airport this is relatively straightforward because of its well-established flight path, movements, runways and aircraft types.

For aerodromes with a relatively high number of movements (defined as an airport), AS 2021 suggests that data tabulated in the standard be supplemented by site-specific field measurements. Where a site is 'conditionally acceptable', AS 2021 recommends that buildings be designed to achieve internal noise levels no greater than identified maximum values from aircraft.

Table 2.2 reproduces recommended internal maximum noise levels for various spaces as categorised in AS 2021. These are the L_{Smax} or maximum noise inside buildings. The spaces with the most onerous criteria are theatres, cinemas and recording studios, although these are often designed and constructed with highly noise attenuating building elements.

For residential buildings, it is necessary to consider aircraft noise levels of greater than 60 dB(A) L_{Smax} as an external level of 60 dB(A) is typically reduced to 50 dB(A) inside, even with a partially open window or door. This satisfies the strictest residential criterion which applies to sleeping areas and dedicated lounges.

Table 2.2 Indoor design sound levels

Building type and activity	Indoor L_{Smax} Design Sound Level, dB(A)
Houses, home units, flats, caravan parks	
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathroom, toilets, laundries	60
Hotels, motels, hostels	
Relaxing, sleeping	55
Social activities	70
Service activities	75

3 Site ANEF exposure

For the purpose of siting suitability, determining planning constraints and identifying noise exposure for the site, EMM has reviewed ANEF contour maps and how they relate to the site. The review has considered the ANEF 2033 and ANEF 2039 recently approved in April 2019.

3.1 ANEF 2033

It is relevant to note that at the time the proponent's planning proposal was submitted, the ANEF 2033 included in the Sydney Airport Master Plan 2033 was the current ANEF (ie in 2017). Correspondence dated December 2017 from Sydney Airport to Inner West Council in response to the planning proposal confirms that ANEF 2033 is the relevant map.

EMM has projected the ANEF 2033 over the site to identify exposure (Figure 3.1) and confirmed a portion of the site fronting Mary Street is located within the 25-30 ANEF zone. The extent of exposure comprises a strip of land approximately 10 m in width to the south up to 30m to the north.

Under the strict adoption of the land use procedures outlined in Table 2.1 this defines an area comprising approximately 2,060 m^2 unacceptable for residential development according to AS2021. However, AS2021 notes that a determining authority (eg Council) can choose to approve residential in these zones. Examples of where Council has done this is discussed later. Such an approach would require treatment to residential buildings according to AS2021. Non-residential uses would be acceptable in this area according to AS2021.

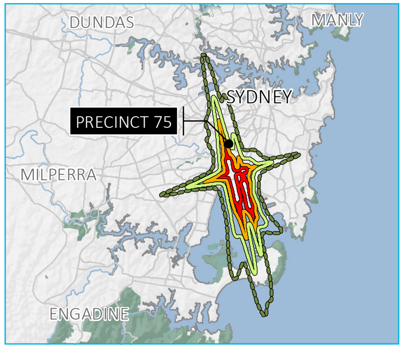
3.2 ANEF 2039

A projection of the ANEF 2039 over the site (Figure 3.2) confirms that there is a shift of the 25 ANEF contour of approximately 50m east across the site. As a result, the extent of exposure for the site within the 25-30 ANEF zone comprises an area of approximately 7,600 m^2 or more than 50% of the site area.

The change in contours from the ANEF 2033 to ANEF 2039 are attributed to factors discussed on Page 259 of the Sydney Airport Master Plan 2039 which states the following:

> In some areas, the contours move further away from the airport (thus increasing the area affected by the ANEF) and in other areas the contours move closer to the airport (thus reducing the area affected by the ANEF). This is apparent for some sections of the ANEF 20 and 25 contours shown in ANEF 2039.
>
> The reasons why some contours in ANEF 2039 are, in some areas, different to those in the previous ANEF 2033 can be summarised as follows:
>
> - Forecast increased aviation activity over the planning period, which will see flights increase to just over 408,000 per annum
> - International passengers are expected to be the main driver of growth, increasing as a proportion of overall passengers (and therefore international flights) over the period to 2039. Aircraft flying to or from international destinations tend to be larger than those flying to or from domestic or regional destinations
> - To ensure balanced operations between the airport's two north-south runways, it has been assumed that some of this growth in international flights will be accommodated on Sydney Airport's parallel north-south runway, noting that such international flights operate from that runway now
> - The new ANEF 2039 assumes Western Sydney Airport opens in late 2026 and the aviation activity forecasts that underpin the ANEF reflect that
> - Updated meteorological data

Importantly, and as will be demonstrated later, the shift in the ANEF map from 2033 to 2039 does not influence the representative maximum design noise level for the site that will be used to ultimately dictate the building fabric design requirements. This is because the runways, flight paths and representative aircraft event (ie the Boeing 747-400 departure) is unchanged.



KEY
- Precinct 75
- Rail line
- Major road
- Minor road
- Watercourse/drainage line
- Cadastral boundary
- Waterbody

Sydney Airport ANEF 2033
- 25 ANEF
- 30 ANEF
- 35 ANEF

Source: EMM (2018); Air Services Australia (2018); DFSI (2017); GA (2015)

GDA 1994 MGA Zone 56

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Site and Sydney Airport ANEF 2033

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75 Mary Street, St Peters (Precinct 75)

Figure 3.1

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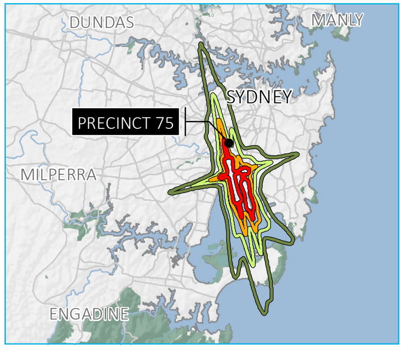

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Sydney Airport ANEF 2039
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- 30 ANEF
- 35 ANEF

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Source: EMM (2018); Air Services Australia (2018); DFSI (2017); GA (2015)

0 100 200 m

GDA 1994 MGA Zone 56

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Site and Sydney Airport ANEF 2039

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Figure 3.2

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4 Additional discussion

4.1 Sydney Airport Masterplan

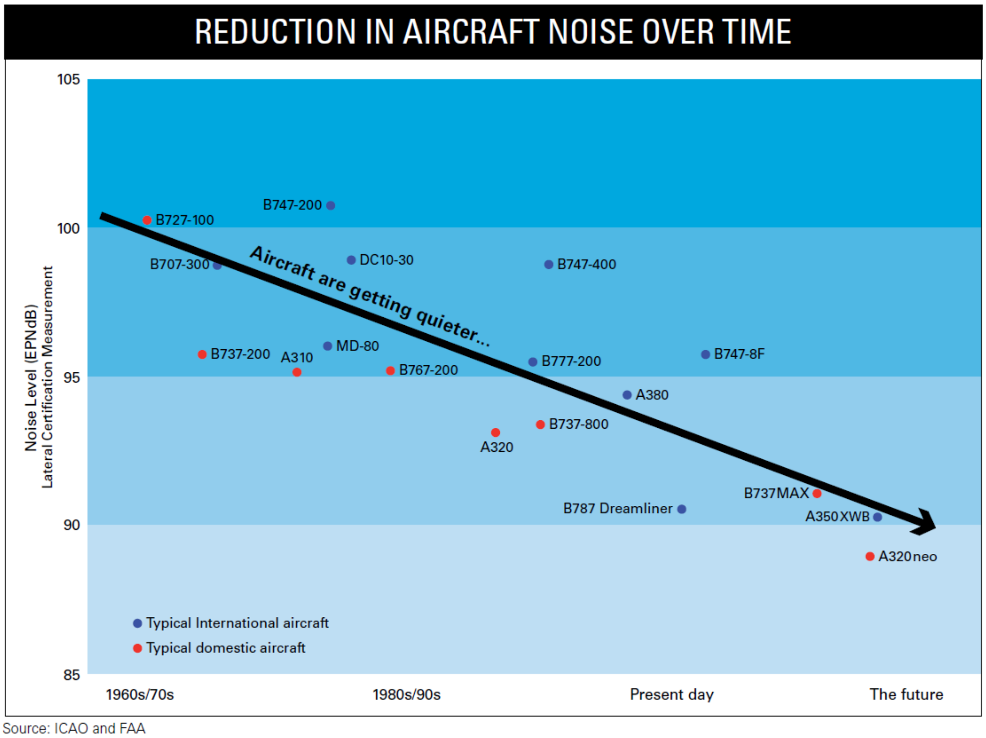
Sydney Airport Master Plan 2033 assists in understanding the future operations and related changes in impacts from aircraft noise.

For example, it is stated that airlines expected to see continued increases in seating density across the industry. Further, Qantas "...intends to replace B767s with the 20-25% larger A330s".

At Section 14.2.1, page 179, the plan states:

> Sydney Airport welcomes the introduction of the new generation of quieter aircraft like the Airbus A380, Boeing B777, B787 Dreamliner and B747-8F. It is expected that other new generation quieter aircraft like the A350XWB, B737 MAX and A320neo will be introduced within the planning period of this Master Plan.
>
> Sydney Airport's past, present and future investment in infrastructure to accommodate these new generation aircraft is designed to ensure residents living close to the airport or under flight paths will continue to benefit from their introduction. For example, to accommodate the A380, which is both larger and much quieter than the older aircraft type it is replacing, Sydney Airport has invested significantly to upgrade infrastructure.

Figure 14.2 of the Master Plan 2033 demonstrates the above and depicts how improved technology has resulted in quieter aircraft (reproduced as Figure 4.1). The expectation as shown is to continue the trend of reduced aircraft noise emissions into the future.



Source: Sydney Airport Master Plan 2033 (2014)

Figure 4.1 Reduction in aircraft noise over time

At page 182, the Master Plan states:

> In 2008, Airservices Australia released a report showing that an Airbus A380 departing from or arriving at Sydney Airport is between 2.1 and 6.7 decibels quieter than the 747-400, the older aircraft type it typically replaces.
>
> Airservices Australia indicates in its report that “a three decibel reduction is regarded as a halving of an aircraft’s noise energy".

Refer to Figure 4.2 demonstrating the above via actual measured noise reductions from comparable aircraft, as reported in the Master Plan at Table 14.6. The A380 has a smaller noise footprint on take-off and landing and hence reduces the impact of aircraft on the community. The reductions in L_{ASmax} noise are significant both in terms of occupant experience and implementation of noise controls for buildings.

Location of NMT	Aircraft type	Arriving or departing	Average LA max [dB(A)]	Reduction in decibels	Reduction in noise energy
Sydenham	A380	Departing	87.7	- 4.4	- 64%
	B747-400	Departing	92.1		
	A380	Arriving	93.9	- 2.6	- 45%
	B747-400	Arriving	96.5		
Leichhardt	A380	Departing	81.7	- 3.9	- 59%
	B747-400	Departing	85.6		
	A380	Arriving	84.4	- 2.1	- 38%
	B747-400	Arriving	86.5		
Annandale	A380	Departing	71.5	- 5.5	- 72%
	B747-400	Departing	77.0		
St Peters	A380	Departing	73.6	- 6.7	- 79%
	B747-400	Departing	80.3		
Croydon	A380	Departing	76.7	- 2.3	- 41%
	B747-400	Departing	79.0		

Source: Airservices Australia

Source: Sydney Airport Master Plan 2033 (2014)

Figure 4.2 Noise monitoring around Sydney Airport

At page 182, the Master Plan states:

> In July 2012, Virgin Australia announced an agreement with Boeing to order 23 of its new generation 737 MAX aircraft, the first airline in Australia to do so. Boeing has said that the noise footprint of this aircraft is 40% smaller than today's B737s."
>
> The B787 Dreamliner began flying to Sydney in August 2013. Qantas has selected the B787 Dreamliner as the cornerstone of its domestic and international fleet renewal program. Under the fleet plan, the Qantas Group has orders for 15 Boeing 787 aircraft, with the first aircraft having arrived in the second half of 2013. Qantas has options and purchase rights for a further 50, available for delivery from 2016. Powered by General Electric's GEnx engines, Qantas indicates that it has a 50% smaller noise footprint. The B787 will, over time, replace older aircraft like the B767-300. Cathay Pacific already flies the new generation B747-8F freighter to Sydney and has said that its noise footprint is 30% smaller than the older freight aircraft type it replaced.

In summary, the long term expectations are reductions in aircraft noise levels from overflight events.

5 Assessment of noise impacts

The following presents the assessment of aircraft noise levels established using the methodology provided in AS2021-2015 with context to the site location and proximity to the Sydney Airport patterns indicated on ANEF 2033.

5.1 Aircraft flyover L_{ASmax} noise levels

Whether ANEF 2033 or ANEF 2039 is adopted for assessing noise (i.e. the position of the 25 ANEF contour across the site) does not alter the L_{ASmax} noise level values for the site determined in accordance with the procedures of AS2021. To determine the typical maximum L_{ASmax} noise exposure for the site and surrounding area, a 50-m-grid was developed and a worse case prediction of a Boeing 747-400 (long haul) departure and arrival on the main north-south runway (16R/34L) was considered.

A summary of the distance coordinates from the main north-south runway (16R/34L) and calculated L_{ASmax} noise levels for take-off and arrival are summarised in Table 5.1 and presented in Figure 5.1. The calculations utilise the centreline distance for landing (DL) and take-off (DT) in addition to the side line distance (DS) as defined in AS2021.

Table 5.1 Site L_{ASmax} noise levels – 747-400 long range

DL (m)	DS (m)	DT (m)	Departure L_{ASmax} dB(A)	Arrival L_{ASmax} dB(A)
1750	350	5550	91	80
1750	400	5550	88	78
1750	450	5550	88	76
1750	500	5550	86	75
1750	550	5550	86	74
1800	350	5600	91	80
1800	400	5600	88	78
1800	450	5600	88	76
1800	500	5600	86	75
1800	550	5600	86	74
1850	350	5650	91	80
1850	400	5650	88	78
1850	450	5650	88	76
1850	500	5650	86	75
1850	550	5650	86	74
1900	350	5700	91	80
1900	400	5700	88	78
1900	450	5700	88	76
1900	500	5700	86	75

Notes: 1. L_{ASmax} noise levels in accordance with AS2021-2015

A review of Table 5.1 and Figure 5.1 confirm that the site is exposed to L_{ASmax} noise levels from departing 747-400 (long range) aircraft of 86-88dB(A). Attended noise measurements at the site were conducted 31 January 2019. Measurements indicated noise levels in the order of 88dB(A) L_{ASmax} from a 747-400 taking off from Sydney Airport which is consistent with the predictions utilising AS2021-2015. Given the infrequency of 747-400 movements, only one take-off was captured. This was the loudest noise level recorded from various aircraft types and as such is also consistent with the AS2021 prediction.

KEY

- Precinct 75
- Major road
- Minor road
- Cadastral boundary

Boeing 747-400 L_{ASmax} (AS2021-2015)

- **00** Departure
- **00** Arrival

Source: EMM (2018); Air Services Australia (2018); DFSI (2017); GA (2015)

0 50 100 m

GDA 1994 MGA Zone 56

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Site L_{ASmax} noise levels - Boeing 747-400 (long range)

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Figure 5.1

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5.2 Aircraft noise reduction (ANR) requirements

AS2021 provides the methodology adopted for calculating the aircraft noise reduction (ANR) values for building elements potentially constructed at the site.

The spectral component of aircraft noise is important in the determination of ANR for each building element, particularly when an ANR of 30 or more is required. We have adopted spectral data from EMM's database of attended noise measurements of B747-400 aircraft for reference in the calculations that follow.

The overall ANR of a building is simply the external aircraft noise level (eg up to 88 dB(A) in this case) less the AS2021 internal noise goal (eg 50 dB(A) for sleep areas and dedicated lounges). A maximum ANR of 38 dB(A) is applicable to the subject site.

The aircraft noise attenuation required of each component is determined using the spectral characteristics of the aircraft flyover, the area and the acoustic transmission loss of the building element and acoustic absorption of the receiver room. Living rooms have been assessed for hard floor finishes and carpet within bedrooms.

6 Recommendations

An assessment of example floor plans has been undertaken as proof of concept in achieving the internal noise level requirements of AS2021 due to noise generated by aircraft flyovers.

The floor plans assessed incorporate a range of different configurations including rooms with significant glazed façade area and light weight façade which will be more susceptible to aircraft noise intrusion when compared to minimal glazing and masonry façade constructions. In this regard, it is shown that the development can comply with the requirements of AS2021 in a typical 'worst case' configuration.

The following acoustic treatments are provided as proof of concept only and it is expected that a detailed analysis of façade constructions will be undertaken with the detailed design of each building.

Table 6.1 and Table 6.2 present the potential building material solutions for each element of the facade that would satisfy the criteria outlined in Table 2.2. These are in-principle recommendations and there are a range of solutions that would satisfy the requirements. The glazing specifications are nominal only and windows, doors and skylight should be specified and selected to achieve the minimum acoustic requirement.

6.1 Acoustic constructions

The recommended glazing and façade constructions for each apartment are provided in Appendix A.

Table 6.1 Minimum glazing constructions

Glazing Type	Construction	Acoustic Rating R_w
1	6.38 mm / 150 mm / 5 mm	45
2	6 mm / 100 mm / 4 mm	43
3	10.38 mm / 12 mm / 6 mm	39
4	10.38 mm laminated	35

Indicative light weight façade constructions to satisfy noise intrusion requirements are provided in Table 6.2. As discussed earlier, light weight options are provided to demonstrate that worst case construction can be built to meet minimum requirements. To that end, it would be prudent to adopt a façade inclusive of masonry in such areas of Sydney where aircraft noise is known to exist (eg brick veneer).

Table 6.2 Minimum façade constructions

Facade Type	Construction	Acoustic Rating R_w
1	9 mm fibre cement sheeting externally, 92 mm metal stud, 2 x 13 mm standard plasterboard internally with R2 insulation in wall cavity (including infill panels above windows doors)	48
2	9mm fibre cement sheeting, 92 mm deep 92 mm metal stud, 1 x 13 mm standard plasterboard internally with R2 insulation in wall cavity (including infill panels above windows doors)	45

6.2 Façade penetrations

Façade penetrations are to be acoustically treated to maintain the acoustic integrity of the façade element in which they are located. This may include fire sprinkler penetrations, outside air louvres and exhaust louvres.

7 Conclusion

EMM has completed a review of potential noise constraints for the site, primarily focused on aircraft noise exposure utilising ANEF 2033, ANEF 2039 and L_{ASmax} noise levels (irrespective of whether ANEF 2033 or ANEF 2039 is adopted) for the site in accordance with AS2021. This was done to determine the suitability to accommodate residential use within the site. With regard to the site suitability for residential use the following has been discussed:

- The calculation of L_{ASmax} noise exposure for the site demonstrates that notwithstanding the possible change in the location of the 25 ANEF contour, actual L_{ASmax} noise levels determined in accordance with the procedures of AS2021 do not alter and would remain consistent whether the ANEF 2033 or ANEF 2039 is applied for the purpose of building fabric design requirements. The analysis confirmed that the site is exposed to L_{ASmax} noise levels in order of 86-88dB(A). Noise measurements at the site indicated L_{ASmax} noise levels in the order of 88dB(A) from a 747-400 flyover and as such is consistent with the AS2021 prediction.

- Based on the review of the information and details discussed in this report, we are of the opinion that notwithstanding that a portion of the site is located within the 25-30 ANEF zone, any residential buildings could be designed and constructed to satisfy the internal design levels of AS2021 in all areas of the site. Based on the derived aircraft noise level for the site, it is considered that building fabric construction would be similar throughout the site, irrespective of where a building is to be located in relation to ANEF 2033 contours.

A study of typical floor layouts has been undertaken to show that the site is capable of complying with internal noise requirements of AS2021 with suitable acoustic treatments. Acoustic treatments should be reviewed and finalised as part of the detailed design for each building to ensure compliance with the project internal noise requirements.

It is the opinion of EMM that the site is acceptable for residential use given previous approvals to development within the ANEF 25-30 contour and on the proviso that the building envelope is treated such that the internal noise requirements of AS2021 are achieved. EMM have provided indicative constructions which show the development can comply with the aircraft noise objectives and as such satisfy the requirements of the planning authority.

Appendix A

Typical acoustic treaments

Table A.1 Recommended acoustic treatment – Building A

Level	Unit	Space	Glazing Recommendation	Lightweight Façade Panel
Ground	G.01, G.06, G.07	Beds	2	2
		Living	4	2
	G.02 & G.05	Beds	2	2
		Living	4	2
	G.03 & G.04	Bed	2	2
		Living	3	2
	G.08	Bed (E)	2	2
		Bed (W)	3	2
		Living	3	2
	G.09	Bed	2	2
		Living	4	2
Typical	X.01	Bed	2	2
		Living	4	2
	X.02	Bed (N)	2	1
		Bed (W)	1	1
		Bed (E)	1	1
		Living	4	2
	X.03	Bed (E)	3	1
		Bed (W)	2	2
		Living	4	2
	X.04	Bed (E)	3	2
		Bed (W)	2	1
		Living	4	2

Table A.1 Recommended acoustic treatment – Building A

Level	Unit	Space	Glazing Recommendation	Lightweight Façade Panel
	X.05 & X.08	Beds	3	2
		Living	4	2
	X.06 & X.07	Bed	2	2
		Living	4	2
	X.09	Bed (E)	3	1
		Bed (W)	2	2
		Living	4	2
	X.10	Bed (E)	3	2
		Bed (W)	2	2
		Living	4	2
	X.11	Bed (E)	3	1
		Bed (W)	3	2
		Living	3	2
	X.12	Bed	2	2
		Living	4	2

Table A.2 Recommended acoustic treatment – Building B

Level	Unit	Space	Glazing Recommendation	Lightweight Façade Panel
Ground	G.01	Bed (E)	2	2
		Bed (W)	1	1
		Living	3	2
	G.02 & G.05	Beds	3	2
		Living	3	2
	G.03 & G.04	Bed	1	2
		Living	3	2
	G.06	Bed (E)	2	2
		Bed (W)	2	2
	G.07 & G.08	Bed	2	2
		Living	4	2
	G.09	Bed (E)	3	1
		Bed (W)	3	2
		Living	3	2
	G.10	Bed	2	2
		Living	3	2
Typical	X.01	Bed (E)	3	2
		Bed (W)	3	2
		Living	3	2
	X.02	Bed (N)	1	1
		Bed (S)	3	2
		Living	3	2

Table A.2 Recommended acoustic treatment – Building B

Level	Unit	Space	Glazing Recommendation	Lightweight Façade Panel
	X.03	Bed (E)	2	1
		Bed (W)	2	2
		Living	3	2
	X.04	Bed (E)	3	2
		Bed (W)	1	1
		Living	3	2
	X.05 & X.08	Bed (E)	3	2
		Bed (W)	3	2
		Living	3	2
	X.06 & X.07	Bed	2	2
		Living	3	2
	X.09	Bed (E)	3	2
		Bed (W)	2	2
		Living	3	2
	X.10	Bed	2	2
		Living	4	2
	X.11	Bed	2	2
		Living	4	2
	X.12	Bed (E)	3	1
		Bed (W)	3	2
		Living	3	2
	X.13	Bed	2	2
		Living	4	2

Table A.3 Recommended acoustic treatment – Building C

Level	Unit	Space	Glazing Recommendation	Lightweight Façade Panel
1-3	X.01 & X.08	Bed (E)	3	2
		Bed (W)	3	1
		Living	2	2
	X.02 & X.07	Bed (E)	2	2
		Bed (W)	2	2
		Living	3	2
	X.03 & X.06	Bed	2	2
		Living	3	2
	X.04 & X.05	Beds	3	2
		Living	3	2
4-7	X.01	Bed (E)	3	2
		Bed (W)	3	1
		Bed (N)	2	2
		Living	2	2
	X.02	Beds	2	2
		Living	3	2
	X.03 & X.04	Beds	3	2
		Living	3	2
	X.05	Bed	2	2
		Living	3	2
	X.06	Bed (E)	2	2
		Bed (W)	2	2
		Living	3	2

Table A.3 Recommended acoustic treatment – Building C

Level	Unit	Space	Glazing Recommendation	Lightweight Façade Panel
	X.07	Bed (E)	3	2
		Bed (W)	3	1
		Living	2	2

Note: Units numbered from left to right on plan

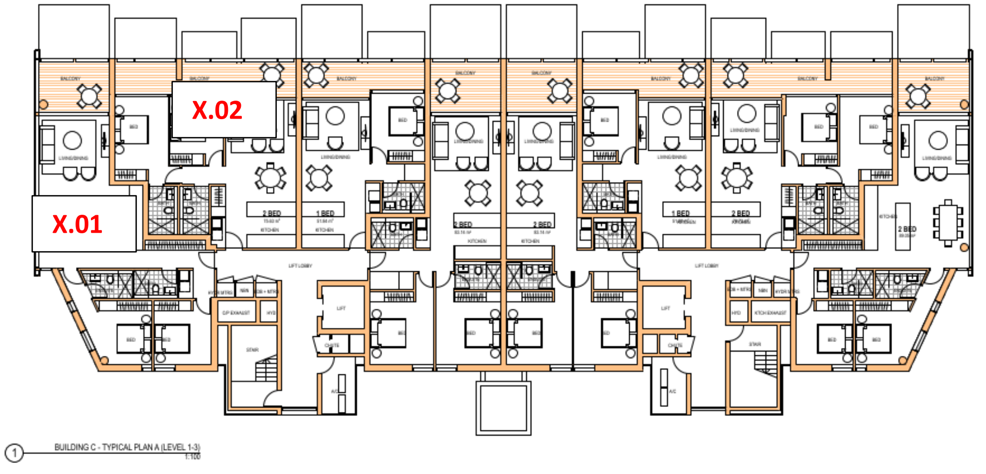
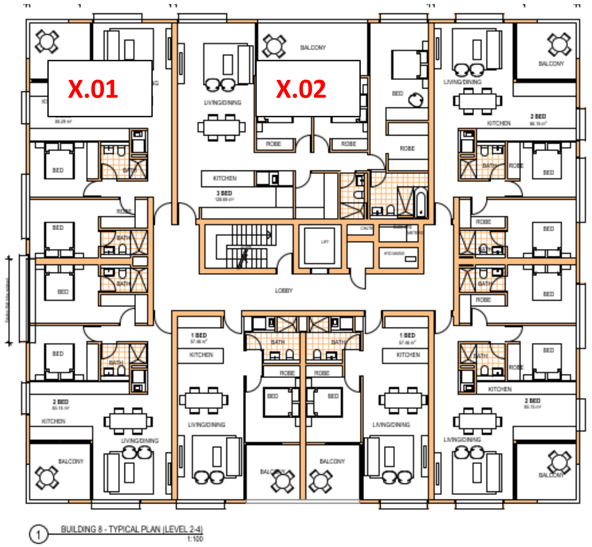


Table A.4 Recommended acoustic treatment – Building 8

Level	Unit	Space	Glazing Recommendation	Lightweight Façade Panel
2-4	X.01, X.03, X.04	Beds	3	2
		Living	3	2
	X.02	Bed (E)	1	2
		Beds	2	2
		Living	3	2
	X.05 & 6	Beds	2	2
		Living	3	2
	X.07	Bed (N)	2	2
		Bed (S)	3	2
		Living	3	2

Note: Units numbered clockwise from top left



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