MARSHALL DAY Acoustics

538 K ROAD
RESOURCE CONSENT - ACOUSTICS

Rp 001 20230317 | 2 November 2023

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1.0 INTRODUCTION

Marshall Day Acoustics (MDA) has been engaged by James Kirkpatrick Group Ltd to advise on a new commercial building at 538 Karangahape Road, Auckland.

This report assesses compliance against the applicable noise and vibration rules. This report is suitable for inclusion in a Resource Consent Application. In summary:

- Construction activities are predicted to generally comply with the construction noise and vibration rules. However, we predict infringements of the noise standards for perimeter works, primarily from any necessary concrete cutting, breaking and piling works. We recommend the implementation of a CNVMP to minimise levels and ensure residual effects are reasonable, including timing of concrete breaking and compaction activities to minimise effects.
- Post construction, commercial activities are predicted to comply with permitted standards with the inclusion of standard design measures at the detailed design stage (e.g. mechanical plant placement and selections).
- Proposed conditions outlined in Section 5.0 should be included in any consent granted.

Appendix A contains a glossary of acoustic terminology.

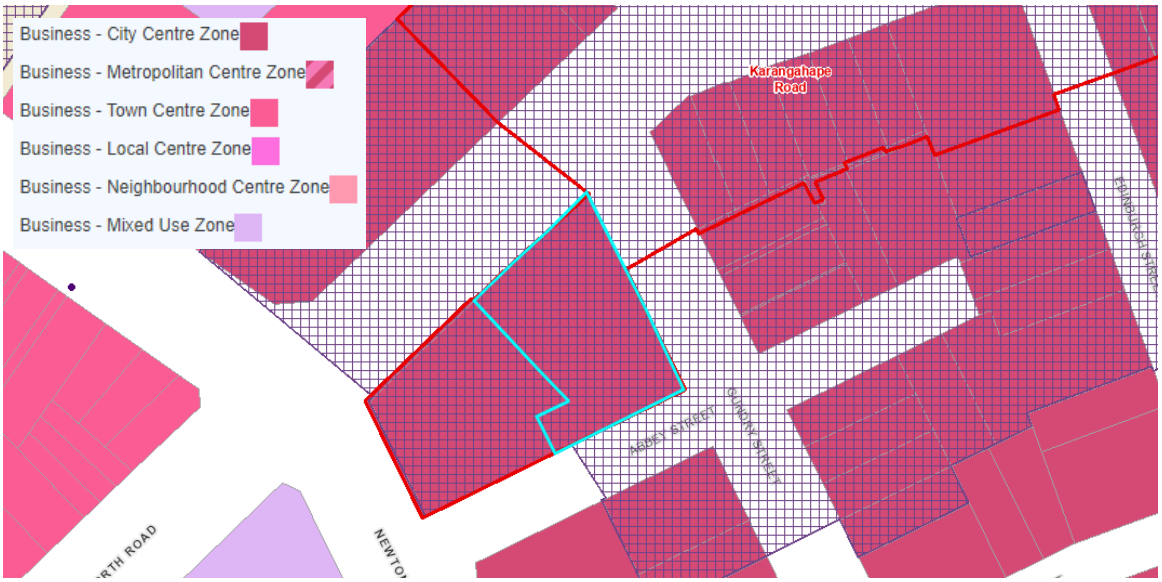
2.0 DESCRIPTION

2.1 The Site

An Auckland Unitary Plan (AUP) map is shown in Figure 1 below. It has been marked up to identify the development site (blue border). The proposed site, and all adjacent sites, are zoned *Business – City Centre Zone*. The site is located with the Karangahape Road Precinct (red border) and the Historic Heritage Overlay Extent of Place (blue hatch), both of which require building frontages to be sympathetic to the character to the area (i.e. are not related to vibration sensitivity)[1].

The area is primarily occupied by low rise commercial buildings. Karangahape Rd, and nearby Newton Rd and Ponsonby Rd, are high trafficked routes. Other side streets, including Gundry St and Abbey St, are lower volume streets servicing local traffic.

Figure 1: AUP Map



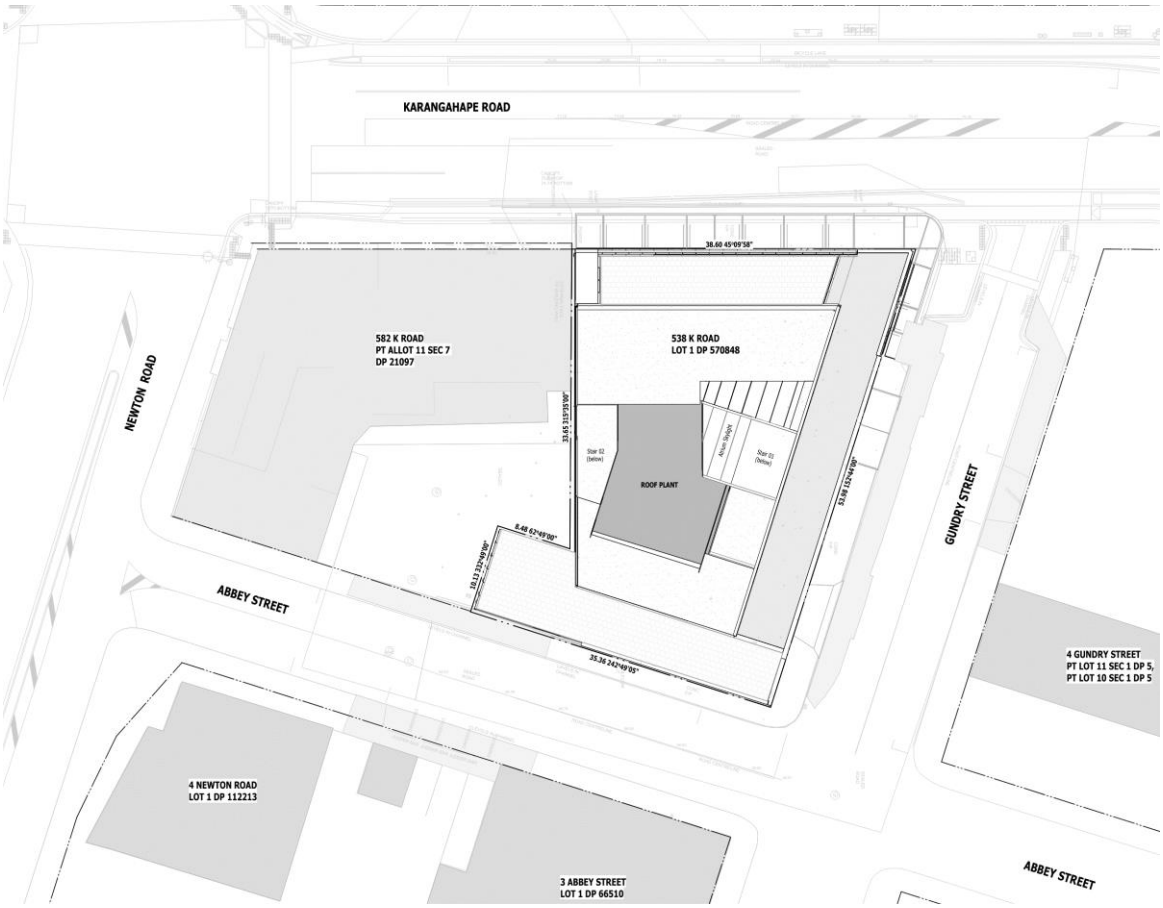
[1] AUP Chapter I206 Karangahape Road Precinct, I206.1 Precinct Description

2.2 Proposed Development

The proposed development ground floor footprint plan is shown in Figure 2. It shows the proposed building will occupy the entire site. The commercial building at 582 Karangahape Road borders the site to the west. Other neighbouring buildings are setback at least 15 – 20m across a car park or road.

The building will include two levels of basement carpark, a retail/showroom ground floor and nine levels of high-quality offices. We understand that the project will aim for a 6 Green Star accreditation and is to be designed with a hybrid structure (concrete for the basement and ground floor, but mass timber construction for the office levels).

Figure 2: Site and Location Plan (Feron Hay Resource Consent Drawing (0)12 rev C)



3.0 CONSTRUCTION NOISE AND VIBRATION

3.1 Construction Methodology

3.1.1 Overview

For the purposes of this report, the construction methodology is described in three phases:

- Demolition: Remove the remaining sub-basement slab and boundary walls on the site
- Foundations: Basement excavation, bored piles and concrete foundations
- Building: Construction of the Glue Laminated Timber (GLT) building above

The preliminary construction programme spans September 2024 to March 2026 (i.e. long-term duration for the purpose of construction noise assessment).

We assume the adoption of conventional construction hours of between 7am – 6pm, Monday to Saturday.

3.1.2 Demolition

Figure 3 is a view from Abbey Street site entrance looking north. It shows the site has been cleared. Part of the sub-basement slab and boundary walls from a previous building remain to be demolished.

Figure 3: Interim Concept Plan site Layout (update with something more appropriate/supplied)

We understand that the demolition activities are estimated to span 1 month. We assume:

- The remaining sub-basement walls and slab are not structurally connected to the adjacent building at 582 K Rd, or any residual connections would be cut prior to demolition.
- The sub-basement walls would be cut, lowered to the ground, or a large excavator (e.g. 20T) with pulveriser attachment would crush the concrete walls in place.
- A large excavator (e.g. 20T) mounted concrete breaker would be used to remove the residual sub-basement slab as quickly and efficiently as possible (minimises the duration of disturbance), and that the breaker would be fitted with breaker blankets to dampen the noise emissions.

The 2.4m high perimeter site hoardings (as shown already in place in Figure 3) would provide effective screening to the ground floor level of neighbouring buildings. However, local screening should be used to provide effective screening to the upper level of the adjacent building at 582 K Rd where practicable. More information on temporary screening is detailed in Section 3.5.2.

3.1.3 Foundations

We understand there are no known basalt deposits that rock breaking, and that the excavation of the sub-basement is estimated to span 1 month. We assume a large excavator (e.g. 20T) would be used to excavate the residual sub-basement level as quickly and efficiently as possible (minimises the duration of disturbance).

We understand the building will be founded on palisade and secant pile walls. A bored/drilled piling method is proposed, which avoids the alternative high noise and vibration methods such as impact and vibratory driven piles. We understand the piling phase is estimated to span 3 months.

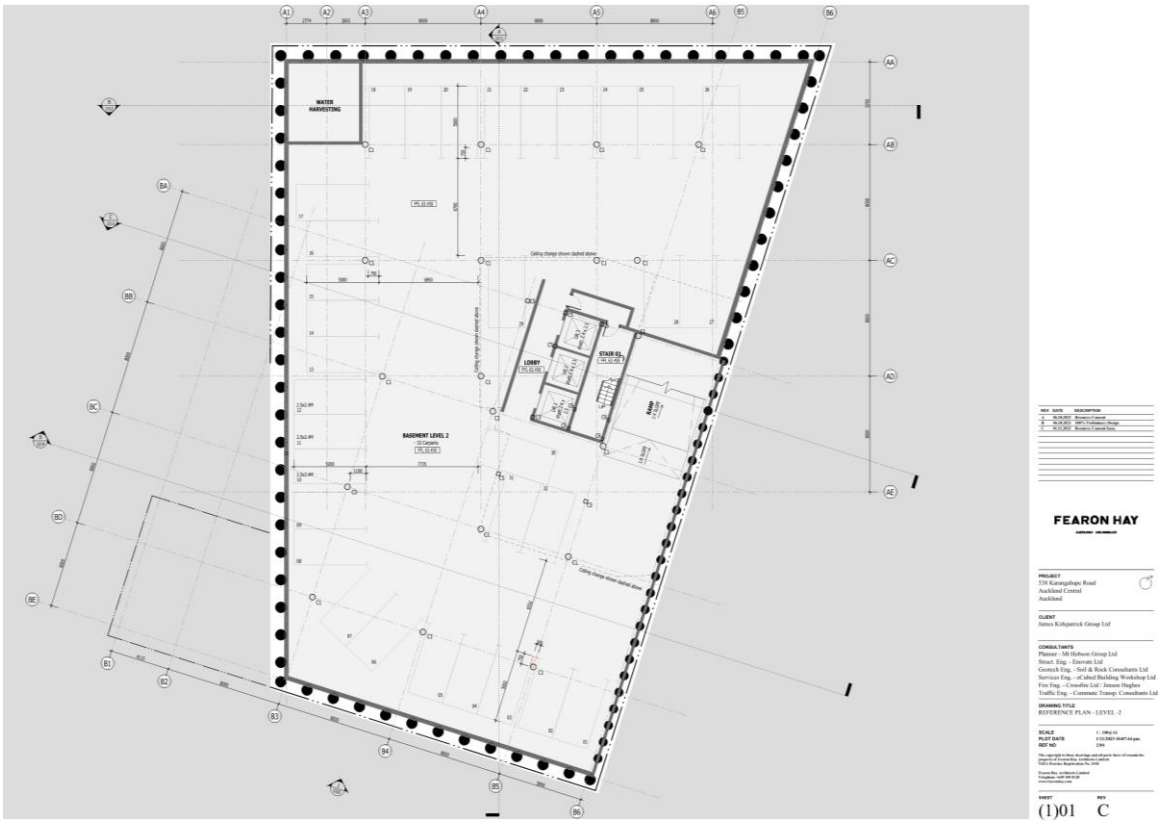
The preliminary design anticipates a total of 110 piles (reproduced as Figure 4), consisting of:

- 67 x 750mm diameter piles
- 25 x 600mm diameter piles
- 18 x 400mm diameter piles

We assume:

- A dedicated piling rig, such as a Soilmec SR-60 would be used to drill the piles.
- Concrete trucks and pumps would be used to fill the piles and form the foundations.

Figure 4: Piling plan (Feron Hay Resource Consent Drawing (1)01 rev C)



3.1.4 Building Construction

The new building would be erected using conventional construction methods, including use of mobile cranes and hand-tools.

3.2 Construction Noise (Rule E25.6.28)

3.2.1 Performance Standards

AUP Rule E25.6.28 sets construction noise limits for the City Centre zone. Construction noise must be measured and assessed in accordance with the provisions of New Zealand Standard NZS 6803:1999 "*Acoustics - Construction Noise*". The relevant limits are reproduced in Table 1.

Table 1: Construction noise limits for construction duration of at least 15 days

Time	Noise Limit	
	Average (L_{Aeq})	Maximum (L_{AFmax})
Monday to Friday 6.30am – 10:30pm	75 dB	90 dB
Saturday 7am-11pm	80 dB	90 dB
Sunday 9am – 7pm	65 dB	85 dB
All other times	60 dB	75 dB

The noise limits apply at 1m from external façades of occupied buildings. The most relevant noise limits are 75 dB L_{Aeq} during the day midweek and 80 dB L_{Aeq} on Saturday. The applicable noise limits generally preclude noisy works on Sundays and at night on any day.

3.2.2 Predicted Noise Levels

Table 2 present the typical levels from noisy construction activities including mitigation from effective perimeter screening (the exception being 582 K Rd). Periods of inactivity, hand tools and idling equipment are generally much quieter and are not addressed further.

Table 2: General construction activity noise levels at 1m from a building façade

Equipment	Sound Power Level (dB L_{Aeq})	Mitigation[2] (dB)	Noise Level (dB L_{Aeq})			Setback (m)	
			10 m	20 m	50 m	75 dB L_{Aeq}	80 dB L_{Aeq}
Demolition							
Concrete cutting	115	10	80	74	65	18	10
Excavator pulveriser	104	10	69	63	55	5	3
Large excavator (e.g. 20t) mounted concrete breaker	121	10	86	80	72	35	20
Foundations and building							
Excavator (20t)	103	10	68	62	54	4	3
Bored piling rig (e.g. SR-60)	106	10	71	65	57	6	4
Concrete truck and pump discharging	103	10	68	62	54	4	3
Drum roller	103	10	68	62	54	4	3
Mobile crane (35t)	98	10	63	57	49	3	1

The proposed activities are predicted to generally comply with the permitted construction noise limits at neighbouring buildings at least 15 – 20m from the site. Any potential infringements would relate to concrete breaking during demolition of the sub-basement slab section adjacent to Abbey St. Using a smaller 8 – 10T excavator mounted breaker would enable compliance with the permitted noise limits, but extend the duration of (permitted) disturbance. Where appropriate, we recommend prioritising a larger unit for a shorter period to minimise the duration of construction noise effects.

The building at 582 K Rd is much closer and more exposed. Demolition of the existing sub-basement walls, and construction of the new building, would occur directly adjacent. No normal construction activities can comply with the permitted standards at the site interface due to proximity. Therefore, the focus switches to management to minimise the effects while works are close.

We have predicted the highest representative noise levels at the most exposed façade in Table 3. These noise levels would only occur for a short period when works are closest. We have provided estimated durations of the infringements of 75 dB L_{Aeq} based on the construction programme. For simplicity, we have ignored the more permissive 80 dB L_{Aeq} noise limit that applies on Saturdays.

[2] Refer to Section 3.5.2, assumes effective site perimeter acoustic screening

Table 3: Highest representative noise levels at the Edition office south façade on level 1 of 582 K Rd

Activity	Predicted Noise Level, dB L_{Aeq}	Duration of Infringement
Concrete cutting and breaking	75 – 84	2 – 4 weeks
Approximately 11 of 110 piles	75 – 77	1 – 2 weeks (of 3 months)

3.2.3 Construction Noise Effects

The noise level received inside a sensitive space (e.g. theatre or office) will depend on the external noise level, the façade performance (particularly the glazing) and the acoustics of the room. These factors can vary widely.

NZS 6803 states that, where it is not possible to measure at 1 metre from the façade, an internal assessment can be done instead assuming a façade sound level difference of 20 decibels. However, 20 decibels is conservative (i.e. low) for modern buildings. With knowledge of the façade glazing type, typical façade performance can be estimated as follows:

- Partially open windows (all buildings) 15 decibels
- Closed windows (commercial building with lightweight facade) 25 decibels
- Closed windows (commercial building with concrete facade) 30 decibels

The building at 582 Karangahape Rd is a modern masonry building with sealed glazing (high sound insulation performance). The building is occupied by several commercial tenancies, including:

- Ponsonby Doctors (8.30am - 5pm Monday – Friday, and 9am -2pm Saturday) and Lux Radiology (8am - 5pm Monday - Friday) share the ground floor. Notably, Lux Radiology offer ultrasound and X-ray imaging services.
- Edition office occupy the upper floor level (9am - 5pm Monday - Friday).

Based on our observations on site:

- The northern façade includes commercial businesses fronting K Rd. This façade is effectively screened from all construction works and distant from residual demolition activities.
- The (most exposed) eastern façade is a concrete block wall with no windows (high sound insulation performance). We also note the adjacent spaces in the building are occupied by stairwells circulation spaces (not noise sensitive).
- The southern façade would have an oblique view of demolition and construction activities on the southern half of the site. We predict that noise exposure on the southern façade would control the perceived noise effects. The upper floor level includes glazing to a commercial office, setback approximately 6m from the eastern façade by the stairwell mentioned above.

The responses of building occupants vary, but with effective prior engagement, Table 4 provides guidance on typical daytime noise effects inside.

Table 4: Daytime noise levels and typical noise effects in commercial buildings

External Noise Level (dB L_{Aeq})	Estimated Internal Noise Level (dB L_{Aeq})	Typical noise effects
80 – 85	50 – 55	Annoyance for some occupants and personal conversations would require a slightly raised voice
75 – 80	45 – 50	Typically acceptable, but concentration and communication would begin to be affected
70 – 75	40 – 45	Noticeable, but unlikely to interfere with daily activities

In summary:

- Most activities would be noticeable at times, but are unlikely to interfere with daily activities.
- The closest concrete breaking and piling works have the potential to result in elevated levels of disruption for occupants in rooms directly adjacent to the southern façade of 582 K Rd. We recommend engagement with the occupants of 582 Krd during construction to manage effects.

3.3 Construction Vibration (Rule E25.6.30)

3.3.1 Performance Standards - Cosmetic Building Damage

AUP rule E25.6.30 (1)(a) requires construction vibration to be measured and assessed in accordance with German Standard DIN 4150-3:1999 "*Structural vibration – Part 3: Effects of vibration on structures*". The criteria relate to the avoidance of cosmetic building damage, such as cracking in paint or plasterwork. Cosmetic building damage effects are deemed 'minor damage' in the Standard and can generally be easily repaired. The cosmetic building damage thresholds are much lower those that would result in structural damage. The Standard states: "*Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur*."

With knowledge of the area, the commercial building criteria is considered appropriate to apply to all neighbouring buildings. The relevant vibration limits start from 10mm/s PPV for continuous vibration, and are higher in other cases. We have used the 10mm/s PPV threshold for assessment purposes.

3.3.2 Performance Standards - Building Amenity

AUP rule E25.6.30 (1)(b) requires construction vibration to comply with 2 mm/s PPV in any axis on the floor of interest. Where construction vibration is predicted to exceed this threshold for more than three days, the occupants of buildings within 50 m must be advised of the works no less than three days prior to the works commencing and the vibration level must not exceed 5 mm/s whilst occupied.

Beyond compliance, we note the imaging services offered by Lux Radiology could be disproportionately affected by construction vibration at permitted levels. Therefore, regardless of compliance, and in accordance with best practice, we recommend engagement with Lux Radiology during construction to manage vibration effects, typically through communication and compatible timing of activities that produce appreciable vibration (where practicable).

3.3.3 Predicted Vibration Levels

Some activities have the potential to generate high levels of vibration during the initial demolition and excavation phases.

Table 5 summarises the expected set back distances required for each main vibration generating activity to achieve compliance with the applicable criteria. The predictions are based on regression analysis of available vibration measurements. The amenity setbacks are based on typical levels, whereas the setbacks for cosmetic building damage are more conservative (i.e. addition of a 100% safety factor). We have also assumed a conservative transfer function of 0.4 to a 1-2 story commercial building[3].

[3] Nelson, P.M. (1987), Transportation noise reference book

Table 5: Indicative vibration levels at building foundations

	Vibration setback distance (m)	
	Vibration Amenity	Cosmetic Building Damage
Equipment	**AUP (2 mm/s PPV)**	**Commercial (10 mm/s PPV)**
Large excavator mounted rock breaker (20T)	12	4
Medium excavator mounted rock breaker (8-10T)	6	2
Small excavator mounted rock breaker (1-5T)	3	<1
Jackhammer	2	<1
Vibratory drum roller (6-8T)	13	2
Large plate compactor (450kg)	7	2
Small plate compactor (80kg)	2	<1

Significant vibration is not expected from other typical construction activities. However, the response of affected parties is expected to vary widely and be influenced by such factors as proximity to the works, the sensitivity of their activities, their attitude to the project and whether they are also impacted by other project-related effects.

To enable compliance with the cosmetic building damage limits:

- Concrete breaking within 4m of a building should use a smaller excavator unless attended vibration monitoring is undertaken
- A vibratory drum roller should not be used within 2m of 582 K Rd unless attended vibration monitoring is undertaken
- A large plate compactor should not be used within 2m of a building unless attended vibration monitoring is undertaken

3.3.4 Amenity Effects

While the primary vibration concern is cosmetic building damage, people may be disturbed at levels significantly below the limits for cosmetic building damage in Section 3.3.1. British Standard BS 5228-2:2009 "*Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*" provides the following guidance on the amenity effects of vibration:

- 0.14mm/s PPV Just perceptible in particularly sensitive environments
- 0.3 mm/s PPV Just perceptible in normal residential environments
- 1 mm/s PPV Typically acceptable with prior notification
- 10 mm/s PPV Likely to be intolerable for any more than a very brief period

There is a large gap in the description of vibration effects between 1 – 10 mm/s PPV. AUP OIP rule E25.6.30 (1)(b) sets a daytime vibration amenity limit of 2mm/s PPV. However, if the occupants of all buildings within 50 m of the works area are advised at least three days prior to commencement, vibration levels of up to 5 mm/s are permitted. To provide further context to these thresholds (which lie within the gap described above), the vibration effects are typically described as follows:

- 2 mm/s PPV Vibration would clearly be felt. However, can typically be tolerated in indoor environments such as offices, houses and retail, if it occurs intermittently during the day and where there is effective prior engagement.
- 5mm/s PPV Highly unsettling for both workplaces and dwellings. If exposure is

prolonged, some people may want to leave the building. Computer screens would shake, and items could fall off shelves if they are not level.

Concrete breaking and vibratory compaction methods may be perceptible at times. Appreciable levels will be limited to immediately proximate works. Potentially affected parties should be informed about the vibration levels they may experience and should be assured vibration damage could only occur at magnitudes well above the threshold of perception.

To enable compliance with the vibration amenity limits:

- Building occupants within 50m of breaking and compaction activities should receive timely communication in accordance with the vibration amenity rules (Section 3.3.2).
- Where practicable, high vibration activities within 13m of 582 K Rd should be timed to avoid occupied periods. This could include the period between 7am and 8.30am each weekday, and on Saturdays (for some, not all, tenancies).

3.4 Imaging equipment

Beyond the requirements of the AUP permitted standards, and as noted in Section 3.3.3, we recommend engagement with Lux Radiology during construction to manage vibration effects on imaging equipment. The engagement should focus on communication and identification of compatible timing for concrete breaking and compaction activities across the wider site (i.e. beyond the 12m setback of identified Section 3.3.4 above).

Initial concrete breaking and compaction activities should be undertaken outside the Lux Radiology opening hours to inform effects on imaging resolution and subsequent compatible timetabling of these works required. Timetabling works best with input from both parties. Lux Radiology could identify windows when imaging equipment would not be used. If so, the contractor should prioritise concrete breaking and compaction activities during these periods to avoid any potential effects on imaging resolution.

3.5 Construction Noise and Vibration Management Plan

3.5.1 Overview

We consider it prudent to seek consent to infringe the construction noise limits in AUP E25.6.28 and the vibration amenity limits in AUP rule E25.6.30 (1)(b). We consider the consent should be subject to the implementation of a Construction Noise and Vibration Management Plan (CNVMP).

The CNVMP would enable the identification and adoption of the best practicable option (BPO) to minimise disruption for the occupants of 582 K Rd. The contents of a CNVMP are set out in Annex E of NZS 6803: 1999, and include:

- The performance standards that must, where practicable, be complied with
- Predicted noise and vibration levels for relevant equipment and/or activities
- Mitigation considerations to identify the BPO with respect to construction noise and vibration
- Noise and vibration monitoring requirements, with triggers and feedback mechanisms
- Communication, consultation and complaints response protocols

We recommend the CNVMP should include the following specific measures to minimise effects.

3.5.2 Noise Barriers

As a minimum we recommend that temporary noise barriers be constructed along the boundary of the site (complete). These will provide effective mitigation for the ground floors of adjacent buildings but will not provide meaningful mitigation for the upper floors for the adjacent building at 582 K Rd.

Effective noise barriers typically reduce the received noise level by 10 decibels.

Where practicable, the following guidelines should be incorporated in the design and utilisation of temporary noise barriers:

- The panels will have a minimum surface mass of 6.5 kg/m^2. Suitable panels include 12 mm plywood or the following proprietary 'noise curtains': proprietary
  - SealedAir 'WhisperFence 24dB' (www.sealedair.com)
  - Hushtec 'Premium Series Noise Barrier' (www.duraflex.co.nz)
  - Soundbuffer 'Performance Acoustic Curtain' (soundbuffer.co.nz)
  - Hoardfast 'Fast Wall Premium PVC partition panels' (www.ultimate-solutions.co.nz)
  - Safesmart 'Acoustic Curtain 6.5kg/m^{2}' (www.safesmartaccess.co.nz)
  - Alternatives will be approved by a suitably qualified and experienced acoustic specialist
- The panels will be a minimum height of 2 m, and higher if practicable to block line-of-sight
- The panels should be abutted or overlapped to provide a continuous screen without gaps at the bottom or sides of the panels
- The panels should be positioned as close as practicable to the noisy construction activity to block line-of-sight between the activity and noise sensitive receivers

3.5.3 Concrete Cutting

When concrete cutting:

- Select blades that:
  - Are sharp
  - Maximise the number of teeth
  - Minimise the blade width
  - Minimise gullet depth
  - Have built in vibration damping slots
- Use a unit fitted with a blade shroud and operate with a water supply
- Use noise barriers for concrete cutting and a noise enclosure for paver cutting stations (Section 3.5.2)
- Minimise the cutting period and/or the number of cutting periods (e.g. complete all cutting in one extended period rather than two shorter periods with the same overall duration)

3.5.4 Concrete Breaking

When concrete breaking:

- Match the size of breaker to the scale of the works. It should be large enough to carry out the work efficiently, but not over-sized (avoiding unnecessary noise and vibration)
- Make an initial perimeter saw cut at the perimeter to reduce vibration transfer to nearby buildings
- Ensure effective noise mitigation is in place using noise barriers and enclosers (Section 3.5.2) and/or a breaker blanket (e.g. Hushtec 'breaker attachment' – www.duraflex.co.nz)
- Minimise the number of breaking periods (e.g. complete all breaking in one extended period rather than two shorter periods with the same overall duration)

- Match the chisel/tip type to the material and use a dampened bit to avoid ringing
- Avoid 'blank' firing by placing the chisel on the concrete before starting, and minimising firing after it breaks through

3.5.5 Compaction

When compacting fill:

- Match the size of plate compactor or roller to the scale of the works (i.e. large enough to undertake the works efficiently, but avoiding oversized units)
- Avoid the use of the vibratory function on rollers where practicable (e.g. roll thinner layers of fill without the vibration function to achieve the same compaction standard)
- Where the vibration function is adjustable, minimise amplitude and maximise the driving frequency to minimise vibration effects where practicable
- Minimise the duration of the vibratory function on rollers (e.g. use vibro mode to settle and align aggregate, then turn vibratory function off for subsequent static rolling compaction)
- Minimise the number of periods (e.g. complete all plate compaction or vibratory rolling in one extended period rather than two shorter periods with the same overall duration)
- Start/stop vibratory function away from buildings and pass by while the vibration level is stable
- Switch off the vibration function within the safe setback distances (Table 5)

3.5.6 Piling

The loudest noise from a bored piling is if the shaft is shaken back and forth or bounced to loosen spoil stuck to the auger. If spoil does not fall off the auger easily, spin in one direction or use tools to scrape the auger clean. If shaking is required due to Health and Safety constraints, ensure bushes are well maintained to avoid steel on steel contact.

3.5.7 Engagement

Written communication (e.g. newsletter) should be provided to building occupants within 50 m of the site at least 1 week prior starting construction. It should include:

- Details of the overall works, its timing and duration
- Contact details and names of personnel whose job is to receive complaints and enquiries
- Acknowledge that some activities are predicted to generate high noise and/or vibration levels and may result in disturbance for short periods

Request typical hours of use for imaging equipment from Lux Radiology and avoid concrete breaking and compaction activities during these periods where practicable.

3.6 Unitary Plan Framework

While construction noise is usually undesirable, it is temporary and not necessarily unreasonable when all the relevant factors are taken into consideration.

The foreword of New Zealand Standard NZS 6803:1999 "*Acoustics – Construction Noise*" states:

> "*Construction noise is an inherent part of the progress of society. As noise from construction is generally of limited duration, people and communities will usually tolerate a higher noise level provided it is* ***no louder than necessary, and occurs with appropriate hours of the day****. The Resource Management Act 1991 requires the* ***adoption of the best practicable option to ensure*** *the emission of noise from premises does not exceed a* ***reasonable level****. The Act also imposes a duty on every person to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by, or on behalf of, that person*."

Additionally, the AUP-OIP objective, policies, rules and matters of discretion support the New Zealand Standard NZS 6803:1999 assessment of construction activities.

AUP-OIP **objectives** E25.2 (1) requires that:

> *"People are protected from* ***unreasonable*** *levels of noise and vibration",*

while (4) states:

> *"Construction activities that cannot meet noise and vibration standards are* ***enabled while controlling duration, frequency and timing*** *to manage adverse effects".*

This acknowledges that there are often periods or activities where the construction noise standards cannot be met. The objective is to enable them provided they are no louder than necessary, aligned with the New Zealand Standard NZS 6803:1999 objectives.

AUP-OIP **policies** E25.3 (2) requires:

> *"Minimise,* ***where*** *practicable, noise and vibration at its source or on the site from which it is generated to mitigate adverse effects on adjacent sites"*

while (10) states:

> *"Avoid, remedy or mitigate the adverse effects of noise and vibration from construction, maintenance and demolition activities while having regard to:*
>
> *a) the sensitivity of the receiving environment; and*
>
> *b) the proposed duration and hours of operation of the activity; and*
>
> c) ***the practicability of complying*** *with permitted noise and vibration standards*."

Again, this acknowledges the practicability of compliance. The noise and vibration assessment and a CNVMP would address all three elements.

AUP-OIP **rules** E25.6.28 (primarily) requires compliance with the stated noise limits. However, as discussed above, this is not always practicable and is often reasonable provided it is the BPO.

AUP-OIP **matters of discretion** in E25.8.2 (1) parts (a) and (b) state (note other parts are not particularly relevant to construction noise):

> *a) "whether activities can be managed so that they do not generate unreasonable noise and vibration levels on adjacent land uses particularly activities sensitive to noise*
>
> *b) the extent to which the noise or vibration generated by the activity:*
>
> - *will occur at times when disturbance to sleep can be avoided or minimised; and*

- *will be compatible with activities occurring or allowed to occur in the surrounding area; and*
- *will be limited in duration, or frequency or by hours of operation; and*
- *will exceed the existing background noise and vibration levels in that environment and the reasonableness of the cumulative levels; and*
- *can be carried out during daylight hours, such as road works and works on public footpaths"*

We consider the construction noise and vibration levels will be reasonable with the adoption and implementation of a Construction Noise and Vibration Management Plan (CNVMP). The works would also be undertaken during the day and are consistent with what would be expected from construction activity on many large building sites within the urban environment.

4.0 COMMERCIAL ACTIVITIES NOISE

4.1 Mechanical Services Plant

The mechanical services plant is in plantrooms and on the roof. Our experience shows that mechanical plant in a Business Zone can readily achieve compliance with the noise rules with good acoustic design, installation, and maintenance.

4.2 Café/Restaurant & Food and Beverage

The ground floor has a café/restaurant and food and beverage tenancies that face K Rd and/or Gundry Street. We anticipate that these tenancies should be able to readily comply with the noise limits at the nearest receivers across respective roads. The operators may need to moderate the level of music noise to ensure compliance.

4.3 Vehicle Movements

There are two basement levels of car parking with direct access onto Gundry Street. Noise from vehicle movements on site are contained within the building envelope and not considered further.

5.0 PROPOSED CONDITIONS OF CONSENT

We recommend that the following conditions be included in any consent granted.

Construction Noise & Vibration

1. Construction noise shall be measured and assessed in accordance with New Zealand Standard NZS 6803:1999 "Acoustics - Construction Noise" and comply with the following Project Standards at any occupied building unless otherwise provided for in the CNVMP in Condition 3.

Time	Noise Limit	
	Average ($L_{Aeq(30min)}$)	Maximum (L_{AFmax})
Monday to Friday 6.30am – 10:30pm	75 dB	90 dB
Saturday 7am-11pm	80 dB	90 dB
Sunday 9am – 7pm	65 dB	85 dB
All other times	60 dB	75 dB

2. Construction vibration shall be measured and assessed in accordance with German Standard DIN 4150-3:2016 "Vibrations in buildings – Part 3: Effects of vibration on structures" and comply with the limits in Tables 1 and 4. Vibration must not exceed 2mm/s PPV in any occupied building unless otherwise provided for in the CNVMP in Condition 3.
3. A Construction Noise and Vibration Management Plan (CNVMP) must be prepared by a suitably qualified person and submitted to Auckland Council for certification at least 5 days prior to the commencement of the works. The certified CNVMP must be implemented throughout the Project.

   The CNVMP objectives are:

   a) Identify and adopt the best practicable option (BPO) for the management of construction noise and vibration;

   b) Define the procedures to be followed when the noise and vibration standards in Condition 1 cannot be met;

   c) Inform the duration, frequency, and timing of works to manage disruption; and

   d) Require engagement with affected receivers and timely management of complaints.
4. The CNVMP shall include:

   a) The relevant measures from NZS 6803:1999 "Acoustics – Construction Noise", Annex E2 "Noise management plans";

   b) The relevant measures from DIN 4150-3:2016 "Vibrations in buildings – Part 3: Effects of vibration on structures", Appendix E "Minimizing the effects of vibration";

   c) Noise and vibration monitoring shall be undertaken by a suitably qualified person and the results made available to Auckland Council upon request. Monitoring shall include the first instance of concrete breaking, compaction, piling, and in response to a relevant complaint; and

   d) Request typical hours of use for imaging equipment in Lux Radiology and avoid concrete breaking and compaction activities during these periods where practicable.

6.0 CONCLUSIONS

Overall, our assessment concludes that the noise and vibration effects (both construction and operational) of this resource consent application are appropriate, subject to the mitigation measures outlined in this report.

In summary:

- Construction activities are predicted to generally comply with the construction noise and vibration rules. However, we predict infringements of the noise standards for perimeter works, primarily from any necessary concrete cutting, breaking and piling works. We recommend the implementation of a CNVMP to minimise effects and ensure residual effects are reasonable, including timing of concrete breaking and compaction activities to minimise effects.
- Post construction, commercial activities noise is predicted to comply with the inclusion of standard design measures at the detailed design stage (e.g. mechanical plant placement and selections).
- Proposed conditions outlined in Section 5.0 should be included in any consent granted.

APPENDIX A GLOSSARY OF TERMINOLOGY

SPL or L_P	Sound Pressure Level. A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.
SWL or L_W	Sound Power Level. A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
dB	Decibel - The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa, i.e. dB = 20 x log(P/Pr)
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
NZS 6801:2008	New Zealand Standard NZS 6801:2008 *"Acoustics – Measurement of environmental sound"*
NZS 6802:2008	New Zealand Standard NZS 6802:2008 *"Acoustics – Environmental Noise"*
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 "Acoustics - Construction Noise"
DIN 4150-3:1999	German Standard DIN 4150-3:1999: "Structural Vibration - Effects of Vibration on Structures"
BS 5228-1:2009	British Standard BS 5228-1:2009: "Code of practice for noise and vibration control on construction and open sites"
PPV	Peak Particle Velocity For Peak Particle Velocity (PPV) is the measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.