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FORESTWAY SHOPPING CENTRE

Noise Impact Assessment

6 November 2023

Revelop

TM206-01F03 Noise assessment (r4)

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1 Introduction

Renzo Tonin & Associates was engaged to conduct an acoustic assessment for the proposed redevelopment of Forestway Shopping Centre at Frenchs Forest.

The proposed redevelopment primarily involves the following:

- Demolish the existing car park and add two basement levels of car parking.
- Demolish Liquorland and car wash buildings on Russel Avenue portion of the site and construct new tenancies including a 'mini major' retailer and gymnasium.
- Upgrade existing loading dock on Grace Avenue.
- Additional rooftop mechanical plant for the new mini major tenancy and Woolworths.

A previous Development Approval (DA) had been submitted to Northern Beaches Council (DA2018/1924) which was broader than the current redevelopment and was refused. On review of previous DA documentation, the noise monitoring conducted in 2018 by Acoustic Logic (ALC) was found to be suitable for reuse in this application. Where relevant, the noise monitoring results from ALC are used in this report for setting criteria.

It is understood that the Forestway Shopping Centre currently operates between 7am and 10pm. The redevelopment application includes a proposal to extend the operating hours of the loading dock on Grace Avenue to 6am – 10pm, an additional one hour in the early morning.

This report assesses noise impact from the proposal to nearby sensitive receivers in accordance with the noise requirements of Northern Beaches Council, the NSW Environmental Protection Authority (EPA) and the NSW Noise Policy for Industry, 2017 (NPfI).

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 description

The site is enclosed by the Forest Way arterial road to the east and local roads Russell Avenue and Grace Avenue to the north and west respectively. The site is predominately surrounded by low density residential housing with some commercial receivers located to the north on Russel Avenue and to the east on Forest Way. Behind the residential properties on Grace Avenue is Fitzpatrick Avenue Reserve. Frenchs Forest Public School is located to the south of the site.

The Warringah LEP 2011 classifies the Forestway Shopping Centre as a local centre surrounded by low density residential. Figure 1 shows the subject site.

The current trading hours for the shopping centre are 7am to 10pm, Monday to Sunday and public holidays. The application will not alter the trading hours of the shopping centre except for the loading dock component on Grace Avenue which is proposed to commence operations at 6am. Internal operations such as maintenance, bakery operation, cleaning and administration may occur outside these hours.

2.2 The proposal

The proposed redevelopment of Forestway Shopping Centre involves the following planned works:

- Car parking on Forest Way to be demolished and re-constructed. The proposed car park facilities would comprise of ground and two basement level car parks. This would result in an increase of car parking spaces from an approximate existing 348 spaces to a proposed approximate 510 car parking spaces.
- The demolition of Liquorland and car wash buildings on Russell Avenue and construction of new mini major and gymnasium tenancies. To accommodate the mini major tenancy, the current Grace Avenue loading dock is to be extended to allow for increased loading dock activity. Presently, the loading dock services ALDI. The arrangement of the loading dock and car park are presented in Figure 2.
- The construction of a boundary wall and roof to enclose the Grace Avenue loading dock and minimise noise breakout from the loading dock operations to nearby sensitive receivers. This is in conjunction with a proposed roller door at the entrance to the loading dock as shown in Figure 3.
- Installation of new rooftop mechanical plant such as condensers and refrigeration equipment above the proposed mini major tenancy. Additional rooftop mechanical plant is also proposed above the existing Woolworths. The indicative locations of plant decks are in Figure 4.

2.3 Acoustic aspects

Based on the proposed design and operational parameters, the following aspects are deemed to require acoustic assessment:

- Loading dock activities
- Vehicle movements and car parking
- New mechanical plant
- New gym operation

2.4 Noise sensitive receivers

The nearby receivers potentially impacted by noise emissions from the proposed redevelopment and used as assessment locations are identified in Table 1 and shown on Figure 1.

Table 1 Representative receiver locations

Receiver ID	Address	Type	Description
R1	4 Russell Avenue, Frenchs Forest	Commercial	Front yard receiver location of the single storey commercial property located approximately 80m north of the loading dock area
R2	54 Grace Avenue, Frenchs Forest	Residential	Front yard receiver location of the single storey residential property located approximately 40m west of the loading dock area.
R3	56 Grace Avenue, Frenchs Forest	Residential	Front yard receiver location of the single storey residential property located approximately 33m west of the loading dock area. Receiver is directly opposite the loading dock and is likely to be the most likely impacted.
R4	58 Grace Avenue, Frenchs Forest	Residential	Front yard receiver location of the single storey residential property located approximately 37m west of the loading dock area.
R5	5 Forest Way, Frenchs Forest	Commercial	Front yard receiver location of the single storey commercial property located approximately 40m east of the car park
R6	9 Forest Way, Frenchs Forest	Residential	Front yard receiver location of the single storey residential property located approximately 40m east of the car park

2.5 Noise monitoring

The noise monitoring conducted by ALC in 2018 has been used for establishing noise criteria. The ALC report determined the ambient noise levels of the area for the standard day, evening and night-time periods using the long-term noise measurement methodology outlined in the NSW EPA's *Noise Policy for Industry* (NPfI). The ALC long-term noise monitoring results are reproduced in Table 2 below.

With respect to the potential noise impacts from the proposed extension of the Grace Avenue loading dock operating hours to the nearest residential receivers (opposite the loading dock, on the western side of Grace Avenue), the NPfI also outlines methods for assessing 'shoulder periods'. 'Shoulder periods' are short periods on either side of a standard time period, where the standard period noise levels are not representative.

The acoustic environment at the site and surrounding area is generally controlled by road traffic noise. Due to the influence of the morning peak traffic, a 'shoulder period' is warranted for 6am – 7am as the night-time period background noise level is not representative.

The measurement data from Location L1 (presented as noise level-vs-time graphs in Appendix 1 of the ALC report) was reanalysed in accordance with Fact Sheet A, Section A3 of the NPfI to determine the 'shoulder period' RBL for the assessment of the Grace Avenue loading dock to the nearest residential receivers.

Table 2 Noise monitoring results

Monitoring location	L_{A90} Rating Background Level (RBL)				L_{Aeq} Ambient noise levels		
	Shoulder	Day	Evening	Night	Day	Evening	Night
L1 – 58 Grace Avenue	42	47	44	38	58	58	53
L2 – 21 Forest Way	-	58	51	35	69	69	65

Notes: Day: 07:00-18:00 Monday to Saturday and 08:00-18:00 Sundays & Public Holidays

Evening: 18:00-22:00 Monday to Sunday & Public Holidays

Night: 22:00-07:00 Monday to Saturday and 22:00-08:00 Sundays & Public Holidays

The shoulder period has been established for 06:00-07:00. The shoulder period rating background level is taken to be the lowest 10th percentile of $L_{AF90,15min}$ dB measurements for the equivalent of one week's worth of valid data taken over the shoulder period (that is, all days included in a single data set of shoulder period)

As required by the NPfI, the external ambient noise levels presented are free-field noise levels. [ie. no façade reflection]

Figure 1 Site location

Figure 2 Proposed works

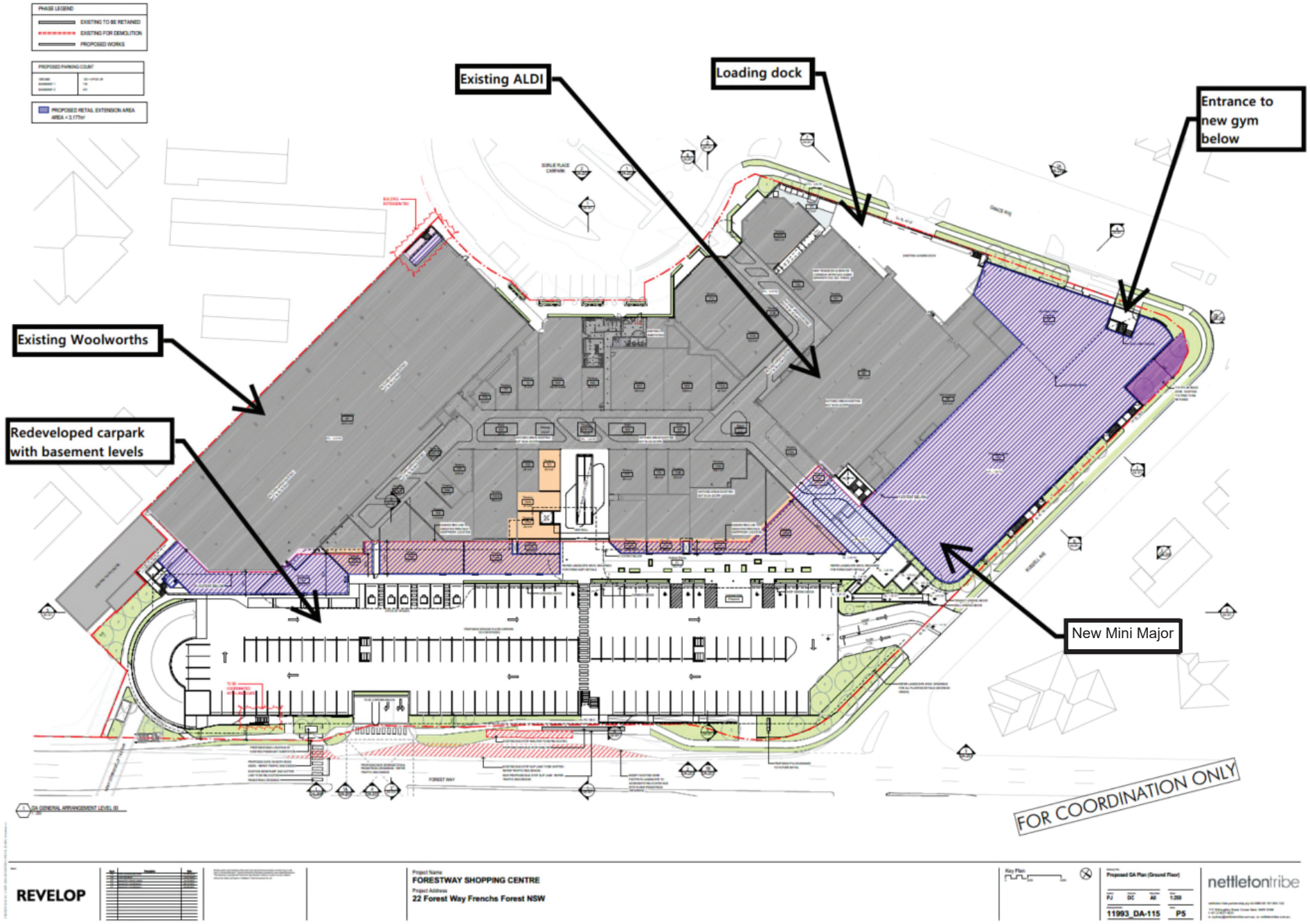


Figure 3 Upgraded loading dock and new boundary wall

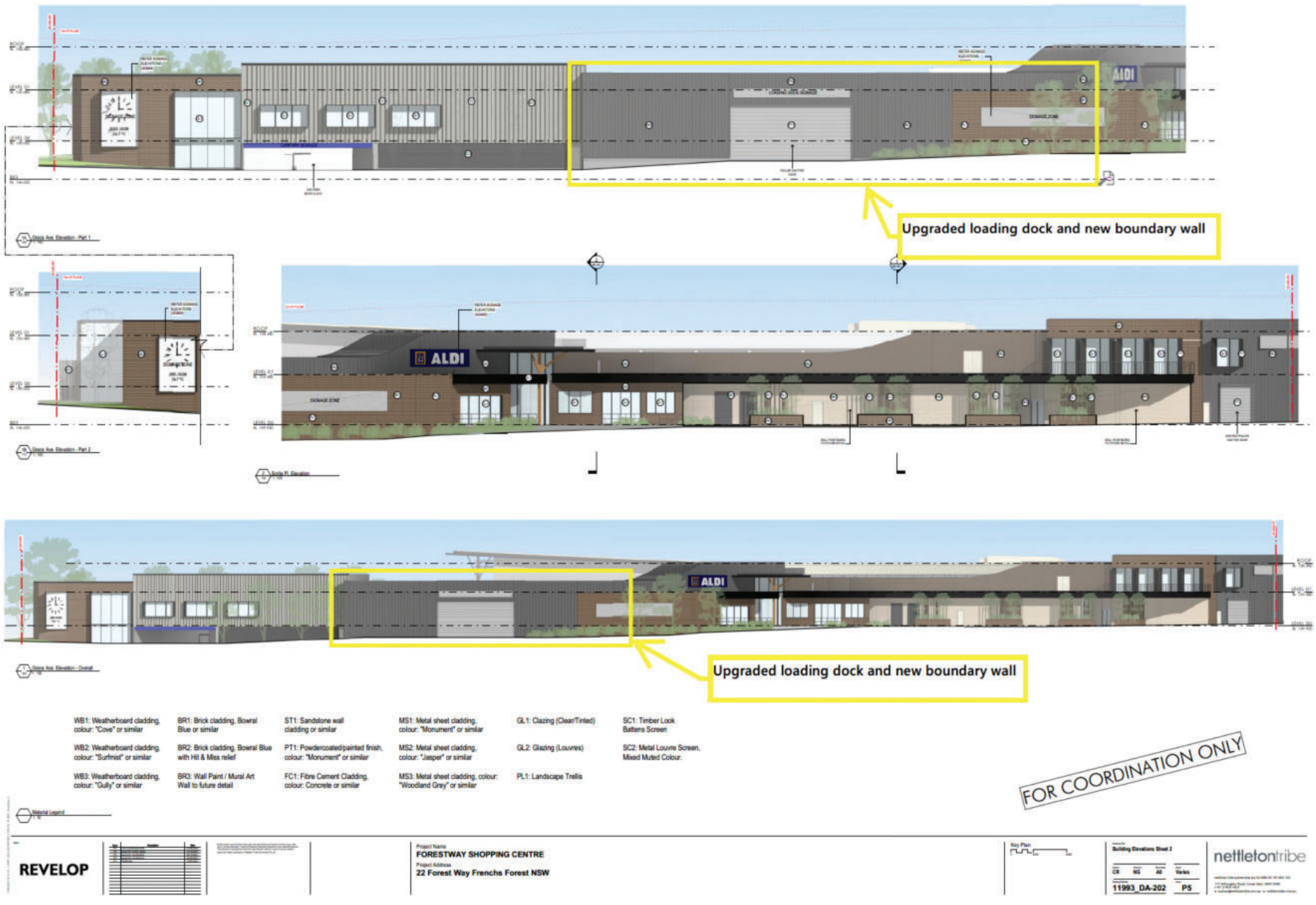
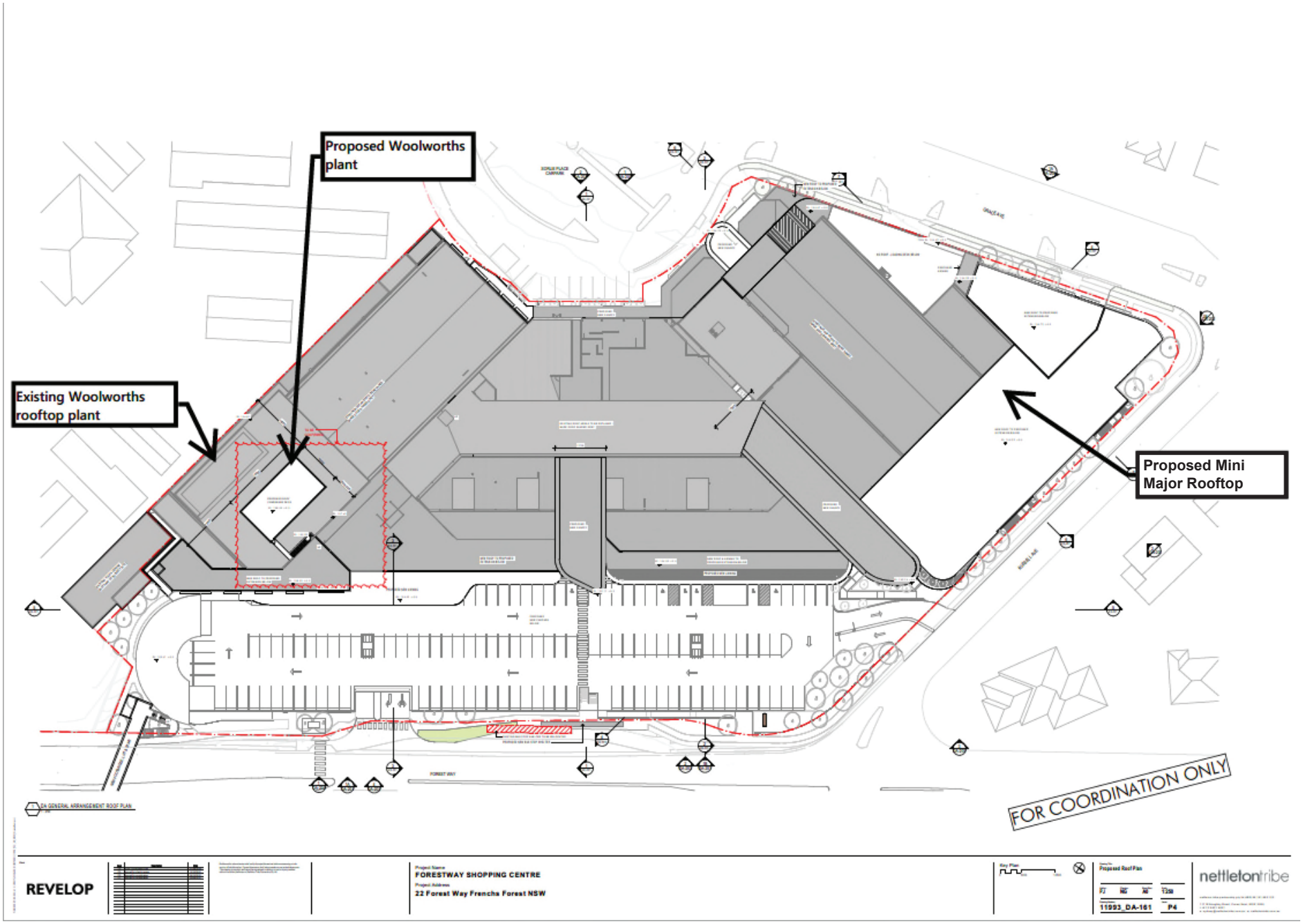


Figure 4 Proposed rooftop plant locations



3 Noise objectives

3.1 Warringah DCP 2011

Part D3 of the Warringah Development Control Plan 2011 is as follows:

1. Noise from combined operation of all mechanical plant and equipment must not generate Noise levels that exceed the ambient background Noise by more than 5dB(A) when measured in accordance with the NSW Industrial Noise Policy at the receiving boundary of residential and other Noise sensitive land uses.

See also NSW Industrial Noise Policy Appendices

2. Development near existing Noise generating activities, such as industry and roads, is to be designed to mitigate the effect of that Noise.

3. Waste collection and delivery vehicles are not to operate in the vicinity of residential uses between 10pm and 6am.

4. Where possible, locate Noise sensitive rooms such as bedrooms and private open space away from Noise sources. For example, locate kitchens or service areas closer to busy road frontages and bedrooms away from road frontages.

5. Where possible, locate noise sources away from the bedroom areas of adjoining dwellings/properties to minimise impact.

Council Land Zoning identifies the site as a B2 local centre, covered in Part F of the Warringah Development Control Plan 2011. Part F does not contain any specific noise controls.

3.1.1 NSW Noise Policy for Industry

Noise impact from site operations including loading dock and car park activities, is assessed in accordance with the NSW 'Noise Policy for Industry' (NPfI), 2017. The assessment procedure has two components:

- Controlling intrusive noise impacts in the short-term for residences; and
- Maintaining noise level amenity for residences and other land uses.

In accordance with the NPfI, noise impact should be assessed against the project noise trigger level which is the lower value of the project intrusiveness noise levels and project amenity noise levels.

3.1.2 Project intrusive noise levels

According to the NPfI, the intrusiveness of a noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the

$L_{Aeq,15min}$ descriptor) does not exceed the background noise level measured in the absence of the source by more than 5dB(A). The project intrusiveness noise level, which is only applicable to residential receivers, is determined as follows:

$L_{Aeq,15minute}$ Intrusiveness noise level = Rating Background Level ('RBL') plus 5dB(A)

Based on the measured background noise levels from the 2018 ALC report and the proposed operating hours of the facility, the intrusiveness noise levels for residential receivers are reproduced in Table 3 below.

Table 3 Intrusiveness noise levels

Receiver	Intrusiveness noise level, $L_{Aeq,15min}$			
	Shoulder	Day	Evening	Night
Monitor 1 – Grace Avenue receivers	42 + 5 = 47	47 + 5 = 52	44 + 5 = 49	38 + 5 = 43
Monitor 2 – Forest Way receivers	-	58 + 5 = 63	51 + 5 = 56	35 + 5 = 40

Notes: Day: 7:00 to 18:00 Monday to Saturday and 8:00 to 18:00 Sundays & Public Holidays
Evening: 18:00 to 22:00 Monday to Sunday & Public Holidays
Night: 22:00 to 7:00 Monday to Saturday and 22:00 to 8:00 Sundays & Public Holidays

3.1.3 Amenity noise levels

The project amenity noise levels for different time periods of day are determined in accordance with Section 2.4 of the NPfI. The NPfI recommends amenity noise levels ($L_{Aq,period}$) for various receivers including residential, commercial, industrial receivers and sensitive receivers such as schools, hotels, hospitals, churches and parks. These "recommended amenity noise levels" represent the objective for total industrial noise experienced at receiver location. However, when assessing a single industrial development and its impact on an area, "project amenity noise levels" apply.

The recommended amenity noise levels applicable for the subject area are reproduced in Table 4 below.

Table 4 Recommended amenity noise levels

Type of Receiver	Noise Amenity Area	Time of Day	Recommended amenity noise level, L_{Aeq}, dB(A)
Residential	Urban	Day	60
		Evening	50
		Night	45
Commercial premises	All	When in use	65

Notes:
1. Daytime 7.00 am to 6.00 pm; Evening 6.00 pm to 10.00 pm; Night-time 10.00 pm to 7.00 am.
2. On Sundays and Public Holidays, Daytime 8.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.
3. The recommended amenity noise levels refer only to noise from industrial sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration.

Furthermore, given that the intrusiveness noise level is based on a 15 minute assessment period and the project amenity noise level is based on day, evening and night assessment periods, the NPfI provides

the following guidance on adjusting the $L_{Aeq,period}$ level to a representative $L_{Aeq,15minute}$ level in order to standardise the time periods.

$$L_{Aeq,15minute} = L_{Aeq,period} + 3dB(A)$$

The project amenity noise levels ($L_{Aeq,\ 15min}$) applied for this project are reproduced in Table 5 below, based on a 'urban' noise amenity area.

Table 5 Project amenity noise levels

Type of Receiver	Noise Amenity Area	Time of Day	Recommended Noise Level, dB(A)	
			$L_{Aeq,\ Period}$	$L_{Aeq,\ 15min}$
Residential	Urban[1]	Day	60	60 + 3 = **63**
		Evening	50	50 + 3 = **53**
		Night	45	45 + 3 = **48**
Commercial premises	All	When in use	65	65 + 3 = **68**

Notes: 1. Urban noise amenity criteria was assigned following the guidelines set out in Section 2.4 of the NPfI.

3.1.4 Project noise trigger levels

In accordance with the NPfI the project noise trigger levels, which are the lower (i.e. more stringent) value of the project intrusiveness noise level and project amenity noise level, have been determined as shown in Table 6 below.

Table 6 Project noise trigger levels

Receiver location	$L_{Aeq,\ 15min}$ Project noise trigger levels, dB(A)			
	Shoulder	Day	Evening	Night
Grace Avenue residential receivers	47	52	49	43
Forest Way residential receivers	-	63	53	40
Commercial receivers	63	63	63	63

3.1.5 Sleep disturbance noise levels

The proposed operation of the Grace Avenue loading dock between 6am and 7am falls under the night-time period. Therefore, the potential for sleep disturbance from maximum noise level events from the operation of the loading dock during the 6am – 7am period needs to be considered. The NPfI contains the following guidance in respect of assessing sleep disturbance from site activities:

The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.

Where the subject development/premises night-time noise levels at a residential location exceed:

- *LAeq,15min 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
- *LAFmax 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater, a detailed maximum noise level event assessment should be undertaken.*

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the NSW Road Noise Policy.

Other factors that may be important in assessing the extent of impacts on sleep include:

- *how often high noise events will occur*
- *the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the subject development*
- *whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods)*
- *current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.*

Maximum noise level event assessments should be based on the LAFmax descriptor on an event basis under 'fast' time response.

The detailed assessment should consider all feasible and reasonable noise mitigation measures with a goal of achieving the above trigger levels.

The sleep disturbance noise levels for the project are presented in Table 7.

Table 7 Sleep disturbance assessment levels

Receiver type	Assessment Level $L_{Aeq,15min}$	Assessment Level L_{AFmax}
Residential	42 + 5 = 47	42 + 15 = 57

4 Noise assessment

4.1 Methodology

To assess the potential noise impact from the proposed redevelopment, the following methodology was used:

- Identify the nearest receivers to the subject site that are potentially most affected.
- Obtain existing background noise levels at the nearest affected receiver locations
- Use measured background noise levels to establish noise goals in accordance with the relevant noise criteria.
- Model the extent of noise impact from the planned development at nearby receivers.
- Identify if noise emissions for the areas under investigation may exceed the relevant criteria and
- Where noise emission from the area under investigation may exceed the relevant criteria, provide recommendations to reduce noise impacts from the site.

4.2 Reference Material

The following documentation has been referenced for this report:

- Noise monitoring conducted by Acoustic Logic in 2018 as presented in document 20180727.1/3008A/R3/AW.
- Architectural drawings by Nettletontribe.

Table 8 Reference drawings

File name	Last issue date	Drawing No.	Rev.	Drawing title
Architectural DA set	07.08.2023	11993_DA-115	P5	Proposed GA Plan (Ground Floor)
	07.08.2023	11993_DA-202	P5	Building Elevations Sheet 2
	07.08.2023	11993_DA-161	P4	Proposed Roof Plans

4.3 Noise sources

To assess the noise levels at the affected receivers, the operation of the loading dock was assumed to contribute the following noise sources as in Table 9. These noise levels were obtained from the Renzo Tonin & Associates source library based on similar past projects and are assumed to reasonably represent the typical operation of a loading dock in an urban area.

Table 9 Loading dock sound power levels

Source type	Number of units	Sound power level, L_{Aeq}	Description
Truck moving	1	102	One truck assumed to be stationary whilst a second truck manoeuvres out of the loading dock during a 15-minute period
Truck reversing with reversing alarm	1	105	One truck assumed to be stationary whilst a second truck manoeuvres out of the loading dock during a 15-minute period
Truck idling with refrigeration unit	2	97	For the proposed redevelopment it is assumed that both trucks are stationary at each loading area.
Truck unloading (with pallet jacks)	2	85	For the proposed redevelopment both trucks are assumed to be unloading at each loading area
Truck airbrake	2	120	It is assumed that a truck braking whilst manoeuvring into/through the loading dock will experience one loud braking noise event

Noise generated by car park activities includes vehicle doors closing, vehicle engines starting, vehicles accelerating and vehicles moving. To assess this noise, the L_{Aeq} noise level was determined for the relevant time period based on the number of vehicle activities expected to occur during that period. Sound Exposure Level (SEL) measurements from our database and library files were used for the assessment.

The number of vehicle movements were modelled according to approximate numbers from the occupancy drawing. Of the approximate 510 car spaces proposed in the redevelopment, it is assumed there is minimal noise breakout from the 400 car spaces on Basement 1 and Basement 2 levels. The remaining 110 uncovered spaces at ground level were considered.

For the worst-case daytime car park activity, it was conservatively assumed that each car space would be vacated and filled within one hour. For car door slams, it was assumed that each vehicle has two passengers.

The sound power levels generated by car park activities used in the predictive noise modelling for this project are presented in Table 10.

Table 10 Car park sound power levels

Source type	Metric	Overall dB(A)	No. of above ground movements	Description
Vehicle door closing, Lw	SEL	84	110	Each vehicle contains 2 x passengers
Vehicle engine starting, Lw	SEL	90	28	One per vehicle exiting the car park.
Vehicle accelerating, Lw	SEL	93	28	Half of all vehicles moving in the car park accelerating
Vehicle moving (10-30km/h), Lw	SEL	84	55	Worst case assumes all spaces vacated and filled in one hour.

Noise levels for rooftop mechanical plant are not yet known. For the purpose of understanding potential impacts for this assessment, it has been assumed that a plant deck would contain multiple items of plant, with a total sound power level of 100dB(A) during the day and evening, and 95dB(A) for night-time under reduced load.

4.4 Predicted noise levels

The predicted $L_{Aeq,15min}$ noise levels at the nearest sensitive receivers are outlined in Table 11.

The assessment during the daytime period assumed all loading dock activities occur with trucks operating a refrigeration unit whilst idling. For the loading dock redevelopment, two deliveries in a 15-minute period were assumed, with one truck manoeuvring and one unloading. For the evening period, a similar scenario for one delivery and unloading was modelled. No loading dock activity was assumed to take place during the night period.

For the proposed operation of the Grace Avenue loading dock during the critical 'shoulder period', the construction of the enclosure around the loading dock requires specific acoustic treatments to the external wall, roof and roller door opening (summarised in Section 5.1) to comply with the project trigger noise level at the nearest residential receivers (opposite the loading dock, on the western side of Grace Avenue).

The assessment assumes that the roller shutter at the entrance to the loading dock is closed whilst activities are occurring inside the loading dock.

Car park activity was estimated based on the number of existing and future car spaces above ground. There would be minimal noise contribution from future basement parking spaces below ground level. The car park assessment conservatively assumed that in the worst-case hour, each space would be vacated and filled. Assessment for the evening period assumed that car park activity would be the same as daytime levels.

For residential receivers on Forest Way the predicted noise levels show that the redevelopment of the car park will comply with the NPfI trigger levels.

Table 11 Predicted noise levels

Receiver ID	Address	Type	NPfI noise trigger levels, dB(A)			Noise level from redevelopment, dB(A)
			Shoulder	Day	Evening	
R1	4 Russell Avenue	Commercial	63	63	63	22
R2	54 Grace Avenue	Residential	47	52	49	42
R3	56 Grace Avenue	Residential	47	52	49	43
R4	58 Grace Avenue	Residential	47	52	49	42
R5	5 Forest Way	Commercial	-	63	63	41
R6	9 Forest Way	Residential	-	63	53	41

The results presented in Table 11 reveal the total noise emission from the redeveloped shopping centre (with the proposed mitigation measures described in Section 5.1) will comply with the project noise trigger levels at all noise sensitive receiver locations surrounding the site.

4.5 Sleep disturbance

The proposed operation the Grace Avenue loading dock between 6am and 7am falls under the night-time period. Therefore, there is a requirement to consider potential sleep disturbance from the loading dock operations before 7am.

Table 7 presents the NPfI maximum and $L_{Aeq,15minute}$ noise level to be considered as screening test targets for sleep disturbance which are assessed external to bedrooms. The first floor level windows along the eastern facade of 54 Grace Avenue and 56 Grace Avenue are the nearest residential receivers to the opening of the loading dock and most likely to be affected by sleep disturbance.

We are instructed that the operation of the loading dock during the 6am – 7am period involves one truck entering the loading dock in a forward direction and then conducting reversing manoeuvres within the enclosed loading dock area. As the roller door will be closed once the truck enters the loading dock, noise from truck movements, reversing alarms and loading/unloading activities within the loading dock are unlikely to give rise to sleep disturbance at the nearest residential receivers due to attenuation through the loading dock enclosure.

The critical source of maximum noise level events is the engine noise as the truck enters the loading dock. Based on similar past projects, the noise source of a truck accelerating into a loading dock has a maximum sound power level of 112dB(A).

Taking into consideration distance attenuation from the opening of the loading dock, the truck movement into the loading dock is predicted to give rise to a maximum noise level of 72dB(A) and an $L_{Aeq,15minute}$ noise level of 42dB(A) outside the first floor level windows of 54 Grace Avenue and 56 Grace Avenue. While the maximum noise level of the truck movement into the loading dock exceeds the sleep disturbance screening test target of 42 + 15 = 57dB(A), it is noted that:

- The occurrence of maximum noise level events is infrequent as the proposed loading dock operations only has one truck entering the loading dock during the 6am – 7am period.
- The proposed loading dock operations between 6am and 7am coincides with a clear change to the noise environment of the area due to morning period of peak traffic and the increasing volume of traffic on the surrounding road network.

As the proposed night-time operations of the loading dock has infrequent maximum noise level events that coincide with increasing traffic noise levels in the area (due to the morning period of peak traffic), the loading dock operations are envisaged to have a low potential of giving rise to sleep disturbance impacts.

Section 5.2 set out noise management measures to further minimise the number of maximum noise level events that could potentially give rise to sleep disturbance.

5 Recommendations

The following recommendations provide in-principal solutions to address project acoustic requirements. This information is presented for the purpose of the approvals process and for preliminary cost planning. It shall not be used for detailed design and construction purposes without approval in writing by the acoustic consultant. Assistance of the acoustic consultant must be sought during the detailed design phase of the project to confirm all details, material quantities and performance specifications.

Before committing to any form of construction or committing to any contractor, advice should be sought from the acoustic consultant to ensure that adequate provisions are made for any variations which may occur as a result of changes to the project.

The advice provided here is in respect of acoustics only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

5.1 Loading dock enclosure

The enclosure of the Grace Avenue loading dock requires acoustic treatment of the external wall, roof and openings to comply with the project trigger noise levels at the nearest noise sensitive receivers. Table 12 identifies the minimum acoustic performance requirements for each building element and provides examples of building constructions that meet the performance requirements.

Once a truck has entered the loading dock, the roller door should be closed to minimise noise impacts to residential receivers on Grace Avenue.

Table 12 Grace Avenue loading dock noise mitigation measures

Building element	Minimum Rw	Construction
Roof	25	30mm Kingspan KS1000RW panels
External wall	25	60mm Kingspan AWP composite wall panel
Roller door	24	Braselmann aluminium double-wall roller shutter (roller shutter profile 1.100 D) with polystyrene hard foam filling

5.2 Loading dock noise management measures

To minimise the number of maximum noise level events that could potentially give rise to sleep disturbance, the following noise management measures are to be incorporated into the 6am – 7am operations of the Grace Avenue loading dock:

- The use of airbrakes as the trucks approach the entrance of the loading dock is to be avoided where reasonable.
- The trucks are to enter the loading dock in a forward direction only to eliminate potential sleep disturbance impacts from trucks manoeuvring and reversing alarms outside the loading dock enclosure.

- To minimise potential noise event (rattle, clangs, bangs, etc.) from the movement of the truck on the loading dock driveway, the redevelopment of the shopping centre is to ensure that the driveway has an even surface and that the drainage grate across the driveway is properly secured.
- The roller door is to be closed once the truck enters the loading dock so that any noise events from truck movements within the loading dock area and loading/unloading activities are subject to acoustic attenuation by the enclosure.
- The roller door should have a rubber seal on the bottom rail to minimise any impact sound on closing.

5.3 Car park mitigation

- None required.

5.4 Gymnasium mitigation

- Provide acoustic seals on lobby external and internal door to provide air lock and prevent noise transmission from indoor areas to outside.

5.5 Mechanical plant mitigation

At this stage of the project detailed information for mechanical plant is not available. In-principle noise management measures are outlined below:

- Based on preliminary noise predictions, it is likely that acoustic screens will be required on the western side of the rooftop plant deck above the new mini major tenancy to provide mitigation to Grace Avenue receivers, and on the eastern side of the new Woolworths rooftop plant deck to provide mitigation to Forest Way receivers.
- Acoustic assessment of mechanical services equipment should be undertaken during the detail design phase of the development to ensure that the cumulative noise of all equipment does not exceed the applicable noise criteria. Development Consent Conditions typically require detailed assessment of mechanical plant and equipment prior to issue of the Construction Certificate.
- Noise control treatment can potentially affect the operation of the mechanical services system. An acoustic engineer should be consulted during the initial design phase of mechanical services system to reduce potential redesign of the mechanical system.
- Mechanical plant noise emission can be controlled by appropriate mechanical system design and implementation of common engineering methods, which may include:
    - procurement of 'quiet' plant
    - strategic positioning of plant away from sensitive neighbouring premises to maximise intervening acoustic shielding between the plant and sensitive neighbouring premises

- commercially available acoustic attenuators for air discharge and air intakes of plant
- acoustically lined and lagged ductwork
- acoustic barriers between plant and sensitive neighbouring premises
- partial or complete acoustic enclosures over plant

- The specification and location of mechanical plant should be confirmed prior to installation on site.
- Equipment shall be mounted on vibration isolators and balanced in accordance with Australian Standard 2625 '*Rotating and Reciprocating Machinery – Mechanical Vibration*'.

6 Conclusion

Renzo Tonin & Associates has conducted a noise impact assessment for the proposed redevelopment at Forestway Shopping Centre, Frenchs Forest. The redevelopment includes an expansion of the Grace Avenue loading dock, and the demolition and construction of car parking located on Forest Way.

Noise impacts from the proposed redevelopment upon potentially affected receivers has been assessed. The findings of this assessment are:

- Operational noise from the proposed car park redevelopment is predicted to comply with the applicable noise criteria.
- Operational noise from the proposed Grace Avenue loading dock redevelopment is mitigated by an enclosure to satisfy the NPfI project noise trigger levels. Section 5.1 sets out the minimum acoustic performance requirements of the enclosure and building construction examples.
- The proposed extension to the operating hours of the Grace Avenue loading dock redevelopment (6am – 7am) is predicted to give rise to maximum noise levels that exceed the NPfI sleep disturbance screening criteria. However, the potential sleep disturbance impacts from the loading dock are envisaged to be low due to the 6am – 7am operations only having one truck entering the loading dock which coincides with the morning period of peak traffic and increasing traffic noise levels in the area. Noise management measures are set out in Section 5.2 to further minimise the number of maximum noise level events that could potentially give rise to sleep disturbance.
- Based on preliminary assumptions of plant deck locations and equipment noise levels, it is determined that screening would likely be required for both the new Woolworths and 'mini major' tenancy plant decks. The specific mitigation measures and screen heights will be determined at detailed design phase when plant has been selected.
- The risk of noise impact from the new gymnasium is low considering that there are no significant areas of window glazing or doors that would provide a noise transmission path to outside. The entry lobby on Grace Ave allows for an air lock setup with double doors to mitigate noise transmission from inside to outside.

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 common sounds in our daytime environment:
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.

threshold of hearing	0 dB	The faintest sound we can hear
	10 dB	Human breathing
almost silent	20 dB	
	30 dB	Quiet bedroom or in a quiet national park location
generally quiet	40 dB	Library
	50 dB	Typical office space or ambience in the city at night
moderately loud	60 dB	CBD mall at lunch time
	70 dB	The sound of a car passing on the street
loud	80 dB	Loud music played at home
	90 dB	The sound of a truck passing on the street
very loud	100 dB	Indoor rock band concert
	110 dB	Operating a chainsaw or jackhammer
extremely loud	120 dB	Jet plane take-off at 100m away
threshold of pain	130 dB	
	140 dB	Military jet take-off at 25m away

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.