Styles Group
Acoustics & Vibration Consultants

CONSTRUCTION NOISE & VIBRATION

MILLDALE STAGE 4C
PROPOSED SUBDIVISION AND DEVELOPMENT

PREPARED FOR

Fulton Hogan Land Development

DATE

25 March 2025

Assessment prepared by Styles Group for Fulton Hogan Land Development.

REVISION HISTORY

Rev:	Date:	Comment:	Version:	Prepared by:	Reviewed by:
1	25/03/25	Final with Draft CNVMP attached	Final	Jamie Exeter, MASNZ, Assoc. NZPI Principal Styles Group	Kelly Leemeyer, MASNZ Senior Consultant Styles Group

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1.0 Introduction

This report has been prepared in support of the application by Fulton Hogan Land Development (**FHLD**) for resource consents to the Environmental Protection Authority under the Fast-Track Approvals Act 2024.

The application seeks to authorise comprehensive residential development and subdivision across Milldale Stages 4C-2 to 4C-5 (inclusive), the establishment of a balance lot, three roads to vest, one accessway to vest, 13 jointly owned access lots (**JOAL**s) and associated earthworks and infrastructure in accordance with the Wainui Precinct.

FHLD has engaged Styles Group to assess the potential noise and vibration effects of the proposed construction work.

The purpose of this report is to:

- Determine the potential construction noise and vibration levels at the nearest occupied dwellings (the **receivers**) based on typical and worst-case scenarios.
- Assess the construction noise and vibration emissions in terms of the permitted standards of the Auckland Unitary Plan (the **AUP**) and identify where consent is required.
- Recommend noise and vibration mitigation measures and consent conditions.
- Describe the potential noise and vibration effects of the proposal in the context of the existing environment and the provisions of the AUP.

Our assessment is based on construction methodologies, plant, timeframes, and other information provided by the relevant experts in the project team.

Our noise level predictions have been prepared using manual calculations and iNoise computer noise modelling software based on the International Standard ISO 9613-1/2 *Attenuation of sound during propagation outdoors*. All calculations and assessments have been undertaken in accordance with NZS 6803:1999 *Acoustics – Construction noise*.

A glossary of acoustical terms used in this document is attached as Appendix A.

2.0 Statement of qualifications and experience

I am a Principal at Styles Group. Styles Group is an acoustics consultancy specialising in environmental noise and vibration, building acoustics, and underwater noise. I have been employed at Styles Group since January 2008.

I hold a Diploma of Audio Engineering from the School of Audio Engineer, which I completed in 2004. I am a professional Member of the Acoustical Society of New Zealand (MASNZ) and served as an elected council member from 2012 until 2018.

I have been working in the field of acoustics for 20 years. I have been measuring, predicting, and assessing environmental noise and vibration within the framework of District Plans and the Resource Management Act for more than 17 years.

I have worked on a significant number of construction projects including many of New Zealand's largest infrastructure projects. I regularly undertake peer review work for Local Government throughout New Zealand. I have provided expert evidence and advice for District Plan changes and reviews for a large number of private and public sector clients. I have written and presented guidelines on the measurement and assessment of environmental noise and construction noise and vibration to council staff and project teams throughout New Zealand.

I am one of three consultants in a working group currently drafting guidelines on the measurement and assessment of construction noise in New Zealand on behalf of the Association of Australasian Acoustical Consultants to address issues and ambiguities in NZS 6803:1999 *Acoustics – Construction Noise*.

I confirm that, in my capacity as author of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

3.0 Project description

The proposed comprehensive residential development and subdivision will be delivered in two phases. These will be enabled under separate resources consents and comprise the following:

1. Civil works and superlot subdivision phase

   The civil works and superlot subdivision phase of the development will carry out the preliminary site establishment works and subsequent subdivision of three parent lots to create superlots across Stages 4C-2 – 4C-5 (inclusive). This phase of the development will create a total of 21 superlots, one balance lot, 13 JOALs, three roads to vest, one pedestrian accessway to vest and associated infrastructure and servicing.

2. Comprehensive residential land use and subdivision phase

   Following the completion of Phase 1, comprehensive residential development and subdivision will be carried out across all 21 superlots.

   It is proposed to create a total of 168 dwellings and subsequently subdivide the lots to create 168 fee simple residential lots. Each dwelling will be serviced and have direct vehicle access to a JOAL or road created through the civil works subdivision phase.

This report covers the construction work required to complete both phases of the project. A full description of the project is provided in the application Assessment of Environmental Effects (**AEE**).

4.0 The proposed construction work

The proposed construction work includes earthworks, roading and infrastructure work, concrete pours, other activities involving the use of heavy machinery and vehicles, and the construction of dwellings.

The noisy activities required for the work are included in Section 9.0. There are no high noise or vibration generating activities required i.e., no hydraulic breaking, vibratory piling, impact piling, or blasting.

The earthworks and civil construction work for Phase 1 will be completed within approximately 12 months. The construction of dwellings during Phase 2 will take an additional 24 to 48 months.

All noisy construction work during both phases will take place between 7:30 AM and 6:00 PM on Monday to Saturday. There will be no noisy construction work on Sundays or public holidays.

Stage 4C-1A and Honohono Avenue, and superlots 5700 and 5701 are being constructed under different consents. Refer to the AEE for further details.

5.0 The construction site and nearest receivers

The site subject to the application is within the Milldale Development and referred to as Stage 4C subdivision area (the **site**). The 5.1251 ha site comprises three balance lots created by the subdivision of Stage 4C-1. Formal titles have not yet been issued for these balance lots which are identified as Lot 9100, Lot 9101, and Lot 9102 on the approved scheme plan. As such, the current legal title for the site applies to the entirety of Stage 4C (including approved Stage 4C-1) and is legally described as Lot 9001, DP 586972 (6.75 ha), 21 Karapapa Road, Milldale, Wainui.

The site is centrally located within the Milldale Development, immediately south of the Business – Local Centre Zone. It is boarded by Parish Drive to the north, Papakiri Road to the west, Karapapa Road to the east and Dendro Ring Road to the south. A full description of the Site and surrounds is provided in the application AEE.

The nearest receivers within the surrounding stages are identified in Table 1.

Table 1: Nearest receivers

Milldale Development Stage	Location and receiver details
4C-1A	SE of Stage 4C-4 (superlots 5700 and 5701). Dwellings in a residential zone. The nearest assessment point is approximately 3-5 m from where construction machinery will be used on site.
4B	SW of Stages 4C-4 & 4C-5. Dwellings in a residential zone. The nearest assessment point is approximately 18 m from where construction machinery will be used on site.
4D	NE of Stages 4C-2 & 4C-3. Dwellings in a residential zone. The nearest assessment point in Stage 4D is at least 20 m from where construction machinery will be used on site.
4F	SE of Stage 4C-2. Dwellings in a residential zone. The nearest assessment point in Stage 4D is at least 19 m from where construction machinery will be used on site.
9	NW of Stages 4C-3 & 4C-5. Commercial buildings in a business zone. The nearest assessment point in Stage 9 is at least 26 m from where construction machinery will be used on site.

6.0 AUP permitted construction noise standards

Standard E25.6.1.3 of the AUP requires all construction noise to be measured and assessed in accordance with NZS 6803: 1999 *Acoustics – Construction Noise*.

The permitted construction noise limits are provided in E25.6.27.

> **E25.6.27. Construction noise levels in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone**
>
> 1) Noise from construction activities in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone must not exceed the levels in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone when measured 1m from the façade of any building that contains an activity sensitive to noise that is occupied during the works.

Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone

Time of week	Time Period	Maximum noise level (dBA)	
		L_{eq}	L_{max}
Weekdays	6:30am – 7:30am	60	75
	7:30am – 6:00pm	75	90
	6:00pm - 8:00pm	70	85
	8:00pm - 6:30am	45	75
Saturdays	6:30am – 7:30am	45	75
	7:30am – 6:00pm	75	90
	6:00pm - 8:00pm	45	75
	8:00pm - 6:30am	45	75
Sundays and public holidays	6:30am – 7:30am	45	75
	7:30am – 6:00pm	55	85
	6:00pm - 8:00pm	45	75
	8:00pm - 6:30am	45	75

2) Noise from construction activities in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone must not exceed the levels in Table E25.6.27.2 Construction noise levels for noise affecting any other activity when measured 1m from the façade of any other building that is occupied during the works.

Table E25.6.27.2 Construction noise levels for noise affecting any other activity

Time Period	Maximum noise levels L_{eq} (dBA)
7:30am – 6:00pm	75
6:00pm – 7:30am	80

3) For a project involving a total duration of construction work that is less than 15 calendar days, the noise levels in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.27.2 Construction noise levels for noise affecting any other activity above may be increased by 5dB in all cases.

4) For a project involving a total duration of construction work that is more than 20 weeks the noise limits in Table E25.6.27.1 Construction noise levels for activities sensitive to noise in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone and Table E25.6.27.2 Construction noise levels for noise affecting any other activity above may be decreased by 5dB in all cases.

Activities sensitive to noise are defined in Chapter J of the AUP as 'any dwelling, visitor accommodation, boarding house, marae, papakāinga, integrated residential development, retirement village, supported residential care, care centres, lecture theatres in tertiary education facilities, classrooms in education facilities and healthcare facilities with an overnight stay facility'.

With respect to the criteria for determining the permitted construction noise limits under E25.6.27:

- The works are outside of the Business – City Centre Zone and the Business – Metropolitan Centre Zone.
- All noisy work will be within the time period of 7:30 AM to 6:00 PM on Monday to Saturday.
- The project will involve a total duration of construction work that is more than 20 weeks.

The permitted construction noise limits for the project are therefore:

- 70 dB L_{Aeq} and 85 dB L_{Amax} at 1 m from the most exposed façade of any occupied dwelling (or any other building housing an activity sensitive to noise).
- 70 dB L_{Aeq} at 1 m from the most exposed façade of any other occupied building.

7.0 AUP permitted construction vibration standards

The AUP permitted construction vibration standards are provided in E25.6.30.

E25.6.30. Vibration

1) Construction and demolition activities must be controlled to ensure any resulting vibration does not exceed:

   a. the limits set out in German Industrial Standard DIN 4150-3 (1999): Structural vibration – Part 3 Effects of vibration on structures when measured in accordance with that Standard on any structure not on the same site; and

   b. the limits in Table E25.6.30.1 Vibration limits in buildings in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building.

Table E25.6.30.1 Vibration limits in buildings

Receiver	Period	Peak Particle Velocity Limit (mm/s)
Occupied activity sensitive to noise	Night time 10pm to 7am	0.3 mm/s
	Daytime 7am to 10pm	2 mm/s
Other occupied buildings	At all times	2 mm/s

Works generating vibration for three days or less between the hours of 7am to 6pm may exceed the limits in Table E25.6.30.1 Vibration limits in buildings above, but must comply with a limit of 5mm/s peak particle velocity in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building, where:

i. all occupied buildings within 50m of the extent of the works generating vibration are advised in writing no less than three days prior to the vibration-generating works commencing; and

ii. the written advice must include details of the location of the works, the duration of the works, a phone number for complaints and the name of the site manager.

The criteria specified in E25.6.30.1.a are designed to prevent cosmetic damage to buildings, while those in E25.6.30.1.b aim to mitigate potential effects on people inside the buildings.

7.1 Vibration building damage limits

The DIN 4150–3:1999 Standard referenced in E25.6.30.1.a recommends vibration limits for avoiding cosmetic building damage according to the design, occupancy, and sensitivity of the subject building. The classifications are:

- Line 1: Buildings used for commercial purposes, industrial buildings, and buildings of similar design
- Line 2: Dwellings and buildings of similar design and/or occupancy
- Line 3: Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g., listed buildings under preservation order).

We have based our assessment against the permitted construction vibration limits on Line 2 of the DIN 4150–3:1999 criteria applying at the neighbouring residential dwellings.

Line 3 would apply to any receiving structure that is deemed by a suitably qualified person to be particularly sensitive to vibration and/or of great intrinsic value e.g., a heritage building. We are not aware of any nearby Line 3 structures.

The guideline values provided in DIN 4150–3:1999 also depend on whether the vibration is ‘short-term’ or ‘long-term’. Short-term vibration is defined by the Standard as vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance. Long-term vibration is all other types of vibration. In our experience in measuring vibration in low-rise structures shows that construction vibration typically meets the short-term criteria.

The DIN 4150–3:1999 frequency-dependent values for short-term vibration are illustrated in Figure 1 for reference. Dominant frequencies for construction vibration in dwellings are typically less than 50 Hz.

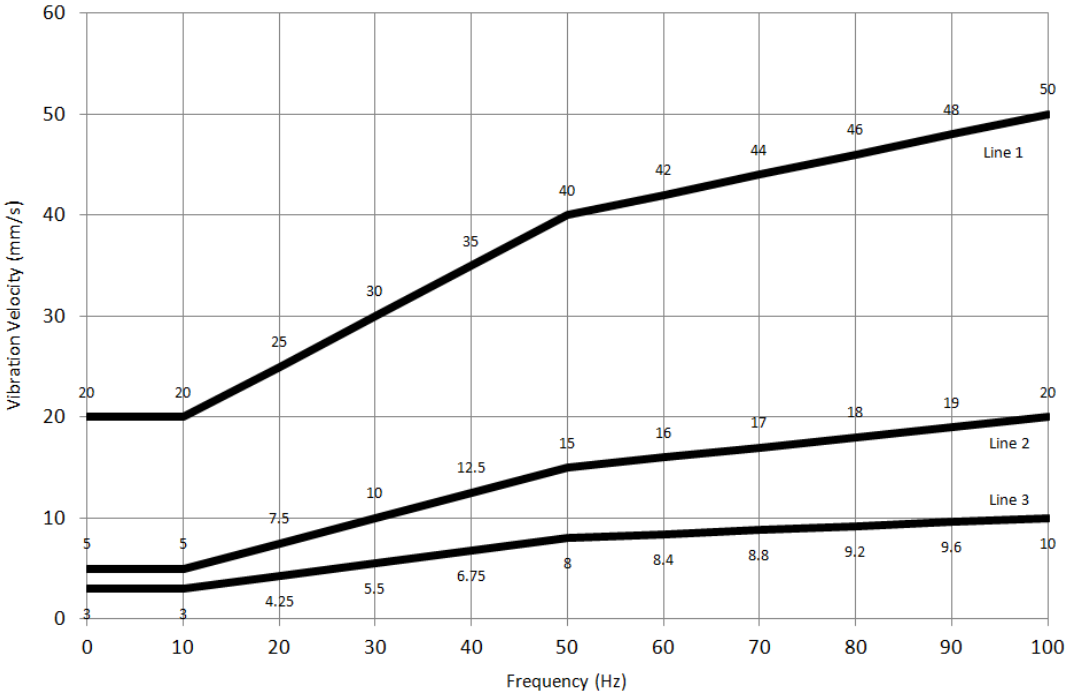

Figure 1: DIN 4150–3: 1999 guideline values for short-term vibration

7.2 Vibration amenity limit

The works will be during the daytime only and vibration will be generated for more than three days. The permitted construction vibration amenity limit under E25.6.30.1.b is therefore 2 mm/s PPV when measured within any occupied building.

8.0 Construction noise and vibration mitigation

The following measures will be adopted at each phase of development to ensure that the permitted construction noise and vibration limits are complied with wherever practicable.

Phase 1: Civil works and superlot subdivision

1. A Construction Noise and Vibration Management Plan (**CNVMP**) will be prepared for Phase 1 of the project. The objectives of the CNVMP will be to identify and require the adoption of the best practicable options to minimise construction noise and vibration effects and ensure compliance with the project noise and vibration conditions. A draft CNVMP is attached to this report as Appendix B.
2. The occupants of buildings within 100 meters of the site will receive written advice at least five days before earthworks begin. This advice will provide an overview of the works, approximate dates for the noisiest activities, and contact details for any questions or concerns.
3. Noisy construction work will only occur between 7:30 AM and 6:00 PM on Monday to Saturday. There will be no noisy work at night or on Sundays and public holidays.
4. Temporary construction noise barriers will be required for some activities to comply with the permitted construction noise limits. The barriers will be at least 2.4 m high and block the line of sight between the noisy activity and the occupied building. They will be made from solid materials (e.g., 12 mm plywood) or proprietary construction noise panels. The requirements for acoustic barriers will be specified in the project CNVMP.

Phase 2: Comprehensive residential development

1. Noisy construction work will only occur between 7:30 AM and 6:00 PM on Monday to Saturday. There will be no noisy work at night or on Sundays and public holidays.
2. Standard construction noise barriers may be required in some circumstances for noisy activities to comply with the permitted construction noise limits (as identified in the following section of this report).

9.0 Construction noise levels

This section sets out our construction noise calculations and an assessment of compliance against the AUP permitted construction noise limits.

9.1 References

We have calculated construction noise levels at the neighbouring sites based on the machinery that will be used on site and the references displayed in Table 2. Our references are based on measurement data. They are generally consistent with the data provided in NZS 6803:1999 Appendix C *Guide to Sound Level Data on Site Equipment and Site Activities* (but more relevant to modern construction equipment than the Standard).

Table 2 also displays the minimum separation distances for each activity to comply with the relevant AUP permitted noise limits based on the following assumptions:

- The minimum distance stated is from the noise-generating plant to the assessment position at 1 m from the most exposed façade of the building (e.g., from the excavator engine to 1 m from the building façade).
- The plant is being used continuously at the reference distance over a 15-minute sample period (i.e., 100% on-time) unless otherwise stated.
- The distances include a +3 dB adjustment to the noise levels for reflections from the façade of the receiving building (as required by NZS 6803:1999).
- Acoustically reflective ground is assumed between the noise source and the receiver.
- The mitigated compliance distances are based on construction noise barriers effectively screening the ground level of the building from the noise-generating activity and reducing the noise levels by 10 dB.

Table 2: Reference noise levels and compliance distances

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
Cutting timber with a bench mounted saw	84 dB	67 m	22 m
Vibratory compaction with 15-t to 20-t roller	76 dB*	27 m	9 m
Drilling for retaining walls with a 12-t rig	75 dB	24 m	8 m
Compaction with plate compactor	71 dB*	15 m	5 m
Cut and fill, clearing, and loading trucks with a 20-t excavator	69 dB	12 m	4 m
Compaction with Cat 815 static compactor 18-t	69 dB*	12 m	4 m
Concrete pump and truck discharging	69 dB	12 m	4 m
Compaction with a single drum static roller	65 dB*	8 m	3 m
Use of handheld power tools	65 dB	8 m	3 m
Grading	62 dB*	6 m	2 m

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
Idling delivery truck, dump truck, moxy, tractor	62 dB	6 m	2 m

* Reference noise level is for a moving noise source.

9.2 Assessment of compliance

Most of the proposed construction activities during Phase 1 and Phase 2 will not require acoustic screening for compliance because the site is separated from the neighbouring stages by roads, and noisy activities such as drilling for larger retaining walls and vibratory compaction will not be required near to the boundary.

Any timber cutting stations used during Phase 2 will not be set up within the mitigated compliance distance (see Table 2) and can readily be screened with a localised acoustic barrier or enclosure.

The only work that will be required within mitigated compliance distances is the construction of an accessway during Phase 1 within Stage 4C-4 near to the boundary of Stage 4C-1A (existing superlot 5701). A 20-t excavator and a plate compactor will be used for this work (at different times) approximately 3-5 m from multiple-level dwellings within Stage 4C-1A.

The noise levels outside the nearest dwellings during this work will be up to 75 dB $L_{Aeq(15\ min)}$ and 90 dB L_{Amax} at the ground floor and up to 80 dB L_{Aeq} and 95 dB L_{Amax} outside the upper-level facades. These predicted noise levels include the mitigation provided by a 2.4 m high acoustic barrier on the boundary.

The construction noise levels at Stage 4C-1A generated by the construction of the accessway are expected to infringe the permitted noise limits intermittently over a period of approximately one to two weeks. Construction noise is therefore a reason for consent.

Noise emissions from all other proposed construction work during Phase 1 and Phanse 2 can consistently comply with the AUP permitted construction noise limits by:

- Undertaking all noisy construction work between 7:30 AM and 6:00 PM on Monday to Saturday.
- Using the smallest and quietest plant practicable to complete the work.
- Using temporary construction noise barriers.
- Operating all machinery outside of the mitigated compliance distances displayed in Table 2.

For most of the project, the highest construction noise levels will be approximately 60 dB to 70 dB $L_{Aeq(15\ min)}$ at the neighbouring sites while the nearest works are completed. When construction activities are more distant the noise levels will generally range from 50 dB to 60 dB $L_{Aeq(15\ min)}$. There will also be periods during the day when little or no noise is generated, and there will be no noise at night, or on Sundays and public holidays.

The predicted construction noise levels represent the loudest 15-minute periods during the noisiest and closest activities. They are not averaged, and they will not be generated continuously or for long periods.

The L_{Amax} noise levels generated by the proposed construction activities will generally be 10 to 15 dB higher than the L_{Aeq} noise levels. Noise from the construction of the accessway near to Stage 4C-1A during Phase 1 may exceed the permitted L_{Amax} noise limit of 85 dB L_{Amax} intermittently over a short period, but noise from all other works will comply.

10.0 Construction vibration levels

The highest construction vibration levels will be generated during Phase 1 by excavation, compaction, and heavy vehicle movements. The Phase 2 works will generate little or no perceptible vibration for the nearest receivers.

The vibration levels in the nearest buildings will depend on the separation distance, the size of the machinery and how it is used, the ground conditions, and the response of the structure.

Table 3 displays typical vibration levels for construction activities that will take place near to the site boundary. These are derived from previous measurements using a geophone buried in the ground. Measuring these activities from a dwelling may provide slightly lower results due to the loss of energy when the vibration transfers from the ground into the foundations.

Table 3: Typical construction vibration levels

Construction activity	Distance	Typical vibration level (PPV)
Compaction with a plate compactor	10 m	1 mm/s
Cut and fill works, loading trucks, and tracking slowly with a 20-t excavator	10 m	1 mm/s
Heavy vehicle or tractor pass-by on even ground	10 m	<1 mm/s

The proposed works will consistently comply with the permitted construction vibration limits for amenity and for avoiding cosmetic building damage without requiring any specific mitigation due to the distance between vibration-generating activities on site and the nearest buildings.

Construction vibration could be perceptible for receivers within Stage 4C-1A during the Phase 1 accessway work, but we do not expect it to exceed 2 mm/s PPV within any dwelling. Vibration is unlikely to be perceptible within any building once the Phase 1 works are 50 m away.

11.0 Potential construction noise and vibration effects

The proposed acoustic screening and standard construction hours will enable the proposed work to comply with the AUP permitted construction noise standards for most of the project.

Noise levels 5-10 dB above the permitted construction noise limits will be generated for a short duration for the nearest receivers within Stage 4C-1A during Phase 1 when the accessway is constructed. These noise levels will only occur during daytime hours over a period of one to two weeks. The potential noise effects will be mitigated through the provisions of a CNVMP and the proposed communication with the neighbours. The Phase 2 works will not generate high noise levels for the receivers in Stage 4C-1A .

The potential noise effects typically associated with construction work are displayed in Table 4. The noise effects indoors are based on windows being closed and a noise level reduction of 25 dB through the façades. This is a typical reduction for newly constructed residential dwellings.

People will generally be able to seek respite indoors during periods of high noise during Phase 1 when construction work is near the site boundary. For most of the project, the noise effects will be no greater than those shown for noise levels of 55-65 dB L_{Aeq} and there will be periods when there is little or no construction noise.

Table 4: Temporary construction noise effects

Noise level at 1 m from the façade ($L_{Aeq\ (15\ min)}$)	Potential noise effects outside the building	Potential noise effects inside the nearest room of the building	Compliance with AUP permitted standards
55-65 dB	Conversation may require raised voices.	Up to 37 dB L_{Aeq} inside. Noise may be audible inside the building but will not cause annoyance or interfere with residential activities.	Compliant with AUP permitted construction noise limits.
65-70 dB	Conversation will require raised voices. People are unlikely to spend time outside.	Up to 42 dB L_{Aeq} inside. Noise may be audible inside the building but is unlikely to cause annoyance or interfere with residential activities.	Compliant with AUP permitted construction noise limits.

Noise level at 1 m from the façade ($L_{Aeq\ (15\ min)}$)	Potential noise effects outside the building	Potential noise effects inside the nearest room of the building	Compliance with AUP permitted standards
70-75 dB	Conversation will require raised voices. People are unlikely to spend time outside. Businesses that use outdoor areas would experience considerable disruption.	Up to 47 dB L_{Aeq} inside. Noise may be noticeable inside the building and could affect concentration but is unlikely to interfere with residential activities.	Infringes AUP permitted construction noise limit by up to 5 dB
75-80 dB	Not applicable because these noise levels are only expected outside the upper-level façade of buildings in Stage 4C-1A	Up to 52 dB L_{Aeq} inside. Annoyance for some occupants. Concentration may be affected but residential and office activities can generally continue. Sound levels for television, radio, and phone conversations would need to be slightly raised.	Infringes AUP permitted construction noise limit by up to 10 dB

Construction vibration may be perceptible intermittently during Phase 1 when heavy machinery is used within approximately 50 m of a building, but it will not exceed 2 mm/s PPV. The following measures will be applied through the CNVMP to minimise potential effects on residential amenity:

- Vibration will only be generated during the daytime.
- Residents will know when to expect perceptible vibration.
- Residents will be informed that the AUP limits for avoiding cosmetic building damage will be consistently complied with.
- Contact details will be provided to the residents to answer any questions or concerns.

Temporary construction noise and vibration effects are unavoidable during large-scale residential developments near occupied dwellings. Elevated noise levels and potentially noticeable vibration are expected for short periods during Phase 1 when machinery is operated near the site boundary. However, noise and vibration will remain within the permitted limits set by the AUP for long-term construction projects for most receivers and will be considerably lower during most of the proposed work. The Phase 2 works will generate lower construction noise and vibration levels.

We do not expect construction noise and vibration to cause unreasonable disturbance on any neighbouring site , including the proposed infringements during Phase 1, if our recommended conditions in the following section are adopted.

12.0 Recommended conditions

We recommend the following conditions for each phase of the project:

12.1 Phase 1: Civil works and superlot subdivision

1. The consent holder must submit a Construction Noise and Vibration Management Plan (CNVMP) to Auckland Council for certification. The CNVMP must be prepared by a suitably qualified person (e.g., MASNZ) and submitted a minimum of ten working days before any construction works authorised by this consent begin. The objectives of the CNVMP must be to identify and require the adoption of the best practicable options to minimise construction noise and vibration effects and ensure compliance with the project noise and vibration conditions. The CNVMP must address the requirements of Annex E of NZS 6803:1999 *Acoustics – Construction Noise* as a minimum and must include sections on communication with the occupants of the nearest sites, responding to complaints, and the acoustic screening required on site for compliance. Construction works must not begin until certification has been received in writing from Council. All construction works on the site must be carried out in accordance with the certified CNVMP.
2. The consent holder must advise the occupants of all buildings within 100 m of the site boundary of the project at least five days before earthworks begin. The advice must be provided in writing and must include the following information:
    i. A general description of the construction works including the duration of the project and the working hours on site.
    ii. The approximate dates and durations of the activities that will generate the highest levels of construction noise and vibration for them.
    iii. A contact name and phone number to advise of any sensitive times for high noise levels and for any questions or complaints during the project.
3. Construction work and heavy vehicle movements must only take place between 7:30 AM and 6:00 PM on Monday to Saturday. No noisy work can be undertaken on Sundays or public holidays. This condition does not prevent meetings or other quiet activities from taking place on site outside of standard construction hours.

4. All construction work must be designed and undertaken to ensure that noise from the site does not exceed the following limits when measured and assessed in accordance with NZS 6803:1999 *Acoustics – Construction noise*.

Construction activity	Assessment location	Noise limits
Construction of the accessway between Stages 4C-4 and 4C-1A	At the ground floor of any occupied dwelling within Stage 4C-1A	75 dB L_{Aeq} & 90 dB L_{Amax}
	At the upper-level of any occupied dwelling within Stage 4C-1A	80 dB L_{Aeq} & 95 dB L_{Amax}
	At all other occupied dwellings	70 dB L_{Aeq} 85 dB L_{Amax}
	At all occupied commercial buildings	70 dB L_{Aeq}
All other construction activities	At all occupied dwellings	70 dB L_{Aeq} & 85 dB L_{Amax}
	At all occupied commercial buildings	70 dB L_{Aeq}

12.2 Phase 2: Comprehensive residential development phase

1. Construction work and heavy vehicle movements must only take place between 7:30 AM and 6:00 PM on Monday to Saturday. No noisy work can be undertaken on Sundays or public holidays. This condition does not prevent meetings or other quiet activities from taking place on site outside of standard construction hours.

13.0 Conclusion

Styles Group has assessed the potential noise and vibration effects of the proposed construction work for Stage 4C of the Milldale Development, and specifically, the noise and vibration effects associated with the two phases of development.

The proposed acoustic screening and CNVMP for Phase 1, and standard construction hours for both project phases will enable the proposed work to comply with the AUP permitted construction noise standards for most of the project.

During the Phase 1 works, the construction noise levels at Stage 4C-1A (existing superlot 5701) generated by the construction of the accessway within Stage 4C-4 are expected to infringe the AUP permitted construction noise limits intermittently by 5-10 dB over a period of approximately one to two weeks. Construction noise is therefore a reason for consent. The infringements will only occur during daytime hours and the potential noise effects will be

managed through the provisions of a CNVMP and the proposed communication with neighbours. All other construction noise can be managed to comply with the AUP permitted construction noise limits.

Construction vibration will consistently comply with the AUP permitted construction vibration limits through both phases of the development and is not a reason for consent.

Construction noise will be noticeable outside the neighbouring buildings and may dominate the noise environment during the day while the nearest works during Phase 1 are completed. However, this will be for a short duration and the noise effects will generally not exceed those enabled by the AUP for long-term construction projects. The construction noise and vibration levels at any occupied dwelling will be significantly lower than the permitted limits for most of the project.

Noise and vibration emissions from the proposed construction work will not cause unreasonable disturbance on any neighbouring site if our recommended conditions are adopted.

Appendix A Glossary

Noise	A sound which serves little or no purpose for the exposed persons and is commonly described as ‘unwanted sound’. The definition of noise includes vibration under the Resource Management Act.
dB (decibel)	The basic measurement unit of sound. The logarithmic unit used to describe the ratio between the measured sound pressure level and a reference level of 20 micropascals (0 dB).
A-weighting	A frequency filter applied to the full audio range (20 Hz to 20 kHz) to approximate the response of the human ear at lower sound pressure levels.
$L_{Aeq(t)}$ (dB)	The A-weighted equivalent sound pressure level with the same energy content as the measured varying acoustic signal over a sample period (t). The preferred metric for sound levels that vary over time because it considers the total sound energy over the time period of interest.
L_{AFmax} (dB)	The maximum A-weighted sound pressure level recorded during the measurement period using a fast time-weighting response.
PPV (mm/s)	Peak particle velocity is the metric commonly used for measuring construction vibration in New Zealand. It is the instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.

Appendix B Draft CNVMP

Styles Group
Acoustics & Vibration Consultants

DRAFT CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

MILLDALE STAGE 4C
CIVIL AND SUBDIVISION WORKS

PREPARED FOR

Fulton Hogan Land Development

DATE

18 March 2025

Construction noise and vibration management plan prepared by Styles Group for Fulton Hogan Land Development.

REVISION HISTORY

Rev:	Date:	Comment:	Version:	Prepared by:	Reviewed by:
1	18/03/25		Draft	Jamie Exeter, MASNZ, Assoc. NZPI Principal Styles Group	

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Appendices

1.0 Introduction

Fulton Hogan Land Development has engaged Styles Group to prepare a Construction Noise and Vibration Management Plan (**CNVMP**) for the civil and subdivision works of Milldale Stages 4C-2 to 4C-5 (the **Site**).

The objectives of this CNVMP are to identify and require the adoption of the best practicable option to minimise adverse construction noise and vibration effects on the neighbouring sites, and to enable compliance with the project construction noise and vibration limits.

This CNVMP has been prepared in accordance with the project conditions and with reference to Appendix E of NZS 6803:1999 *Acoustics – Construction noise*. It may be updated as the works progress if changes become necessary.

A glossary of the acoustical terms used in this document is provided as Appendix A.

2.0 Contacts

The contact for queries or complaints regarding the project, and the manager responsible for implementing this CNVMP is:

To be confirmed ph:

The consultant engaged to provide construction noise and vibration monitoring is:

Styles Group Acoustics & Vibration Consultants ph: 09 308 9015

3.0 Project conditions

The conditions of consent with respect to construction noise and vibration emissions are provided in Appendix B.

Please refer to Sections 5.0 and 0 of this CNVMP for interpretation of the construction noise and vibration limits in accordance with the working hours and receiving sites.

4.0 Duration of works and hours of construction

The indicative programme of works is set out in Table 1.

Table 1: Indicative programme of works

Stage	Activity	Time frame
To be completed		

Noisy construction work and heavy vehicle movements will only be undertaken between 7:30 am and 6:00 pm, Monday to Saturday. Quiet activities (e.g., meetings) may take place outside of these hours if they are generally inaudible at the neighbouring sites. There will be no noisy works on Sundays or public holidays.

5.0 Project construction noise limits

The applicable noise limits for the project are set out in Table 2.

All construction noise must be measured and assessed in accordance with the New Zealand Standard NZS 6803:1999 *Acoustics – Construction Noise*. This means the noise limits apply at 1 m from the façade, and 1.2 to 1.5 m above the relevant floor level, of any building that is occupied during the works (the **Receivers**). The noise limits do not apply at unoccupied buildings.

Table 2: Project construction noise limits

Receiver	Noise limit L_{Aeq}	Noise limit L_{AFmax}
To be completed		

6.0 Project construction vibration limits

The construction vibration limits for the project are set out in Table 3.

Table 3: Project construction vibration limits

Receiving building	Vibration limit
To be completed	

All construction vibration must be measured and assessed in accordance with DIN 4150-3:1999 *Structural Vibration – Part 3 Effects of vibration on structures* (**DIN 4150-3:1999**).

6.1 Construction vibration limits for occupied buildings

The project limit for avoiding disruption in occupied buildings is 2 mm/s PPV in any axis when measured in the corner of the floor of the storey of interest in multi-storey buildings, or within 500 mm of ground level at the foundation of a single storey building.

6.2 Construction vibration limits for avoiding building damage

The guideline values of DIN 4150-3:1999 referenced in Table 3 are designed to avoid minor building damage, such as cracked plaster. The Standard does not consider the potential effects of vibration on the occupants of the building.

The Standard uses a three-tiered classification system for buildings according to their susceptibility to vibration damage, as follows:

Line 1: *Buildings used for commercial purposes, industrial buildings and buildings of similar design (Line 1);*

Line 2: *Dwellings and buildings of similar design and/or occupancy (Line 2);*

Line 3: *Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value e.g. buildings listed buildings under preservation order (Line 3).*

The DIN 4150-3:1999 guideline values are also determined by the frequency and the nature of the vibration (short-term or long-term). The short-term vibration limits of the Standard should be applied unless measurements demonstrate that the vibration is producing resonance in the structure, or it is occurring often enough to cause structural fatigue.

The applicable limits also depend on whether the vibration is measured and assessed at the foundations of the building or at the upper level. The Standard should therefore be referred to in full when being applied. A suitably qualified structural expert should be consulted if there are concerns about a building being particularly sensitive to vibration, or where the DIN 4150–3:1999 classification of the building or the nature of the vibration requires confirmation.

The DIN 4150–3:1999 frequency-dependant guideline values for short-term vibration measured at the foundations of the building are illustrated in Figure 1. Construction vibration measured in residential, commercial, and industrial buildings is typically less than 50 Hz. It occurs for a limited duration, and it does not often produce resonance in low rise structures.

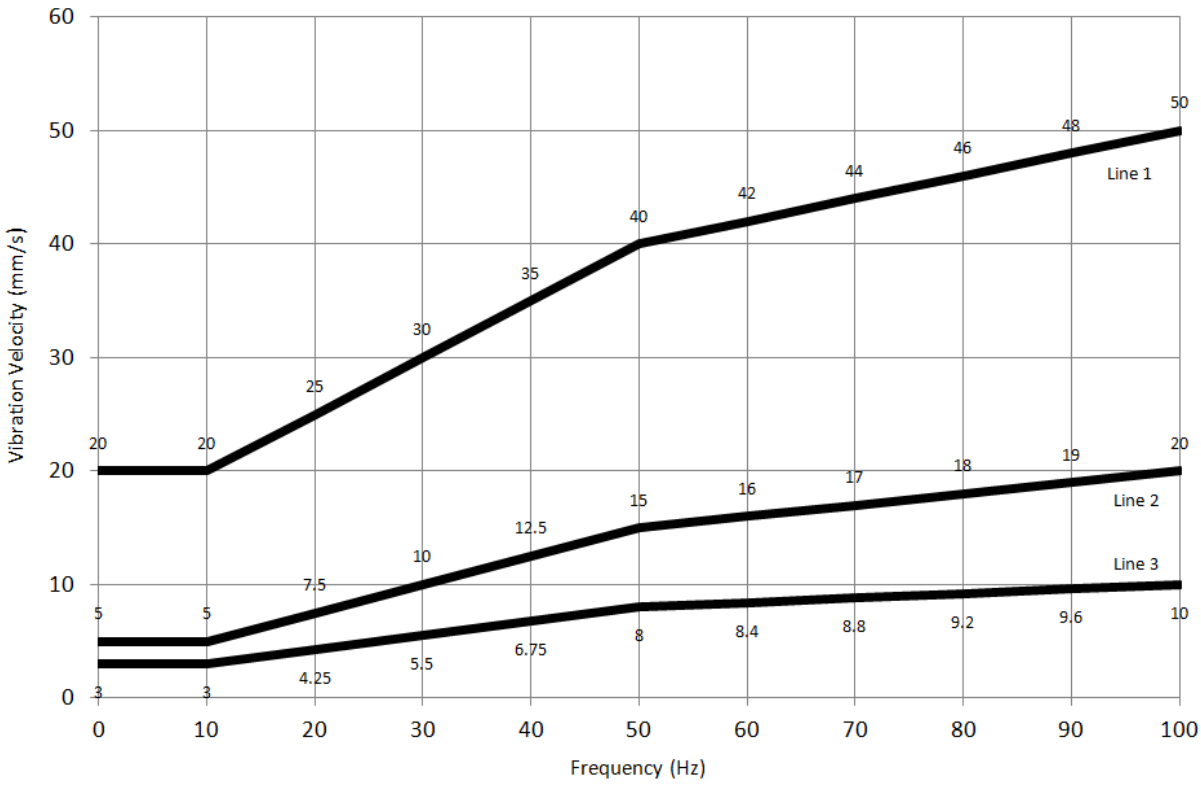


Figure 1: DIN 4150–3:1999 guideline values for short-term vibration

7.0 The neighbouring sites

The nearest neighbouring sites to the construction works are displayed in Table 4.

Table 4: Nearest receivers

Milldale Development Stage	Location and receiver details
4C-1A	SE of Stage 4C-4 (superlots 5700 and 5701). Dwellings in a residential zone. The nearest assessment point is approximately 3-5 m from where construction machinery will be used on site.
4B	SW of Stages 4C-4 & 4C-5. Dwellings in a residential zone. The nearest assessment point is approximately 18 m from where construction machinery will be used on site.
4D	NE of Stages 4C-2 & 4C-3. Dwellings in a residential zone. The nearest assessment point in Stage 4D is at least 20 m from where construction machinery will be used on site.
4F	SE of Stage 4C-2. Dwellings in a residential zone. The nearest assessment point in Stage 4D is at least 19 m from where construction machinery will be used on site.
9	NW of Stages 4C-3 & 4C-5. Commercial buildings in a business zone. The nearest assessment point in Stage 9 is at least 26 m from where construction machinery will be used on site.

The properties nearest the works will experience the highest levels of construction noise and vibration. The sites that include buildings within approximately 100 m of the works are identified in the attached Appendix C.

8.0 Community liaison

The occupants of all buildings within 100 m of works (Appendix C) will be provided the following information by letter drop at least five working days before works begin:

i. A brief overview of the works
ii. The expected start date and duration of the works
iii. The days and hours of the week when works may be undertaken
iv. The approximate timing and duration of the highest noise and vibration activities
v. The noise and vibration mitigation that will be in place
vi. The availability of noise and vibration monitoring to address any concerns
vii. Contact details for the receipt of any noise or vibration complaints or concerns.

9.0 Complaints about noise and vibration

Any complaints received by staff from the public will be directed to the manager identified in Section 2.0. Staff will not enter into debate or ague with members of the public about noise or vibration issues.

A register will be kept and maintained on site to record the details of any complaints, including:

i. The time and date of the noise and/or vibration event

ii. The nature of the noise and/or vibration and what it was caused by (if known)

iii. The name and contact number of the complainant (if given)

iv. The action taken in response to the complaint

v. Any corrective action measures implemented in accordance with Section 14.0.

The register will be kept for the duration of the construction project and made available to Auckland Council on request.

10.0 Noise emissions and separation distances

Table 5 sets out minimum separation distances from the ground-level facade of the nearest occupied building for compliance with the project noise limits.

If works are required closer to an occupied building than the separation distances stated in Table 5, further noise mitigation measures will be required, such as localised screening (see Section 0).

Table 5: Noise sources and calculated separation distances

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
Vibratory compaction with 15-t to 20-t roller	76 dB*	27 m	9 m
Drilling for retaining walls with a 12-t rig	75 dB	24 m	8 m
Compaction with plate compactor	71 dB*	15 m	5 m
Cut and fill, clearing, and loading trucks with a 20-t excavator	69 dB	12 m	4 m

Construction activity	Unmitigated $L_{Aeq(15\ min)}$ noise level at 10 m	Unmitigated compliance distance	Mitigated compliance distance (with noise barrier)
Compaction with Cat 815 static compactor 18-t	69 dB*	12 m	4 m
Concrete pump and truck discharging	69 dB	12 m	4 m
Compaction with a single drum static roller	65 dB*	8 m	3 m
Use of handheld power tools	65 dB	8 m	3 m
Grading	62 dB*	6 m	2 m
Idling delivery truck, dump truck, moxy, tractor	62 dB	6 m	2 m

* Reference noise level is for a moving noise source.

11.0 Noise mitigation measures

The noise mitigation measures in this section will be implemented wherever practicable.

11.1 General noise mitigation measures

- The minimum separation distances set out in Section 10.0 will be observed at all times.
- The quietest plant, machinery, and methods available will be used wherever practicable. This includes using plant that is no larger than necessary to complete the works.
- All construction equipment will be maintained throughout the project to ensure it is not generating unnecessary noise e.g., all tracked plant will be greased to reduce squeaking.
- When machinery or plant is not required to be running, it should be switched off and not left idling.
- All plant on site will utilise broadband reverse alarms in place of traditional pure tone ‘beepers’ where practicable.
- The tail gates of trucks will not be slammed shut or allowed to fall.
- Material will not be dropped from height into empty trucks. Softer materials will be loaded into trucks first, where possible.

- Tools and equipment will not be dropped on hard ground. Materials will not be dragged along the ground.
- Vehicle horns will not be used unless in the case of an emergency.
- Any radios or music played on site will be used quietly so they are inaudible at the nearest dwellings.
- Stationary equipment such as pumps and generators will be located as far from occupied dwellings as practicable.
- There will be no shouting or swearing on site. Communication over distance will be by radio or phone.
- Equipment generating excess or unnecessary noise will be stopped (when safe) and reported to the Site Manager.
- Daily pre-start meetings held by the Site Supervisor will include discussions about any noise and vibration issues, and any complaints received.
- All workers on site will be made aware of the potential impacts of noise on neighbours.

11.2 Acoustic barriers

- All acoustic barriers will be at least 2.0 m high, have a surface mass of no less than 10 kg/m^2 and be solid with no gaps between panels or between the barriers and the ground. Proprietary construction noise barriers (such as Echo Barrier[1], Soundbuffer[2] or Hushtec[3]) with a lower surface mass may be used only if they equal or exceed the overall noise reduction properties of the barriers otherwise specified in this section. All acoustic barriers must block line of sight between the noise source and the receiver and be positioned as close as practicable to the noise source.
- Acoustic barriers will be used where any construction plant must be operated within the unmitigated compliance distances (Table 5).
- Acoustic barriers will be located as close as practicable to the noise sources to improve its effectiveness.
- Quiet machinery and structures will be positioned to provide as much screening as possible to noisy equipment on the site.
- Where localised acoustic barriers are used, they will block the line-of-sight from the noisiest part of the activity to the receiver by as much as possible (including windows at upper-level facades). The barrier will extend past the noise source

[1] https://supplyforce.co.nz/echo-barrier

[2] http://soundbuffer.co.nz

[3] https://duraflex.co.nz/hushtec

by a distance of 1.5 times the height of the machinery being operated and partially surround the noise source if possible. If proprietary flexible screens are used, they must have a surface mass of at least 6 kg/m^2 and have no gaps between the sheets.

12.0 Vibration mitigation measures

The operation of tracked excavators, vibratory compaction rollers, other heavy plant, and trucks on site has the potential to generate vibration within the nearest dwellings.

The vibration received within the nearest dwellings will depend largely on the equipment used, the separation distance, the ground conditions, how the plant is operated, and the response of the receiving structure.

The following measures will be observed when working within 50 m of any occupied dwelling, to ensure that vibration complies with the project conditions and does not cause unreasonable disturbance:

- Workers will be informed of the need to reduce vibration effects at the nearest dwellings and the mitigation measures available to achieve this.
- Excavators and heavy vehicles will be driven slowly (fast movement across an uneven site can generate high vibration levels).
- The lightest plant practicable and available will be used for the works.
- Wheeled plant will be selected over tracked plant where practicable.
- Excavator operators will avoid banging buckets on the ground.
- Any vibratory compaction works necessary will be undertaken making passes parallel to the site boundary. The operator will not change direction or stop in the nearest part of the site to an occupied dwelling.

Equipment generating excessive or unnecessary vibration will be stopped (where safe) and reported to the Site Manager.

13.0 Noise and vibration monitoring and reporting

This section sets out requirements for construction noise and vibration monitoring during the project.

Noise and vibration measurements will be performed:

i. At the beginning of any activity within the mitigated (with barrier) setback distances specified in Table 5 to monitor compliance with the project noise limits.

ii. If the noise or vibration from any activity on the site appears excessive in the opinion of the Site Manager or Auckland Council.

iii. Following the receipt of any reasonable construction noise or vibration complaint.

All monitoring will be undertaken by a suitably qualified and experienced person (e.g., MASNZ) or any person trained by the project construction noise and vibration consultant. A noise monitoring form is attached as Appendix D.

All noise monitoring will be undertaken using a sound level meter conforming to at least IEC651 Type 2 criteria, and in accordance with NZS 6803:1999 *Acoustics - Construction Noise*.

All vibration monitoring will be undertaken in accordance with DIN 4150-3:1999 *Structural Vibration – Part 3 Effects of Vibration on Structures*.

The results of any site and plant specific noise and vibration monitoring will be used to update this CNVMP to ensure that minimum compliance distances and mitigation measures are specifically tailored to the project.

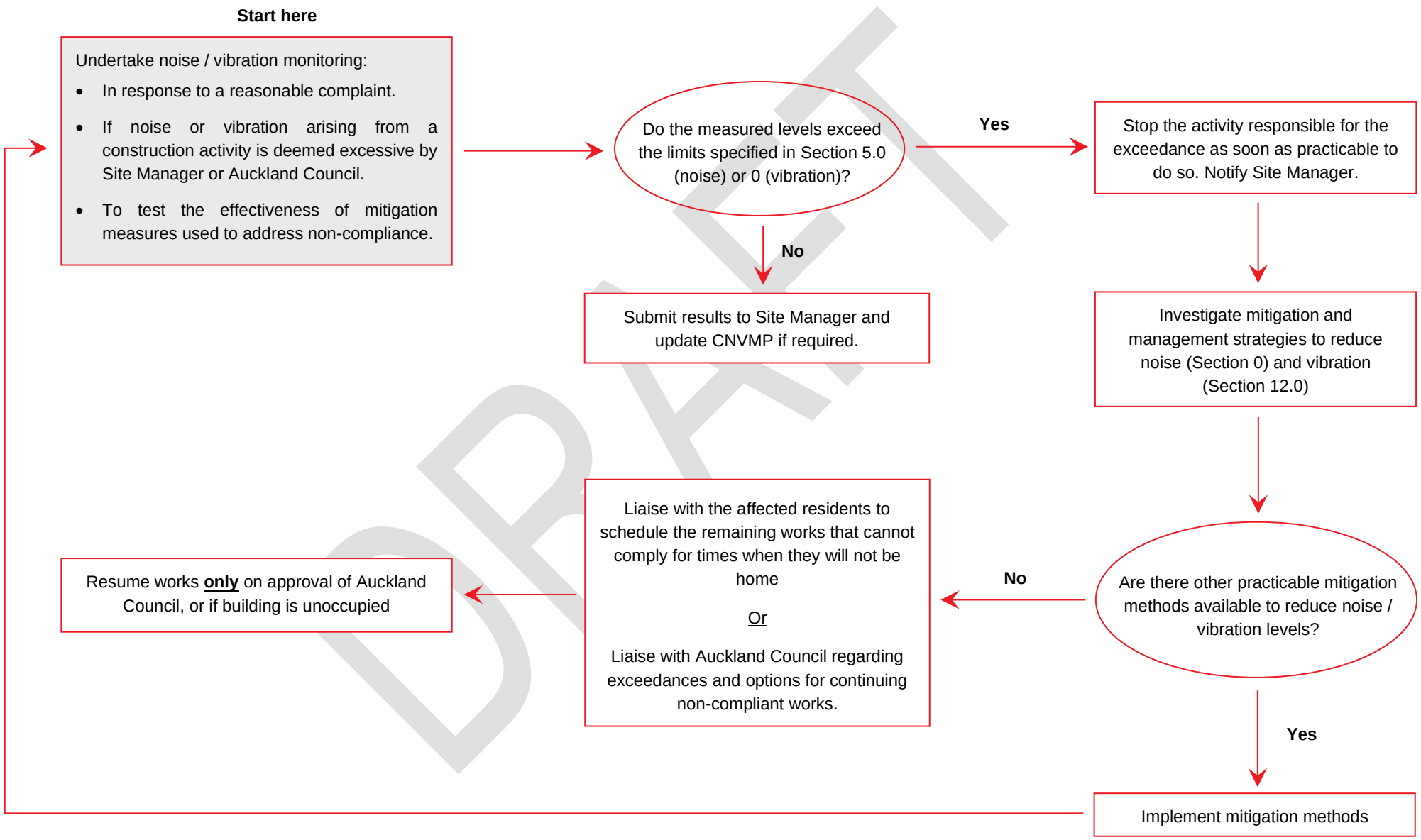
The results of all noise and vibration monitoring will be retained for the duration of the project and made available to Auckland Council on request.

Any non-compliance with the noise limits identified through monitoring will be addressed by following the corrective action measures in Section 14.0 of this CNVMP.

14.0 Corrective action measures

The corrective action measures illustrated overleaf in Figure 2 will be followed if non-compliance with the project noise or vibration limits is identified through monitoring.

Figure 2: Process for corrective action measures



15.0 Amendments to CNVMP

The CNVMP may be updated throughout the works where necessary to adapt to changing work methodologies or a changing receiving environment.

Any material updates to the certified CNVMP will be clearly marked using underlining for additional text and strikethrough for any deletions. The amended CNVMP will be provided to Auckland Council for certification before being actioned.

All activities will be undertaken in accordance with the latest version of the certified CNVMP.

16.0 General requirements

A copy of this CNVMP will be kept at the work site for the duration of the project.

This CNVMP may be updated throughout the works with the approval of the Project Manager and in consultation with Auckland Council.

All personnel will be informed about the need to reduce noise and vibration to a minimum and the effects of excessive noise on the neighbouring sites. As part of their training, special attention will be given to:

i. Proper selection, use and maintenance of tools and plant.

ii. Positioning of machinery on site.

iii. Avoidance of unnecessary noise.

iv. Procedures for receiving noise and vibration complaints.

Appendix A Glossary of terms

Noise	A sound which serves little or no purpose for the exposed persons and is commonly described as 'unwanted sound'. The Resource Management Act definition of noise is "includes vibration".
dB (decibel)	The basic measurement unit of sound. The logarithmic unit used to describe the ratio between the measured sound pressure level and a reference level of 20 micropascals (0 dB).
A-weighting	A frequency filter applied to the full audio range (20 Hz to 20 kHz) to approximate the response of the human ear at lower sound pressure levels.
$L_{Aeq(t)}$ (dB)	The A-weighted equivalent sound pressure level with the same energy content as the measured varying acoustic signal over a sample period (t). The preferred metric for sound levels that vary over time because it takes into account the total sound energy over the time period of interest.
L_{AFmax} (dB)	The maximum A-weighted sound pressure level recorded during the measurement period using a fast time-weighting response.
NZS 6803:1999	N.Z. Standard NZS 6803:1999 *Acoustics – Construction noise*.
DIN 4150–3:1999	German Standard DIN 4150-3:1999 *Structural Vibration – Part 3: Effects of vibration on structures*. Typically adopted for the assessment of structure borne vibration in New Zealand.
PPV	Peak particle velocity, measured in mm/s. The standard metric for the measurement of ground borne vibration in New Zealand. The instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position.
CNVMP	Construction noise and vibration management plan. A document to help the contractor manage noise and vibration emissions during construction works.

Appendix B Resource consent conditions

To be completed

Appendix C The construction site

To be completed

Appendix D Noise monitoring form

Name: Date:

Notes for noise monitoring

All sections of this form must be completed when undertaking construction noise measurements for the project. Please provide a sketch of the area, sound sources and measurement position on the rear of this form.

Measurements are to be undertaken at 1 m from the façade of the receiving building most exposed to the sound under investigation, and 1.2 m to 1.5 m above the relevant floor level. No adjustment to the measured level is to be made for reflected sound from the façade. Valid measurements cannot be undertaken in persistent rain or in wind speeds greater than 5 m/s.

Adjustments to the measured level may be required to correct for distance and façade reflections if measurements must be undertaken at a proxy location.

Sound source and instrumentation

Location of works	
Description of construction activity being monitored	
Measurement instrumentation (type and serial number)	
Date of most recent laboratory calibration	
Field calibration check (time and adjustment)	

Meteorological conditions

Cloud cover (octas)	
Rain	
Wind speed and direction	

Methodology

Location/orientation of microphone	
Height of microphone above ground and distance to facade of receiving building	
Distance between microphone and sound source	
Ground conditions between sound source and microphone	
Any barriers or objects between sound source and microphone	
Distance to any reflective surfaces other than receiving facade	
Extraneous noise sources	

Measurement results

Sample start time	Duration of sample	L_{Aeq} (dB)	L_{AFmax} (dB)	Sound source controlling the measured levels	Adjustments required for distance, facade correction or barriers

Do the measurements show full compliance with the project noise limits?

Yes: *The measurement results can be used to update the site-specific noise levels and construction separation distances within the CNVMP.*

No: *The CNVMP must be referred to for the appropriate corrective action measures and further noise mitigation options.*