



CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

NZ Transport Agency Waka Kotahi
Mill Road Stage 1

AUGUST 2026

Contents

1	INTRODUCTION	1
1.1	Scope of the CNVMP	1
1.2	Contact details	2
2	PROJECT DETAILS	2
2.1	Overview of works	2
2.2	Construction methodology	2
2.3	Timeframe	3
3	PROJECT CRITERIA	4
3.1	Construction noise criteria	4
3.2	Construction vibration criteria	5
3.3	Site specific noise and vibration management schedule (Schedule)	6
4	SENSITIVE RECEIVERS	7
5	NOISE	7
5.1	Predicted noise levels	7
5.2	Noise effects	8
5.2.1	Daytime noise effects	8
5.2.2	Night-time noise effects	9
6	VIBRATION	10
6.1	Predicted vibration levels	10
6.2	Vibration effects	11
7	GENERAL MITIGATION AND MANAGEMENT	12
7.1	Training	12
7.2	Equipment selection	12
7.3	Timing	12
7.4	General measures	12
7.5	Noise barriers	13
7.6	Excavators	14
7.7	Concrete cutting	14
7.8	Concrete breaking	14
7.9	Piling	15
7.10	Compaction	15
7.11	Schedules to the CNVMP	15
8	SPECIFIC MITIGATION AND MANAGEMENT	16
8.1	Retaining wall construction	16
8.1.1	Retaining walls in urban section	16
8.1.2	Retaining walls at Murphys Road intersection	17
8.1.3	Retaining wall south of Mill Road	18
8.2	Bridge construction	18
8.2.1	Puhinui Gully bridge	19
8.2.2	Cheeseman's Bush bridge	19

8.2.3	Mill Road Crossover bridge	19
8.3	Stormwater pipe construction.....	19
9	ENGAGEMENT	20
9.1	Communication	20
9.1.1	Before construction	20
9.1.2	During construction	20
9.2	Consultation	20
9.3	Complaints response	21
10	MONITORING	22
10.1	Overview	22
10.2	Noise.....	22
10.3	Vibration	23
10.4	Building condition surveys	24
11	AUDITING OF CNVMP AND SCHEDULES.....	24
12	CNVMP REVIEW REQUIREMENTS	25
APPENDIX A	GLOSSARY OF TERMINOLOGY	26
APPENDIX B	SENSITIVE RECEIVERS WHERE NOISE CRITERIA MAY BE INFRINGED.....	27
APPENDIX C	INDICATIVE NOISE LEVEL PREDICTIONS	32
APPENDIX D	PILING NOISE MAPS (INDICATIVE).....	38
APPENDIX E	INDICATIVE VIBRATION ENVELOPES	40
APPENDIX F	BUILDING CONDITION SURVEYS	46

Copyright information

Copyright ©. This copyright work is licensed under the Creative Commons Attribution 4.0 International licence. In essence, you are free to copy, distribute and adapt the work, as long as you attribute the work to the NZ Transport Agency Waka Kotahi (NZTA) and abide by the other licence terms. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

Disclaimer

NZTA has endeavoured to ensure material in this document is technically accurate and reflects legal requirements. However, the document does not override governing legislation. NZTA does not accept liability for any consequences arising from the use of this document. If the user of this document is unsure whether the material is correct, they should refer directly to the relevant legislation and contact NZTA.

QUALITY REVIEW AND APPROVAL RECORD

Item	Name	Date
Prepared by:	Raditya Putra, Marshall Day Acoustics	August 2026
Reviewed by:	Siiri Wilkening, Marshall Day Acoustics	August 2026
Approved for lodgement by:	Nicola Bishop, NZTA	August 2026

1 INTRODUCTION

This Construction Noise and Vibration Management Plan (**CNVMP**) is required for the construction phase of the Mill Road Stage 1 Project (**the Project**). The objective of the CNVMP is to develop and implement the Best Practicable Option (**BPO**) for the management of construction noise and vibration effects.

This CNVMP will be implemented throughout the construction period and applies to the extent of the Project shown in Figure 1¹. It is the primary tool for managing the Project's construction noise and vibration effects.

A glossary of terminology is included in **Appendix A**.

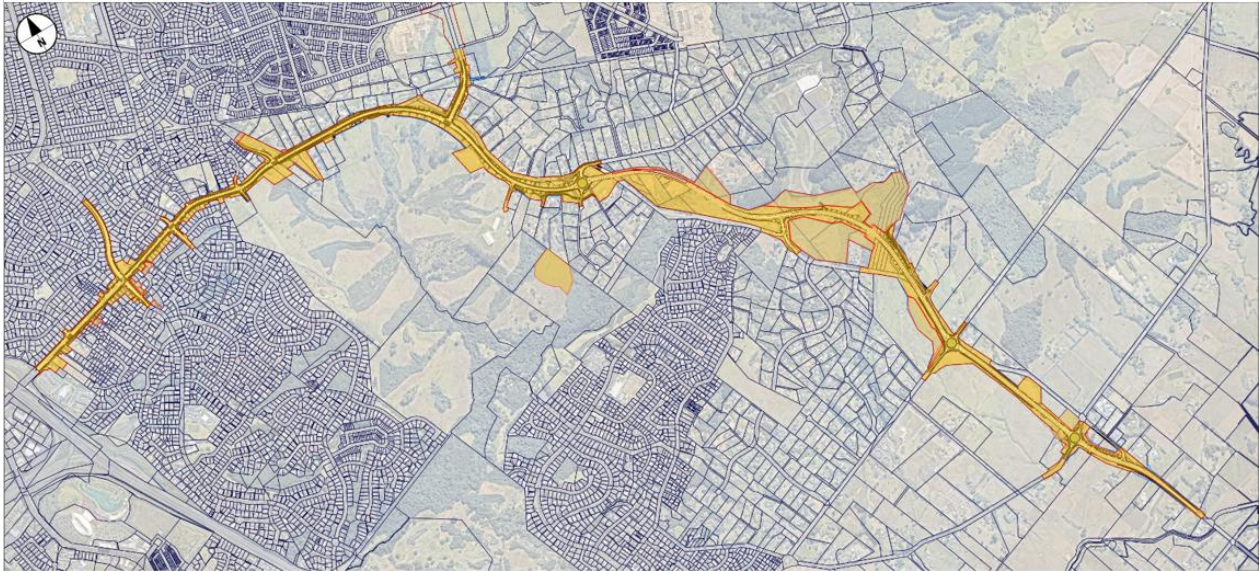


Figure 1: Extent of Mill Road Stage 1

1.1 Scope of the CNVMP

The scope of this CNVMP is to describe the development and implementation of measures for the management and minimisation of noise and vibration effects, including to achieve compliance with the relevant noise and vibration limits. This CNVMP is, therefore, specific to the construction of the Project which involves large scale earthworks, bridge and pavement construction, construction traffic and plant movements/ operations and other activities which will generate noise and vibration within the works area.

This CNVMP sets out the BPO for construction noise and vibration management that will be implemented to avoid, remedy or mitigate adverse construction noise and vibration effects. It also outlines community engagement to be undertaken with surrounding affected residents in relation to the construction noise and vibration aspects of the Project.

¹ This CNVMP does not apply to the section of Murphys Road that will be constructed by Auckland Transport in future (beyond the tie-in shown in Figure 1).

1.2 Contact details

Contact details for the relevant personnel are listed in Table 1. The Project Manager is responsible for implementing this CNVMP.

Table 1: Contacts

Role	Name	Organisation	Phone	Email
Project Manager	TBC	TBC	TBC	TBC
Engagement	TBC	TBC	TBC	TBC
Acoustic Specialist	TBC	TBC	TBC	TBC

2 PROJECT DETAILS

2.1 Overview of works

The works for the Project involve the construction of a four lane, divided carriageway from Manukau through to Phillips Road intersection with Mill Road.

Site maps showing the works corridor and sensitive receivers are attached in **Appendices C** and **D**.

The works are expected to take place over a 7-year period. This means that the long-duration construction noise limits apply (Section 3.1).

Construction hours will generally be 0730 – 1800 hrs, Monday to Saturday but longer hours and night-time works may be required at some times in order to effectively complete work tasks and minimise traffic disruption (e.g. works which would require motorway closure).

2.2 Construction methodology

The key construction activities for this Project are summarised in Table 2.

Table 2: Construction methodology overview

Activity	Methodology
Urban road widening	• Vegetation clearance • Demolition of houses • Removal of above ground features such as fences, sheds, paths, washing lines, etc. • Removal of services back to mains road • Establish laydown areas • Lower driveways and construct retaining walls • Cut material at front of retaining walls • Construct new pavement for widened area • Road milling • Construct new paths • Construct raised medians • Landscaping

Activity	Methodology
Murphys Road Intersection	• Vegetation clearance • Construction of two large retaining walls using bored concrete piles • Construct access tracks to pile locations • Excavate down to capping beam level or construction platform level • Create platforms for piling rigs and cranes including laydown areas • Bore piles to required level, install cages, pour pile to top level • Construct capping beam by pouring site concrete • Excavate between retaining walls • Installation of props
General Bridge Construction	• Establish site facility • Vegetation clearance • Form required crane pads • Commence piling activity • Fix reo, form and cast columns • Construct ground improvement as required • Install cross head formwork • Install bearings • Land beam units • Fix topping slab reinforcement • Form topping slab for final casting
Peri-urban and Rural Road Widening	• Vegetation clearance • Demolition of houses • Removal of above ground features such as fences, sheds, paths, washing lines, etc. • Removal of services back to mains road • Establish laydown areas • Lower driveways and construct retaining walls • Cut material at front of retaining walls • Construct new pavement for widened area • Road milling • Construct new paths • Construct raised medians • Landscaping

2.3 Timeframe

Construction of the Project is expected to commence once all statutory approvals are in place and funding has been secured. Construction is anticipated to occur over an approximately 7-year period..

The Project will be procured as several construction packages.

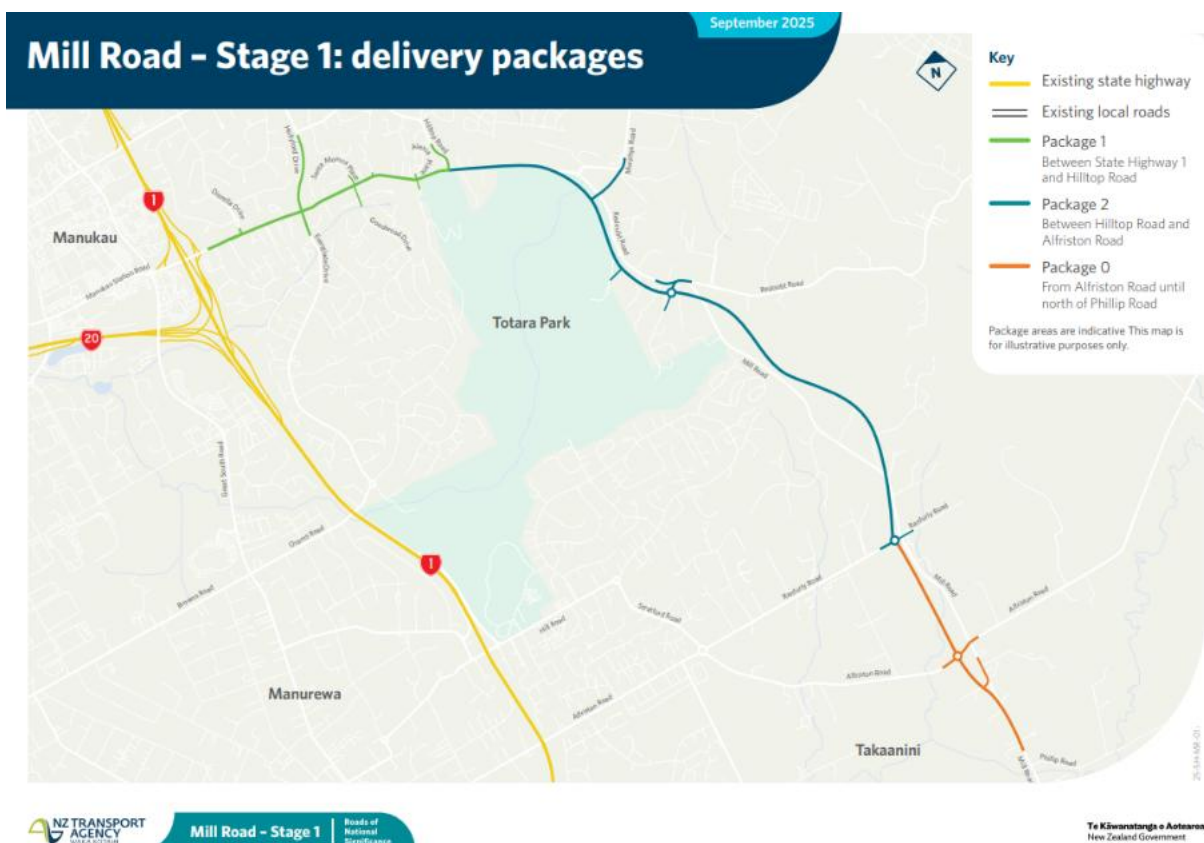


Figure 2: Mill Road Stage 1 construction packages

3 PROJECT CRITERIA

The Project will be constructed within the three existing designations that were secured by Auckland Transport (**AT**) in 2016 and altered by the alteration to the designation that forms part of the substantive application under the fast-track process. This section sets out the Project Criteria.

3.1 Construction noise criteria

Construction noise must be measured and assessed according to New Zealand Standard NZS 6803:1999 “*Acoustics – Construction Noise*”. The noise criteria apply at 1m outside the façades of buildings, and only while the buildings are occupied.

The relevant construction noise criteria are summarised in Table 3, and shall be complied with as far as practicable.

Table 3: Project construction noise criteria

Time of week	Time period	Noise limit dB	
		L _{Aeq}	L _{Amax}
Occupied activity sensitive to noise ²			
Weekdays	6:30 am – 7:30 am	55	75
	7:30 am – 6:00 pm	70	85
	6:00 pm – 8:00 pm	65	80
	8:00 pm – 6:30 am	45	75
Saturdays	6:30 am – 7:30 am	55	75
	7:30 am – 6:00 pm	70	85
	6:00 pm – 8:00 pm	45	75
	8:00 pm – 6:30 am	45	75
Sundays and Public Holidays	6:30 am – 7:30 am	45	75
	7:30 am – 6:00 pm	55	85
	6:00 pm – 8:00 pm	45	75
	8:00 pm – 6:30 am	45	75
Other occupied buildings			
All days	7:30 am - 6:00 pm	70	NA
	6:00 pm – 7:30am	75	NA

3.2 Construction vibration criteria

Construction vibration shall be measured in accordance with ISO 4866:2010 '*Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures*' and shall comply with the vibration standards set out in the following table as far as practicable.

² Activities sensitive to noise are defined as '*Any dwelling, visitor accommodations, boarding house, marae, Papakainga, 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*'.

Table 4: Project construction vibration criteria

Receiver	Details	Category A	Category B
Occupied Activities sensitive to noise	Night-time 2000h - 0630h	0.3mm/s ppv	1mm/s ppv
	Daytime 0630h - 2000h	1mm/s ppv	5mm/s ppv
Other occupied buildings	Daytime 0630h - 2000h	2mm/s ppv	5mm/s ppv
All other buildings	At all other times Vibration transient	5mm/s ppv	BS 5228-2* Table B2
	At all other times Vibration continuous	5mm/s ppv	BS 5228-2* 50% of Table B2 values

*BS 5228-2:2009 'Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration'

3.3 Site specific noise and vibration management schedule (Schedule)

Where the noise and vibration standards above cannot practicably be achieved, a Schedule must be prepared which details the mitigation and management methods specific to the potential infringement.

The Project Environmental Manager (or suitably qualified person) shall proactively predict noise and vibration levels of upcoming activities and determine if a Schedule is needed. This should be done by area and activity, enabling 3 to 4 weeks for review and allowing for engagement with residents, design of mitigation measures and the provision of the Schedules to Council for information.

Any Schedules must be implemented through the construction process they apply to and updated where necessary. The objective of a Schedule is to set out BPO for the management and mitigation of noise and/or vibration effects of the construction activity beyond measures set out in the CNVMP. Each Schedule shall form part of the CNVMP.

Any Schedule shall include the following details:

- Construction activity location, start and finish times;
- The nearest neighbours to the construction activity;
- The predicted noise and/or vibration level for all receivers where the levels are predicted or measured to exceed the criteria of Table 3 and Category A of Table 4 and the predicted duration of the exceedance;
- The proposed mitigation options that have been selected, and the options that have been discounted as being impracticable and the reasons why; and
- A summary of the consultation undertaken with owners and occupiers of sites subject to the Schedule, and how consultation has and has not been taken into account
- Location, times and types of monitoring

Each Schedule shall be provided to the Manager for information at least five working days (except in unforeseen circumstances) in advance of works that are covered by the scope of the Schedule. If any comments are received from the Manager, these shall be considered prior to commencement of works to which the Schedule applies.

4 SENSITIVE RECEIVERS

The following sensitive receivers have been identified where construction noise and/or vibration levels may be exceeded and where a Schedule may need to be prepared. There are 170 properties where construction noise and/or vibration levels may be exceeded.

A table of these receivers is included in **Appendix B**, and they are shown on the figures in **Appendices C and D**.

5 NOISE

5.1 Predicted noise levels

Table 5 predicts levels for high-noise construction activities. It identifies the equipment that requires mitigation and/or management and the source-receiver distances where the risk begins. It will be kept up to date by the Acoustic Specialist or a suitably trained project member (e.g. the Environmental Manager) when new information becomes available, e.g. through noise monitoring (Section 10.2).

Predicted worst case noise levels at the affected receivers are shown in **Appendix C**. In addition, we have provided indicative noise level contours for piling noise in **Appendix D**.

Table 5: Indicative noise levels at 1m from a building façade without mitigation³

Equipment	Sound Power Level (dB L _{Aeq})	Noise Level (dB L _{Aeq})			Setback (m)
		10 m	20 m	50 m	70 dB L _{Aeq}
Excavator mounted concrete breaker	121	96	90	81	132
Sheet piling	116	91	85	76	83
Concrete saw	115	90	84	75	76
Chainsaw	114	89	83	74	69
Bored or screw piling (large rig)	111	86	80	71	52
Concrete breaker (1-5T)	111	86	80	71	52
Dozer	109	84	78	69	44
Truck (driving)*	108	78	72	63	25
Plate compactor	108	83	77	68	40
Excavator (20t)	103	78	72	63	25
Bored or screw piling (small excavator mounted rig)	103	78	72	63	25
Concrete truck and pump discharging	103	78	72	63	25
Vibratory roller	103	78	72	63	25
Paving machine	103	78	72	63	25
Mobile crane (35T) operating	98	73	67	58	14
Bitumen emulsion application	94	69	63	54	9
Generator (150kVA)	93	68	62	53	8
Truck (idling)	91	66	60	51	6

* Takes account of time component of passing noise source

³ In accordance with the requirements of NZS 6803:1999, inclusive of 3 decibels façade reflection

5.2 Noise effects

A CNVMP is not an effects assessment. However, the following commentary can be used to provide context to the contractor to aid with engagement.

The noise level received inside a sensitive space (e.g. bedroom, office, living room) 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 (older style lightweight house) 20 decibels
- Closed windows (modern lightweight house) 25 decibels
- Closed windows (modern masonry apartment or commercial building) 30 decibels

Table 6 provides guidance on daytime noise effects inside different types of buildings based on the external noise level and typical the glazing types.

Table 6: Daytime noise levels in commercial & industrial buildings and habitable rooms in dwellings

External Noise Level (dB L _{Aeq})	Estimated Internal Noise Level (dB L _{Aeq})			
	Sealed glazing (office building)	Closed windows (modern building)	Closed windows (older building)	Open windows (all buildings)
90 – 95	60 – 65	65 – 70	70 – 75	75 – 80
85 – 90	55 – 60	60 – 65	65 – 70	70 – 75
80 – 85	50 – 55	55 – 60	60 – 65	65 – 70
75 – 80	45 – 50	50 – 55	55 – 60	60 – 65
70 – 75	40 – 45	45 – 50	50 – 55	55 – 60

5.2.1 Daytime noise effects

How people may experience noise inside or outside a building is described in Table 7. This table was developed in expert conferencing⁴ in conjunction with other acoustic specialists. That table does not take account of non-sensitive activities such as factories, storage spaces and similar uses.

⁴ Northern Corridor Improvements project, together with Mr Jon Styles and Mr Rhys Hegley

Table 7: Potential daytime noise effects for varying noise levels

External façade noise level (dB L_{Aeq})	Potential daytime effects outdoors	Corresponding internal noise level (dB L_{Aeq})	Potential daytime effects indoors
Up to 65	Conversation becomes strained, particularly over longer distances.	Up to 45	Noise levels would be noticeable but unlikely to interfere with residential or office daily activities.
65 to 70	People would not want to spend any length of time outside, except when unavoidable through workplace requirements.	45 to 50	Concentration would start to be affected. TV and telephone conversations would begin to be affected.
70 to 75	Businesses that involve substantial outdoor use (for example garden centres such as Bunnings) would experience considerable disruption.	50 to 55	Face to face and phone conversations and TV watching would continue to be affected. Office work can generally continue.
75 to 80	Some people may choose hearing protection for long periods of exposure. Conversation would be very difficult, even with raised voices.	55 to 60	Phone conversations would become difficult, and face to face conversations would need slightly raised voices. For residential activities TV and radio sound levels may need to be raised. Continuing office work may become difficult.
80 to 90	Hearing protection would be required for prolonged exposure (8 hours at 85 dB) to prevent hearing loss.	60 to 70	Face to face conversations would require raised voices. In a residential context, people may actively seek respite if these levels are sustained for more than a period of a few hours. Concentration would start to be affected; continuing office work would be difficult and may become unproductive.

5.2.2 Night-time noise effects

The noise level received inside a noise sensitive space (e.g. bedroom) will depend on the external noise level, sound insulation performance of the façade (particularly the glazing) and room constants (such as the room dimensions and surface finishes). These factors can vary widely.

Table 8 provides guidance on the potential night-time effects inside sensitive spaces, depending on the external noise level and façade glazing type.

Table 8: Night-time noise levels in bedrooms of dwellings

External noise level (dB L _{Aeq})	Estimated internal noise level (dB L _{Aeq})			
	Sealed glazing	Openable windows (modern building)	Openable windows (older style building)	Open windows
70 – 75	40 – 45	45 – 50	50 – 55	55 – 60
65 – 70	35 – 40	40 – 45	45 – 50	50 – 55
60 – 65	30 – 35	35 – 40	40 – 45	45 – 50
55 – 60	25 – 30	30 – 35	35 – 40	40 – 45
50 – 55	20 – 25	25 – 30	30 – 35	35 – 40
45 – 50	15 – 20	20 – 25	25 – 30	30 – 35

The potential effects are colour coded as follows:

- Typically acceptable
- Sleep disturbance for some occupants
- Sleep disturbance for most occupants

The above table shows that consultation and management may be required if night-time works are proposed in the vicinity of dwellings, where internal noise levels would affect sleep.

6 VIBRATION

6.1 Predicted vibration levels

Table 9 predicts levels for high-vibration construction activities. It identifies the equipment that requires mitigation and/or management, and the source-receiver distances where the risk begins.

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) to inform the need for pre-construction building condition surveys (Section 10.4).

Table 9 will be kept up to date by the Acoustic Specialist or a suitably trained staff member (e.g. the Environmental Manager) when new information becomes available and through vibration monitoring (Section 10.3).

Table 9: Indicative distances to comply with vibration limits at building foundations

Equipment	Vibration Setback Distance ⁵				
	0.3 mm/s PPV	1 mm/s PPV	2 mm/s PPV	5 mm/s PPV	10 mm/s PPV
Vibratory Roller	143	38	18	14	6
Bored piling	11	3	1	1	<1
Plate compactor	34	12	7	6	3

Figures showing the indicative vibration envelope are included in **Appendix E**.

⁵ Cross reference with Table 4 for the Category A and B vibration limits

6.2 Vibration effects

The following commentary can be used to provide context to the contractor to aid with engagement.

The main vibration concern of building owners and occupants is usually building damage, but they will feel vibration at levels much lower than those that would cause damage. Identified receivers will be informed about the vibration levels they may experience and be assured that vibration damage can only occur at levels well above the threshold of perception (Section 9.1).

British Standard BS 5228-2:2009 “*Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*” provides guidance on the amenity effects of vibration. The descriptions are reproduced in Table 10, and are supplemented with our own descriptions for 2mm/s and 5mm/s (to bridge the gap between 1 and 10 mm/s in the Standard):

Table 10: Potential noise effects for varying vibration levels

Vibration level (mm/s PPV)	Potential effects indoors
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments
1	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents. What people feel would be subject to the source/activity (i.e., continuous motion or a one-off event) and associated frequency (i.e., fast or slow vibration) but could include a steady vibration from sources such as vibratory compaction, or a small jolt such as from the movement of a large digger. Vibration at this level could rattle crockery and glassware. Sleep disturbance would be almost certain for most people.
2	Vibration would clearly be felt in all situations. Can be tolerated in indoor environments such as offices, houses, and retail, where it occurs intermittently during the day and where there is effective prior engagement.
5	Unlikely to be tolerable in a workplace or residential environment without prior warning and explanation. If exposure was prolonged, some people could want to leave the building affected. Computer screens would shake, and light items could fall off shelves.
10	Likely to be intolerable for anything more than a very brief exposure.

A vibration amenity limit of 0.3mm/s PPV applies in dwellings at night. This level of vibration is extremely low and within the margins of any reliable prediction method. It is essentially a ‘no effects’ threshold to avoid sleep disturbance and practically requires that no high-vibration activities occur at night.

7 GENERAL MITIGATION AND MANAGEMENT

7.1 Training

All staff will participate in an induction training session before starting work on the construction, with attention given to the following matters:

- Activities with the potential to generate high levels noise and/or vibration.
- Mitigation and management measures (Section 7).
- Sensitive receivers and any agreements made through engagement (Section 4 and Section 9).
- Monitoring requirements (Section 10).

As the construction progresses, any updates of noise and vibration matters will be addressed during regular site meetings and/or 'toolbox' training sessions.

7.2 Equipment selection

When selecting construction equipment:

- Use quieter construction methodologies where practicable (e.g. bored piling instead of drop hammer piling).
- Use electric motors rather than diesel engines where practicable.
- Use rubber tracked equipment rather than steel tracked equipment where practicable.
- Use equipment that is suitably sized for the task.
- Maintain equipment well to minimise rattles, squeaks etc.
- Fit engines with exhaust silencers and engine covers where practicable.
- Avoid tonal reversing or warning alarms (beepers). Alternatives include broadband alarms (squawkers/quackers), flashing lights, proximity sensors, reversing cameras and spotters.

7.3 Timing

Avoid night works unless it can be demonstrated to be the BPO.

Timing is an important management tool, particularly where a receiver expresses concern about construction works at a certain time of day. Where necessary, high noise and vibration works will be programmed to minimise disturbance.

Timing activities to be undertaken when nearby sensitive receiver buildings are unoccupied is the most effective measure as it avoids the effect. For example, piling works could be undertaken during the daytime when occupants of a dwelling are at work/school.

Timing should be considered as the first measure for all activities which are predicted to exceed the relevant noise and vibration limits. If timing is not practicable, then other measures such as noise barriers, revising methodology and temporary relocation should be considered.

7.4 General measures

Complaints can arise even if the noise and vibration levels comply with the Project limits. To minimise complaints, the following common mitigation measures are recommended:

- Avoid unnecessary noise. This means managing the site to ensure:
 - No shouting.
 - No unnecessary use of horns.
 - No loud site radios.

- No rough handling of material and equipment.
- No banging or shaking excavator buckets.
- No unnecessary steel on steel contact (e.g. during the loading of scaffolding on trucks).
- No high engine revs. This includes choosing the right sized equipment and turning engines off when idle.
- Avoid unnecessary vibration. This means managing the site to ensure:
 - No unnecessary dropping of heavy objects.
 - No potholes, bumps or corrugations in site accessways.
 - Excavator operators are skilled and use their machine considerately.
- Mitigate track squeal from tracked equipment, such as excavators. This may include tensioning and watering or lubricating the tracks regularly.
- Locate stationary equipment (e.g. generators) away from noise sensitive receivers and/or screen them behind site buildings and material stores.
- Orient mobile machinery to maximise the distance between the engine exhaust and the nearest sensitive building façade (e.g. excavators).
- Utilise noise barriers where appropriate (Section 7.5).
- Utilise specific measures for the following activities:
 - Excavators (Section 7.6).
 - Concrete cutting (Section 7.7).
 - Concrete breaking (Section 7.8).
 - Piling (Section 7.9).
 - Compaction (Section 7.10).
- Engagement is complete (Section 9) prior to commencing high-noise and vibration activities.
- Undertake monitoring (Section 10).

7.5 Noise barriers

Temporary noise barriers will be used where an activity is predicted to exceed the construction noise limits (Section 5.1), unless they are ineffective (e.g. where a receiver is elevated and would look over the barrier). They will be installed prior to works commencing and maintained throughout the works.

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

Where practicable, the following guidelines will be used in designing and installing temporary noise barriers:

- The panels will have a minimum surface mass of 6.5 kg/m². Suitable panels include 12 mm plywood or the following proprietary 'noise curtains':
 - 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/m²' (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 will be abutted, battened or overlapped to provide a continuous screen without gaps at the bottom or between panels.

- Barriers will be positioned as close as practicable to the high-noise activity to block line-of-sight between the activity and noise sensitive receivers. A site hoarding at the boundary may not be effective for all receivers. Add extra barriers close to high-noise activities to ensure effective mitigation for sensitive receivers on upper floors.

7.6 Excavators

All excavators can generate high noise and vibration levels. The actual level they generate depends very much on the experience and temperament of the operator.

- Use the right sized excavator for the job.
- Operate the bucket and armature with smooth movements (avoid jerking).
- Tip material from the bucket rather than shaking it clean where practicable.
- Avoid hitting the bucket on the ground or dropping heavy objects.
- Control the weight shift of the excavator to avoid the tracks lifting and thudding on the ground.

7.7 Concrete cutting

- Concrete cutting of roads will be restricted to between the hours of 7am to 7pm, Monday to Saturday as far as practicable.
- Select blades that:
 - Are sharp;
 - Maximise the number of teeth;
 - Minimise the blade width;
 - Minimise gullet depth; and
 - 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 7.5).
- 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).

7.8 Concrete breaking

- Avoid evening and night-time periods and Sundays/public holidays, as far as practicable.
- Minimise the amount of breaking needed (e.g. use a crushing shear or pulveriser attachment in place of a breaker, or use a cut and lift approach to enable breaking offsite).
- 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).
- For concrete breaking, 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 enclosures (Section 7.5) and/or a breaker blanket (e.g. Hushtec 'breaker attachment' – www.duraflex.co.nz).
- Minimise the breaking period (e.g. remove larger boulders for breaking offsite), and/or 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 rock or concrete before starting, and minimising firing after it breaks through.

7.9 Piling

- Piling that is predicted to exceed the relevant noise and/or vibration limits, will be restricted to between the hours of 7am to 7pm, Monday to Saturday, as far as practicable.
- Prioritise piling methods that minimise noise and vibration (e.g. augured, screw or press-in piles rather than drop-hammer, impact hammer or vibratory methods).
- Avoid shaking the auger to remove spoil. Shaking the kelly bit connection creates very loud banging that often results in noise complaints. If spoil does not fall off the auger easily, use tools to scrape the auger clean if necessary. If shaking is required due to Health and Safety constraints, ensure bushes are well maintained to minimise steel on steel contact.

7.10 Compaction

- Avoid evening and night-time periods and Sundays/public holidays, as far as practicable.
- 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 (Section 6.1).

7.11 Schedules to the CNVMP

Where an infringement of the noise and/or vibration criteria is predicted or measured, a Schedule to the CNVMP will be prepared. The objective of the Schedule is to set out the Best Practicable Option for the management of noise and/or vibration effects of the construction activity beyond those measures set out in this CNVMP.

The Schedule will contain the following content:

- Construction activity location, start and finish times.
- The nearest neighbours to the construction activity.
- The predicted noise and/or vibration level for all receivers where the levels are predicted or measured to exceed the applicable standards and predicted duration of the exceedance.
- The proposed mitigation options that have been selected, and the options that have been discounted as being impracticable and the reasons why.
- The consultation undertaken with owners and occupiers of sites subject to the Schedule, and how consultation has and has not been taken into account.
- Location, times and types of monitoring.
- A process to submit the Schedule to the Manager for information at least 5 working days in advance of the works it relates to.

8 SPECIFIC MITIGATION AND MANAGEMENT

8.1 Retaining wall construction

8.1.1 Retaining walls in urban section

The Project consists of multiple retaining walls in the urban section of the Project (along Redoubt Road). The retaining walls are relatively small, and some will be constructed using bored piles, whilst others are block or precast panels. The bored piling is likely to be carried out with an excavator mounted drill, due to the size of the retaining walls. Many of the retaining walls are located within 10 metres of the closest dwellings.

Bored piling within 25 metres of a building is predicted to exceed the daytime construction noise limits. Table 11 shows buildings that are located within 25 metres of the retaining walls. Most of these buildings will receive noise levels up to 78 dB L_{Aeq} during bored piling at the closest locations. Engagement and consultation will be required to all dwellings listed in Table 11 prior to construction of the retaining walls.

Table 11: Buildings within 25 metres of bored piling with an excavator

Address	Building type
78 Redoubt Road	Residential
4 Everglade Drive	Residential
6 Everglade Drive	Residential
4 Flamingo Court	Residential
10 Flamingo Court	Residential
12 Flamingo Court	Residential
18 Flamingo Court	Residential
101 Redoubt Road	Residential
80 Redoubt Road	Residential
10A Rosewood Place	Residential
10 Rosewood Place	Residential
8B Rosewood Place	Residential
8A Rosewood Place	Residential
6 Rosewood Place	Residential
4 Rosewood Place	Residential
2 Rosewood Place	Residential
1 Santa Monica Place	Residential
104 Redoubt Road	Motel
2 Bartells Drive	Residential
1 Bartells Drive	Residential
116 Redoubt Road	Residential
120 Redoubt Road	Residential
128 Redoubt Road	Residential
1 Goodwood Drive	Residential

Address	Building type
3 Goodwood Drive	Residential
4 Goodwood Drive	Residential
133A Redoubt Road	Residential
135 Redoubt Road	Residential
134 Redoubt Road	Residential
1 Alexia Place	Residential
3 Alexia Place	Residential
2 Timo Way	Residential
4 Timo Way	Residential
6 Timo Way	Residential
8 Timo Way	Residential
21 Timo Way	Residential
190 Redoubt Road	Residential
200 Redoubt Road	Residential

8.1.2 Retaining walls at Murphys Road intersection

The Murphys Road intersection consists of two large retaining walls. These retaining walls will be constructed using bored piles. The bored piling is likely to be carried out with a large rig due to the size of the retaining walls.

Bored piling within 52 metres of a dwelling is predicted to exceed the daytime construction noise limits. Table 12 shows dwellings that are located within 52 metres of the large retaining walls and the predicted worst case noise levels that these dwellings will receive during piling. Engagement and consultation will be required to all dwellings listed in Table 12 prior to construction of the retaining walls.

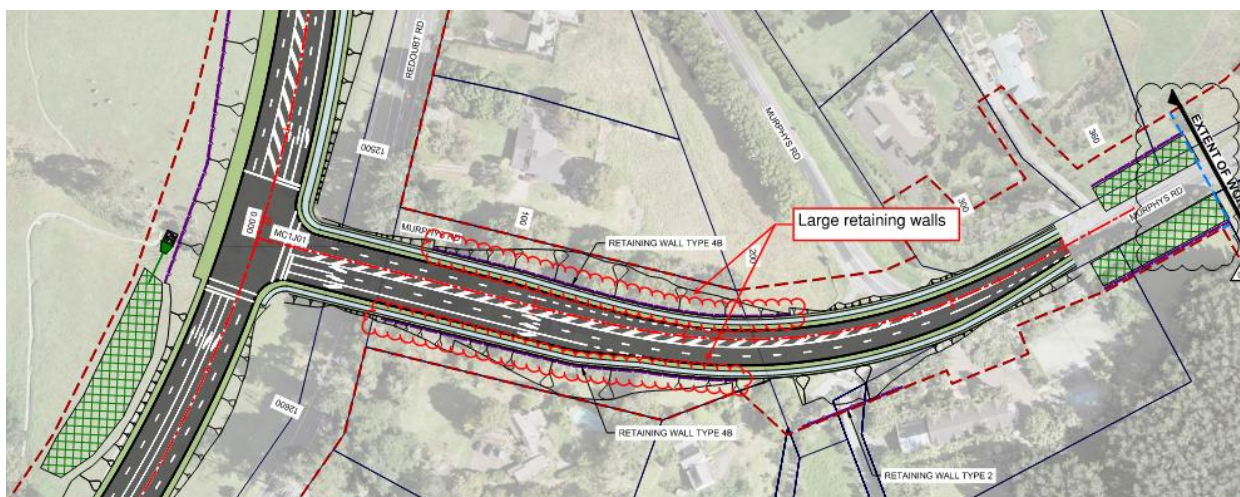


Figure 3: Location of large retaining walls

Table 12: Dwellings within 52 metres of bored piling with a large rig

Dwellings	Predicted noise level, dB L _{Aeq}
236 Redoubt Road	80
246 Redoubt Road	79
17 Murphys Road	71
51 Murphys Road	72*

*Closest retaining walls are small and constructed with an excavator mounted drill. The large retaining walls are further than 52 metres away.

8.1.3 Retaining wall south of Mill Road

The realignment of Puhinui Gully bridge means that the road alignment moves northeast, closer to dwellings at 361 to 375 Redoubt Road. A large retaining wall will be constructed between 20 and 30 metres from the closest dwelling façades.

Bored piling within 52 metres of any dwelling is predicted to exceed the daytime construction noise limits. Table 13 shows dwellings that are located within 52 metres of the large retaining walls and the predicted worst case noise levels that these dwellings will receive during piling. Engagement and consultation will be required to all dwellings listed in Table 13 prior to construction of the retaining walls.



Figure 4: Location of large retaining walls

Table 13: Dwellings within 52 metres of bored piling with a large rig

Dwellings	Predicted noise level, dB L _{Aeq}
361 Redoubt Road	76
375 Redoubt Road	80

8.2 Bridge construction

The Project includes the construction of the following bridges:

- Puhinui Gully bridge
- Cheeseman's Bush bridge
- Mill Road Crossover bridge

8.2.1 Puhinui Gully bridge

The Puhinui Gully bridge passes over a creek. Bored piling is required to construct the bridge. These works are likely to be carried out during the day as they do not go over any roads. There are no buildings in the immediate vicinity of the bridge. The closest dwellings are in the residential area in Manurewa, located approximately 80 metres away to the southwest. There are dwellings in rural areas, located further than 100 metres away to the north. We predict compliance with the daytime noise limit as the closest dwellings are further than 52 metres away. Refer to the figure in **Appendix D**.

8.2.2 Cheeseman's Bush bridge

The Cheeseman's Bush Bridge passes over a creek. Bored piling is required to construct the bridge. These works are likely to be carried out during the day as they do not go over any roads. There are no buildings in the immediate vicinity of the bridge. The closest dwelling is located approximately 110 metres away to the southwest. We predict compliance with the daytime noise limit as the closest dwellings are further than 52 metres away. Refer to the figure in **Appendix D**.

8.2.3 Mill Road Crossover bridge

The Mill Road Crossover bridge passes over the existing Mill Road. Bored piling is required to construct the bridge and will be restricted to daytime hours from Monday to Saturday. The closest dwelling to the proposed bridge is 353 Redoubt Road, which is approximately 27 metres away. The predicted noise level for piling works is 77 dB L_{Aeq} (refer figures in **Appendix D**).

Night-time works may be required to place the Mill Road bridge deck. This will need to be done using cranes. The following mitigation will be required:

- Place the crane in the area furthest from the dwellings (e.g. on the site of 345 Redoubt Road).
- No tonal reversing alarms.
- Notification and engagement with closest dwellings: 341A and B, 343 and 353 Redoubt Road.

Since the night-time works are likely to be limited to one or two nights only, it is unlikely that temporary relocation will need to be offered. Predicted noise levels range up to 57 dB L_{Aeq} , which would result in internal noise levels of approximately 32 dB L_{Aeq} with windows closed.

8.3 Stormwater pipe construction

A stormwater pipe will be constructed along Hollyford Drive and Everglade Drive, terminating at a deep chamber in a park off Everglade Drive.

The works will largely be undertaken at night-time as they will require work in the active traffic lanes. The highest noise activities will likely be concrete cutting and concrete braking during the initial phase of each night. The following mitigation will be required:

- Place a temporary barrier around the cutting/breaking area.
- No tonal reversing alarms.
- Complete the high noise activities as early in the night as possible.

The chamber will likely be constructed using sheet piling in close proximity to neighbouring houses. These works will be undertaken during daytime as they are off the active road. The following mitigation will be required:

- Use the lowest noise/vibration methodology practicable (e.g. pushing in sheet piles rather than vibrating them in).
- Notify neighbours of the works in advance.
- Use temporary barriers where practicable.
- Place pumps and other permanent equipment away from houses or in enclosures.

9 ENGAGEMENT

9.1 Communication

9.1.1 Before construction

Written communication (e.g. newsletter) will be provided to building occupants within 130 m of the site at least one week prior to starting construction. It will include:

- Details of the overall works, its timing and duration.
- Contact details and names of personnel whose job is to receive complaints and enquiries (should also match a person identified in Section 1.2).
- Acknowledge that some activities (listed in this document) are predicted to generate high noise and/or vibration levels and may result in disturbance for short periods.

9.1.2 During construction

Once construction has begun, ongoing communication is important. Regular communication during the works will include:

- Public site signage that includes contact details.
- Details of upcoming activities that may result in disturbance.
- Any changes to scheduled timing and duration of activities.

Occupants of buildings predicted to receive vibration levels exceeding 1mm/s PPV for more than three days will be advised at least three days prior to the works commencing.

Occupants of buildings within 100m of night works will be advised at least five days prior to the works commencing.

9.2 Consultation

Consultation will be offered to the sensitive receivers listed in **Appendix B** and shown on the figures in **Appendices C, D and E**. These are the neighbours where noise and/or vibration is predicted to exceed the performance standards.

The purpose of consultation is to address concerns about noise and vibration on a case-by-case basis. A copy of all correspondence will be made available to Council upon request.

Where nearby sensitive receivers are identified with particularly noise and/or vibration sensitive equipment and/or activities, a suitably qualified and experienced specialist (e.g. Member of the Acoustical Society of New Zealand) will review the performance standards to ensure they are appropriate and participate in consultation.

Receivers that do not want ongoing consultation, will be offered communication (Section 9.1).

The following will be implemented by the Project Manager (or nominated person):

- If any exceedance of the cosmetic building damage standard is measured, that vibration activity will cease as soon as safe and practicable to do so.
- Review the construction methodology, mitigation measures and management strategies to ensure they represent the BPO. The BPO considers:
 - Practicability;
 - Predicted noise/vibration benefits;
 - The interests of affected parties;
 - Implications for Project timing and duration; and
 - Cost.

- Consultation with affected parties to understand their sensitivities, including times they are home. The objective is to establish a collaborative approach to managing adverse noise and vibration effects.
- A Project representative will be contactable during work hours (Section 1.2).
- A record of consultation will be kept at the site office and be available to affected parties and Council if requested.
- Implement any measures agreed with the affected party in good faith.
- Monitor the activity to verify the extent of any adverse effects (Section 10).
- If the vibration cosmetic building damage limits are exceeded (Section 3.2), a building condition survey will be undertaken (Section 10.4).
- Consider installing mechanical ventilation systems in buildings where external windows must be closed to avoid significant adverse noise effects and no alternative ventilation system is present. Only consider this option after all other BPO management and mitigation has been applied.
- Consider temporary relocation of sensitive receivers where all BPO management and mitigation measures have been applied and significant adverse noise effects are still likely. This will be in exceptional cases only, and advice from the Acoustic Specialist will be sought prior.

9.3 Complaints response

Complaints will be acknowledged immediately where practicable and responded to within one day. If a more detailed response is needed, it will be provided within a timeframe agreed with the complainant.

All construction noise and/or vibration complaints will be recorded in a complaints file that is available to affected parties and Council on request. For each complaint, an investigation will be undertaken as soon as practicable using the following steps:

- Acknowledge receipt of the concern or complaint and record:
 - The name, address and contact details of the complainant (unless they elect not to provide);
 - Time and date the complaint was received and who received it;
 - Time and date of the activity that caused the complaint (estimated where not known);
 - The complainant's description of the activity and its resulting effects; and
 - Any relief sought by the complainant (e.g. scheduling of the activity).
- Identify the relevant activity and review the activity log to verify the complaint (or otherwise).
- If a complaint relates to building damage, inform the on-duty site manager as soon as practicable and stop the relevant works pending an investigation. In most cases, stopping the activity will provide immediate relief. But in some cases, this may not be practicable for safety or other reasons, in which case the complainant will be kept updated regularly during the time it takes to stop the activity.
- Review data from monitoring (if available) to identify the time in question and, if possible, verify exceedance.
- Review the predicted noise and/or vibration levels to determine if the activity was identified. Consider attended monitoring to verify the underlying reference level assumptions.
- Review the mitigation and management measures in place to ensure the BPO has been applied (Section 7). Review the relief sought by the complainant. Adopt further mitigation and management measures as appropriate.
- Review the potential residual effects if predicted to continue to exceed the relevant performance standards.
- Report the findings and recommendations to the Project Manager, implement changes and update this CNVMP as appropriate.
- Report the outcomes of the investigation to the complainant, identifying where the relief sought by the complainant has been adopted or the reason(s) otherwise.

10 MONITORING

10.1 Overview

This is where a suitably qualified acoustic engineer visits the site and measures levels in real time. This enables:

- Review of the implementation of this CNVMP, including the mitigation and management measures in Section 7 and engagement in Section 9.
- Verification if the predicted levels are representative and confirm whether the response protocols are appropriate for the resulting effects.
- Determination of compliance.

10.2 Noise

Construction noise is recommended to be monitored:

- The first time of piling, concrete cutting, concrete breaking or milling is used on site (to confirm the values in Section 5.1).
- In response to a reasonable noise complaint (Section 9.3).
- At 1m from the building façade facing the construction site, or a proxy position adjusted for distance
- By a suitably qualified and experienced specialist (e.g. Member of the Acoustical Society of New Zealand) or a suitably trained person on site in accordance with the requirements of New Zealand Standard NZS 6803: 1999 “Acoustics - Construction Noise”.
- For an appropriate duration, reported with the measured level (e.g. 65 dB LAeq (30min)).
- The results will be used to update Section 5.1 if appropriate.

A noise monitoring flowchart is presented in Figure 5.

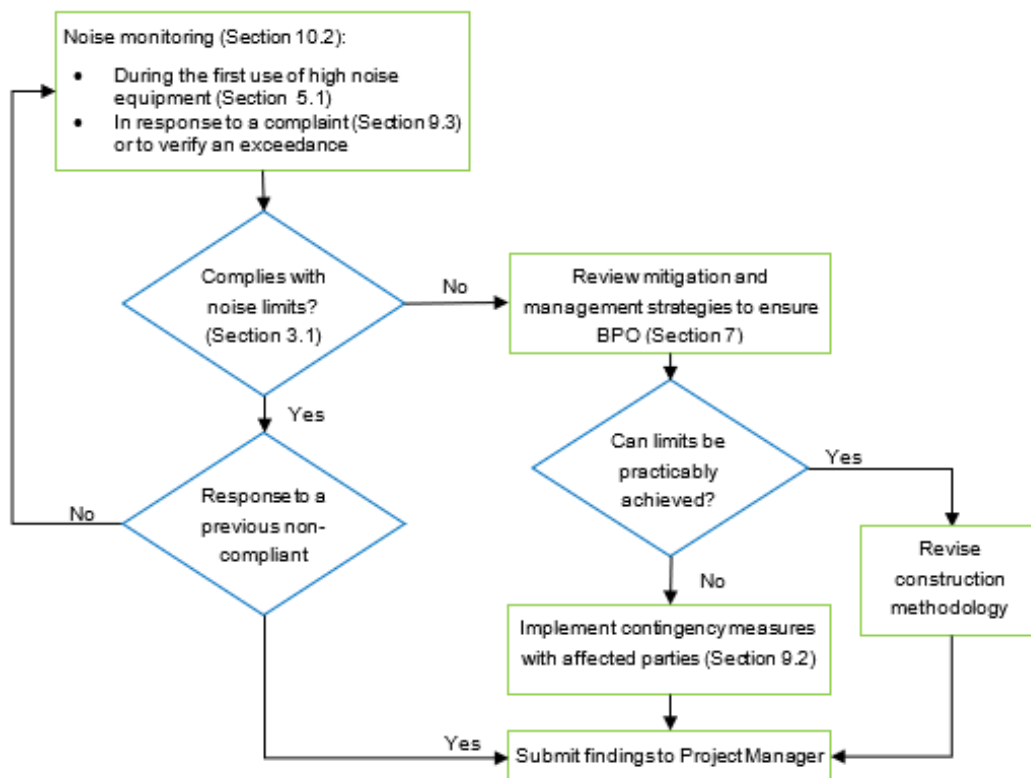


Figure 5: Noise monitoring flow chart

10.3 Vibration

Construction vibration is recommended to be monitored:

- When an activity has potential to exceed the limits in Section 3.2, e.g. during the first time vibratory rolling within 38 metres of a dwelling is carried out.
- In response to a reasonable vibration complaint (Section 9.3).
- On the foundations and/or the top floor of the closest building as appropriate (Section 3.2), provided access to the building has been requested and granted.
- By a suitably qualified and experienced specialist (e.g. Member of the Acoustical Society of New Zealand) or a suitably trained person on site in accordance the requirements of German Standard DIN 4150-3:2016 “*Vibrations in buildings – Part 3: Effects of vibration on structures*”.
- For a representative construction duration, measured in 2 second intervals.
- The results will be used to update Section 6.1 if appropriate.

A vibration monitoring flowchart is presented in Figure 6.

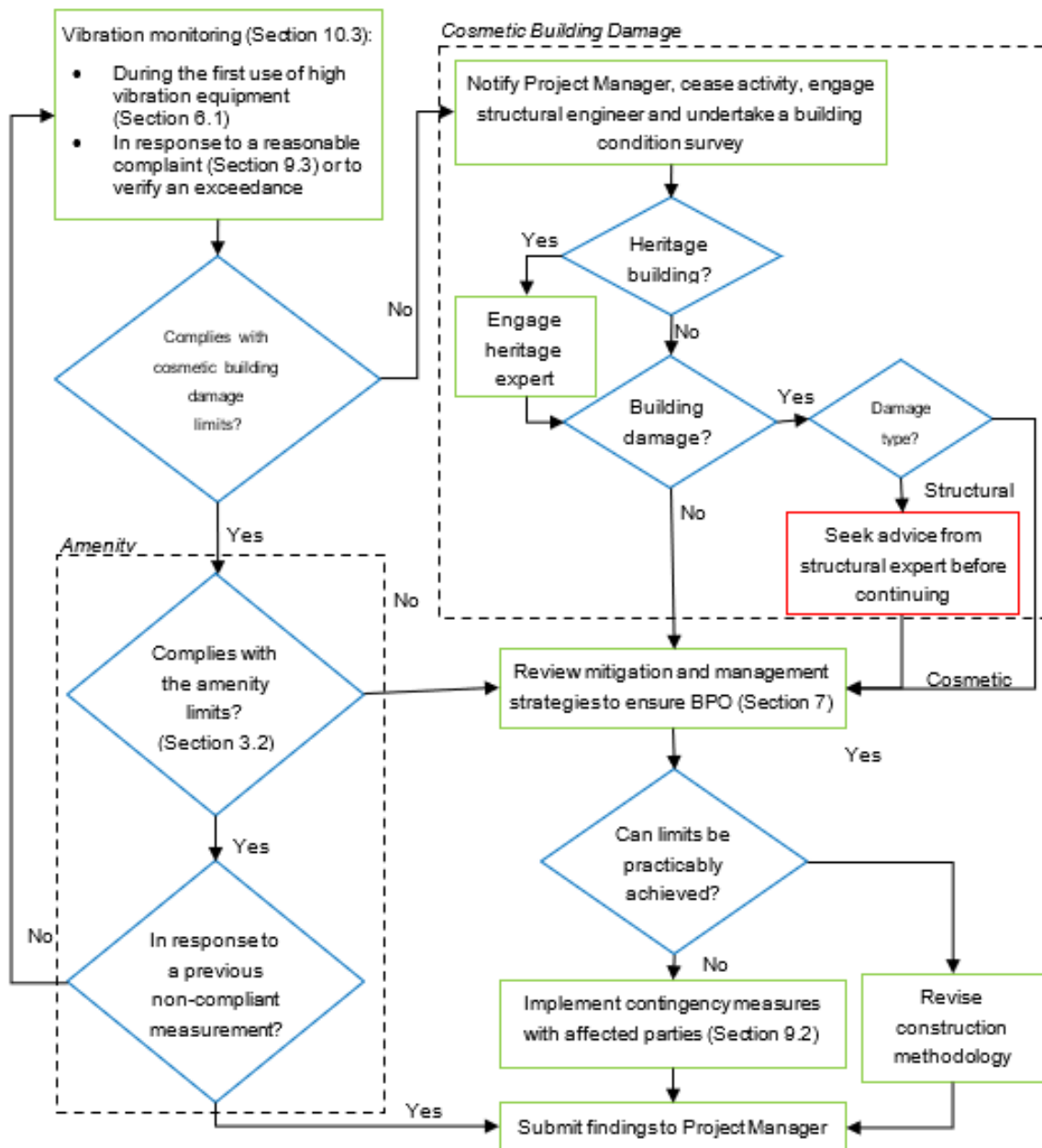


Figure 6: Vibration monitoring flow chart

10.4 Building condition surveys

Building condition surveys document the state of a building, including any existing cracks or other damage. Completing this before construction provides a benchmark if damage claims are made during construction.

A pre-construction building condition survey will be undertaken at all of the identified buildings predicted to receive vibration levels at or above 3mm/s PPV, which is the midpoint between daytime vibration levels for Category A and B. The Category A limits are for amenity whilst the Category B limits are for building damage. Therefore, we have taken the midpoint between the two categories to assess which properties should have building condition surveys carried out.

A condition survey will be undertaken for the following buildings listed in **Appendix F**.

The Communications and Engagement Manager will make a written request to the property owner for permission to undertake a building condition survey at the following times:

- Before construction starts, where vibration is predicted to exceed the cosmetic building damage limits (Section 3.2).
- During construction, where vibration is measured to exceed the cosmetic building damage limits in (Section 3.2) and/or in response to a reasonable damage claim (Section 9.3).
- After construction, to avoid subsequent claims of damage from construction vibration.

If monitoring shows that the vibration limit was exceeded, but no cosmetic damage has occurred, then that activity can continue provided the measured vibration level is not exceeded further and the construction methodology already adheres to the BPO. If damage has occurred, alternative construction methods will be investigated and the contractor shall rectify the damage at its own cost, as soon as practicable, in consultation with the owner of the property.

Each building condition survey will:

- Be undertaken by a suitably qualified person.
- Provide a description of the building.
- Determine the appropriate structure type classification⁶ with respect to DIN 4150-3:2016 “*Vibrations in buildings – Part 3: Effects of vibration on structures*” (i.e. historic/sensitive, residential or commercial/industrial).
- Document and photograph the condition of the building, including any cosmetic and/or structural damage.
- Will be available to the property owner and Council on request.

11 AUDITING OF CNVMP AND SCHEDULES

The CNVMP and Schedules shall be audited frequently, by a suitably qualified person. This may be done in conjunction with surveys, preparation of Schedules or if changes to the CNVMP are proposed.

The audit will involve updating the predicted noise and vibration levels with measured data during construction, checks that the recommended mitigation measures have been implemented and that engagement has been accurately documented in the Schedules. The mitigation and management methods outlined in the CNVMP should be regularly reviewed to ensure that they are implemented.

⁶ Classifications with respect to Tables 1 and 4 of DIN 4150-3:2016 “Vibrations in buildings – Part 3: Effects of vibration on structures” (i.e. historic/sensitive, residential or commercial/industrial)

12 CNVMP REVIEW REQUIREMENTS

A review of the CNVMP should be carried out periodically throughout the construction phase. The CNVMP shall be reviewed once every year to ensure that the management and mitigation methods remain relevant, noise and vibration levels are updated based on measurements taken, and that the construction methodology set out has not been changed.

APPENDIX A GLOSSARY OF TERMINOLOGY

Term	Meaning
Noise	A sound that is unwanted by, or distracting to, the receiver.
dB	Decibel (dB) is the unit of sound level. Expressed as a logarithmic ratio of sound pressure (P) relative to a reference pressure (Pr), where $dB = 20 \times \log(P/Pr)$.
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) to more closely approximate the frequency bias of the human ear. A-weighting is used in airborne acoustics.
L_{Aeq} (t)	The equivalent continuous (time-averaged) A-weighted sound level commonly referred to as the average level. The suffix (t) represents the period, 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 6803:1999	New Zealand Standard NZS 6803: 1999 "Acoustics - Construction Noise"
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into vertical (up and down vibration), horizontal transverse (side to side) and horizontal longitudinal direction (front to back) components.
PPV	Peak Particle Velocity (PPV) is the measure of the vibration amplitude, zero to maximum, measured in mm/s.
BS 5228:2009	British Standard BS 5228:2009 "Code of practice for noise and vibration control on construction and open sites, Part 1: Noise, Part 2: Vibration"
DIN 4150-3:2016	German Standard DIN 4150-3:2016 "Vibrations in buildings – Part 3: Effects of vibration on structures"

APPENDIX B SENSITIVE RECEIVERS WHERE NOISE CRITERIA MAY BE INFRINGED

Address	Building type
1 Alexia Place, Flat Bush, Auckland	Residential
3 Alexia Place, Flat Bush, Auckland	Residential
6 Alexia Place, Flat Bush, Auckland	Residential
8 Alexia Place, Flat Bush, Auckland	Residential
1A Aspiring Avenue, Clover Park, Auckland	Residential
3 Ancona Lane, Goodwood Heights, Auckland	Residential
1 Bartells Drive, Goodwood Heights, Auckland	Residential
2 Bartells Drive, Goodwood Heights, Auckland	Residential
3 Bartells Drive, Goodwood Heights, Auckland	Residential
4 Bartells Drive, Goodwood Heights, Auckland	Residential
3 Birchlea Rise, Goodwood Heights, Auckland	Residential
4 Birchlea Rise, Goodwood Heights, Auckland	Residential
37 Derrimore Heights, Clover Park, Auckland	Residential
39 Derrimore Heights, Clover Park, Auckland	Residential
1/43 Derrimore Heights, Clover Park, Auckland	Residential
45 Derrimore Heights, Clover Park, Auckland	Residential
47 Derrimore Heights, Clover Park, Auckland	Residential
49 Derrimore Heights, Clover Park, Auckland	Residential
51 Derrimore Heights, Clover Park, Auckland	Residential
2 Diorella Drive, Clover Park, Auckland	Residential
4 Elsted Place, Goodwood Heights, Auckland	Residential
6 Elsted Place, Goodwood Heights, Auckland	Residential
8 Elsted Place, Goodwood Heights, Auckland	Residential
10 Elsted Place, Goodwood Heights, Auckland	Residential
12 Elsted Place, Goodwood Heights, Auckland	Residential
16 Elsted Place, Goodwood Heights, Auckland	Residential
1 Elsted Place, Goodwood Heights, Auckland	Residential
10 Everglade Drive, Goodwood Heights, Auckland	Residential
11 Everglade Drive, Goodwood Heights, Auckland	Residential
13A Everglade Drive, Goodwood Heights, Auckland	Residential
15 Everglade Drive, Goodwood Heights, Auckland	Residential
1 Flamingo Court, Goodwood Heights, Auckland	Residential
10 Flamingo Court, Goodwood Heights, Auckland	Residential
12 Flamingo Court, Goodwood Heights, Auckland	Residential
18 Flamingo Court, Goodwood Heights, Auckland	Residential
1 Goodwood Drive, Goodwood Heights, Auckland	Residential
3 Goodwood Drive, Goodwood Heights, Auckland	Residential

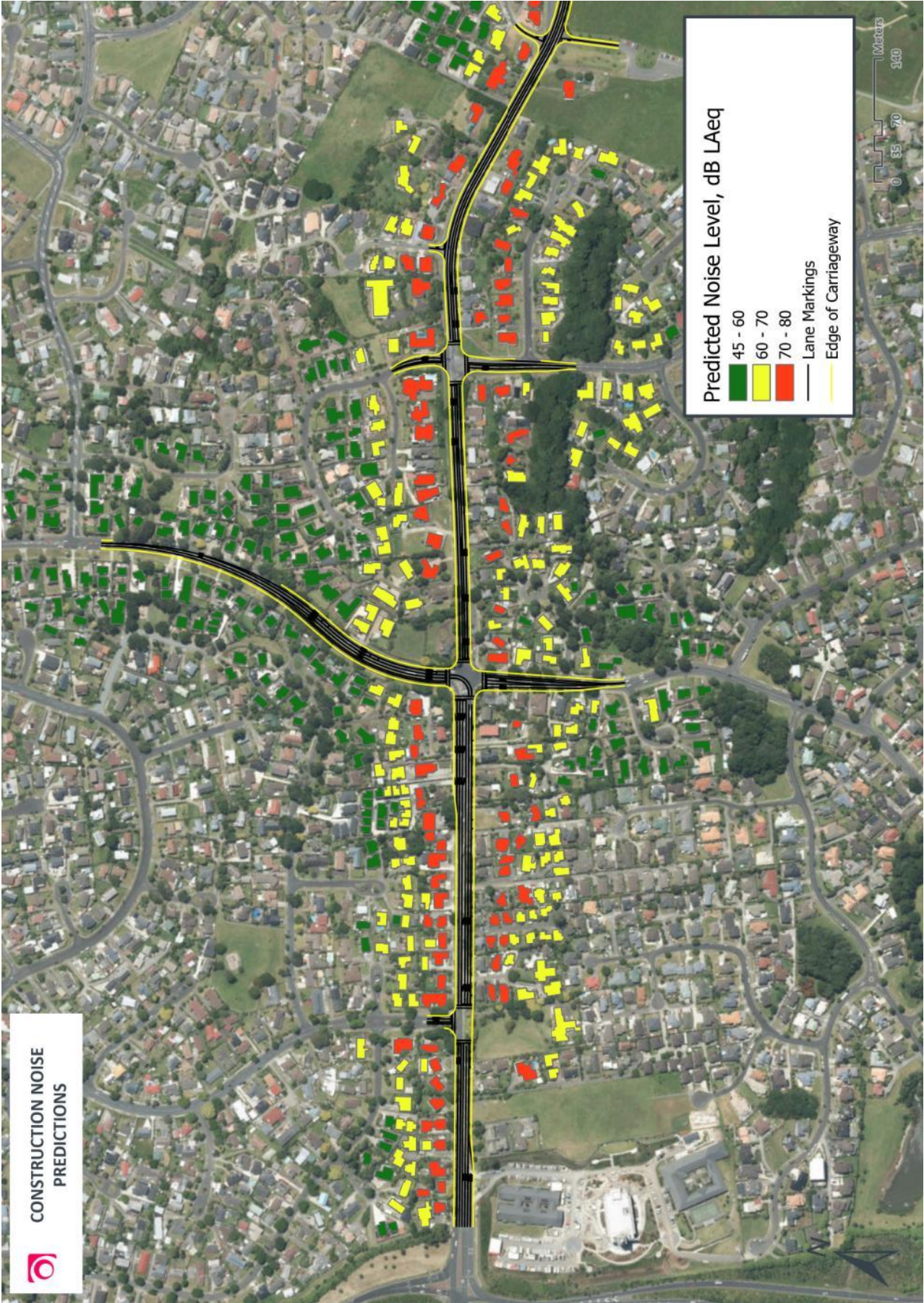
Address	Building type
4 Goodwood Drive, Goodwood Heights, Auckland	Residential
9 Goodwood Drive, Goodwood Heights, Auckland	Residential
11 Goodwood Drive, Goodwood Heights, Auckland	Residential
5 Goodwood Drive, Goodwood Heights, Auckland	Residential
17 Hollyford Drive, Clover Park, Auckland	Residential
19 Hollyford Drive, Clover Park, Auckland	Residential
1/21 Hollyford Drive, Clover Park, Auckland	Residential
23 Hollyford Drive, Clover Park, Auckland	Residential
1/25 Hollyford Drive, Clover Park, Auckland	Residential
2/25 Hollyford Drive, Clover Park, Auckland	Residential
1/27 Hollyford Drive, Clover Park, Auckland	Residential
29 Hollyford Drive, Clover Park, Auckland	Residential
31 Hollyford Drive, Clover Park, Auckland	Residential
20 Hollyford Drive, Clover Park, Auckland	Residential
22 Hollyford Drive, Clover Park, Auckland	Residential
24 Hollyford Drive, Clover Park, Auckland	Residential
26 Hollyford Drive, Clover Park, Auckland	Residential
28 Hollyford Drive, Clover Park, Auckland	Residential
30A Hollyford Drive, Clover Park, Auckland	Residential
32 Hollyford Drive, Clover Park, Auckland	Residential
36 Hollyford Drive, Clover Park, Auckland	Residential
1/38 Hollyford Drive, Clover Park, Auckland	Residential
1/40 Hollyford Drive, Clover Park, Auckland	Residential
7 Hollyford Drive, Clover Park, Auckland	Residential
9 Hollyford Drive, Clover Park, Auckland	Residential
222 Mill Road, Alfriston, Auckland	Residential
295 Mill Road, Takanini, Auckland	Residential
310 Mill Road, Takanini, Auckland	Residential
314 Mill Road, Takanini, Auckland	Residential
324 Mill Road, Takanini, Auckland	Residential
333 Mill Road, Takanini, Auckland	Residential
333 Mill Road, Takanini, Auckland	Residential
2/3 Monde Place, Clover Park, Auckland	Residential
140 Ranfurly Road, Alfriston, Auckland	Residential
4 Redoubt Road, Goodwood Heights, Auckland	Residential
4 Redoubt Road, Goodwood Heights, Auckland	Residential
6 Redoubt Road, Goodwood Heights, Auckland	Residential
14 Redoubt Road, Goodwood Heights, Auckland	Residential
16 Redoubt Road, Goodwood Heights, Auckland	Residential
18 Redoubt Road, Goodwood Heights, Auckland	Residential

Address	Building type
22 Redoubt Road, Goodwood Heights, Auckland	Residential
24 Redoubt Road, Goodwood Heights, Auckland	Residential
26 Redoubt Road, Goodwood Heights, Auckland	Residential
2/28 Redoubt Road, Goodwood Heights, Auckland	Residential
30 Redoubt Road, Goodwood Heights, Auckland	Residential
32 Redoubt Road, Goodwood Heights, Auckland	Residential
34 Redoubt Road, Goodwood Heights, Auckland	Residential
36 Redoubt Road, Goodwood Heights, Auckland	Residential
40 Redoubt Road, Goodwood Heights, Auckland	Residential
46 Redoubt Road, Goodwood Heights, Auckland	Residential
52 Redoubt Road, Goodwood Heights, Auckland	Residential
52 Redoubt Road, Goodwood Heights, Auckland	Residential
61 Redoubt Road, Goodwood Heights, Auckland	Residential
63 Redoubt Road, Goodwood Heights, Auckland	Residential
71 Redoubt Road, Goodwood Heights, Auckland	Residential
78 Redoubt Road, Goodwood Heights, Auckland	Residential
80 Redoubt Road, Goodwood Heights, Auckland	Residential
81 Redoubt Road, Goodwood Heights, Auckland	Residential
88 Redoubt Road, Goodwood Heights, Auckland	Residential
99 Redoubt Road, Goodwood Heights, Auckland	Residential
104 Redoubt Road, Goodwood Heights, Auckland	Motel
116 Redoubt Road, Goodwood Heights, Auckland	Residential
120 Redoubt Road, Goodwood Heights, Auckland	Residential
128 Redoubt Road, Goodwood Heights, Auckland	Residential
134 Redoubt Road, Goodwood Heights, Auckland	Residential
135 Redoubt Road, Goodwood Heights, Auckland	Residential
142 Redoubt Road, Flat Bush, Auckland	Residential
149 Redoubt Road, Flat Bush, Auckland	Residential
156 Redoubt Road, Flat Bush, Auckland	Residential
162 Redoubt Road, Flat Bush, Auckland	Residential
170 Redoubt Road, Flat Bush, Auckland	Residential
176 Redoubt Road, Flat Bush, Auckland	Residential
189 Redoubt Road, Flat Bush, Auckland	Residential
190 Redoubt Road, Flat Bush, Auckland	Residential
206 Redoubt Road, Flat Bush, Auckland	Residential
208 Redoubt Road, Flat Bush, Auckland	Residential
210 Redoubt Road, Flat Bush, Auckland	Residential
228 Redoubt Road, Tōtara Park, Auckland	Residential
272 Redoubt Road, Tōtara Park, Auckland	Residential
272 Redoubt Road, Tōtara Park, Auckland	Residential

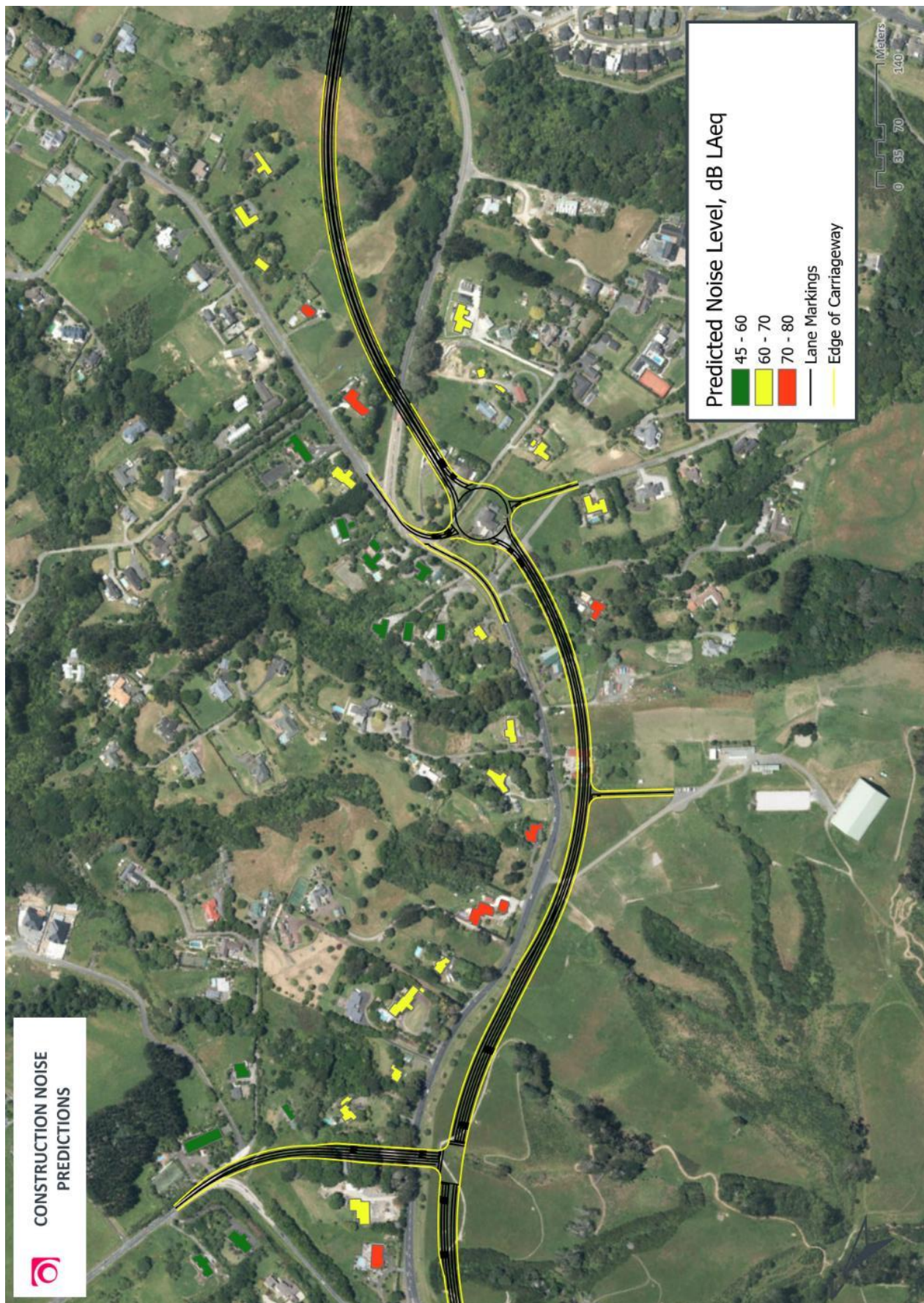
Address	Building type
280 Redoubt Road, Tōtara Park, Auckland	Residential
304 Redoubt Road, Goodwood Heights, Auckland	Residential
314 Redoubt Road, Goodwood Heights, Auckland	Residential
323 Redoubt Road, Tōtara Park, Auckland	Residential
353 Redoubt Road, Tōtara Park, Auckland	Residential
361 Redoubt Road, Tōtara Park, Auckland	Residential
1/30 Redoubt Road, Goodwood Heights, Auckland	Residential
1/38 Redoubt Road, Goodwood Heights, Auckland	Residential
2/38 Redoubt Road, Goodwood Heights, Auckland	Residential
1/10 Redoubt Road, Goodwood Heights, Auckland	Residential
1/28 Redoubt Road, Goodwood Heights, Auckland	Residential
119A Redoubt Road, Goodwood Heights, Auckland	Residential
12A Redoubt Road, Goodwood Heights, Auckland	Residential
12B Redoubt Road, Goodwood Heights, Auckland	Residential
133A Redoubt Road, Goodwood Heights, Auckland	Residential
2A Redoubt Road, Goodwood Heights, Auckland	Residential
41B Redoubt Road, Goodwood Heights, Auckland	Residential
41C Redoubt Road, Goodwood Heights, Auckland	Residential
43A Redoubt Road, Goodwood Heights, Auckland	Residential
45A Redoubt Road, Goodwood Heights, Auckland	Residential
45B Redoubt Road, Goodwood Heights, Auckland	Residential
47A Redoubt Road, Goodwood Heights, Auckland	Residential
47B Redoubt Road, Goodwood Heights, Auckland	Residential
54B Redoubt Road, Clover Park, Auckland	Residential
57A Redoubt Road, Goodwood Heights, Auckland	Residential
57B Redoubt Road, Goodwood Heights, Auckland	Residential
69A Redoubt Road, Goodwood Heights, Auckland	Residential
68 Redoubt Road, Goodwood Heights, Auckland	Residential
70 Redoubt Road, Goodwood Heights, Auckland	Residential
72 Redoubt Road, Goodwood Heights, Auckland	Residential
99A Redoubt Road, Goodwood Heights, Auckland	Residential
2 Rosewood Place, Goodwood Heights, Auckland	Residential
4 Rosewood Place, Goodwood Heights, Auckland	Residential
6 Rosewood Place, Goodwood Heights, Auckland	Residential
8A Rosewood Place, Goodwood Heights, Auckland	Residential
8B Rosewood Place, Goodwood Heights, Auckland	Residential
10 Rosewood Place, Goodwood Heights, Auckland	Residential
10A Rosewood Place, Goodwood Heights, Auckland	Residential
1 Santa Monica Place, Goodwood Heights, Auckland	Residential
3 Santa Monica Place, Goodwood Heights, Auckland	Residential

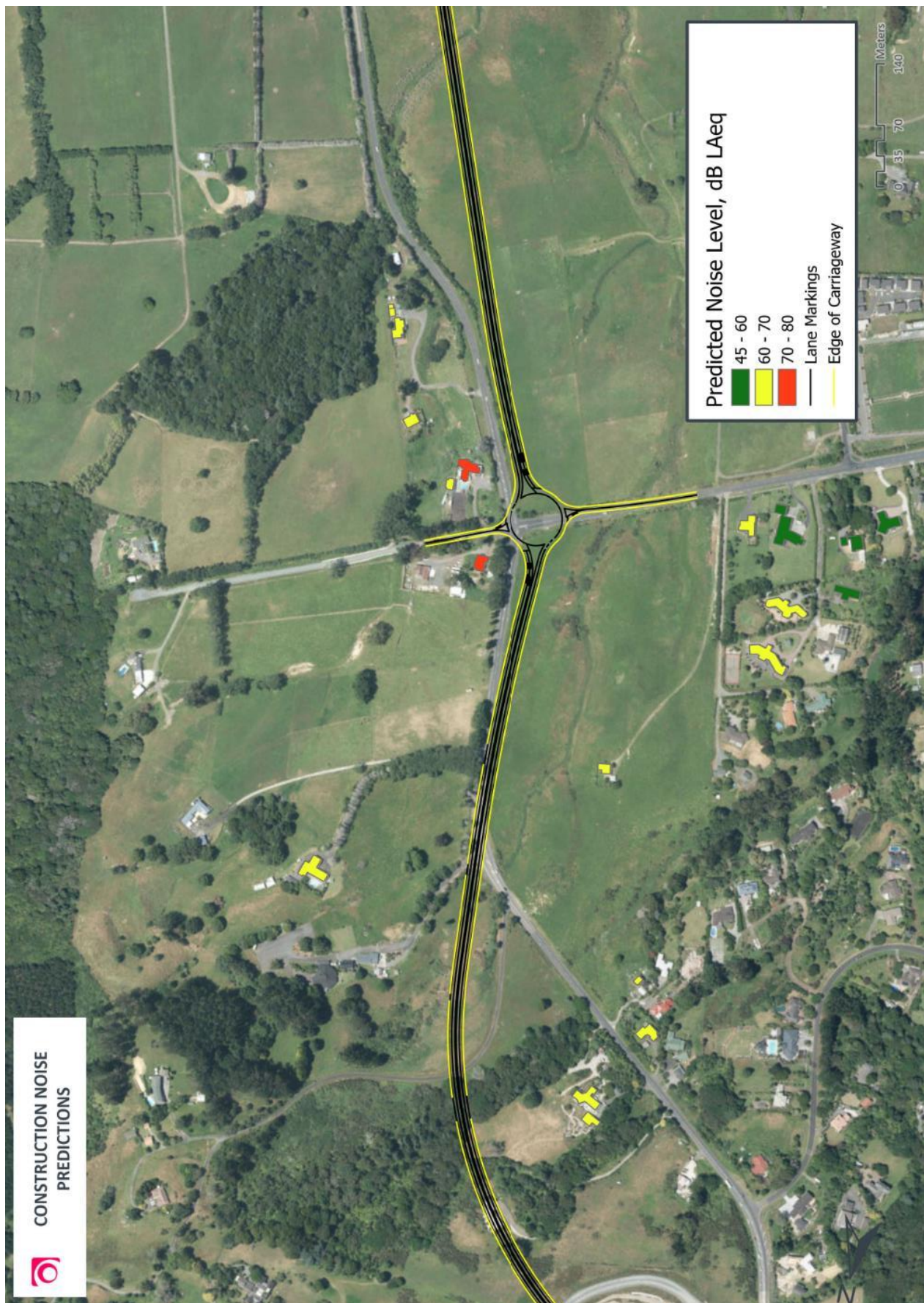
Address	Building type
35 Santa Monica Place, Goodwood Heights, Auckland	Residential
2 Sikkim Crescent, Clover Park, Auckland	Residential
2 Timo Way, Flat Bush, Auckland	Residential
4 Timo Way, Flat Bush, Auckland	Residential
6 Timo Way, Flat Bush, Auckland	Residential
8 Timo Way, Flat Bush, Auckland	Residential
19 Timo Way, Flat Bush, Auckland	Residential
21 Timo Way, Flat Bush, Auckland	Residential
25 Waheguru Lane, Goodwood Heights, Auckland	Residential
27 Waheguru Lane, Goodwood Heights, Auckland	Residential
4 Wilisa Rise, Goodwood Heights, Auckland	Residential

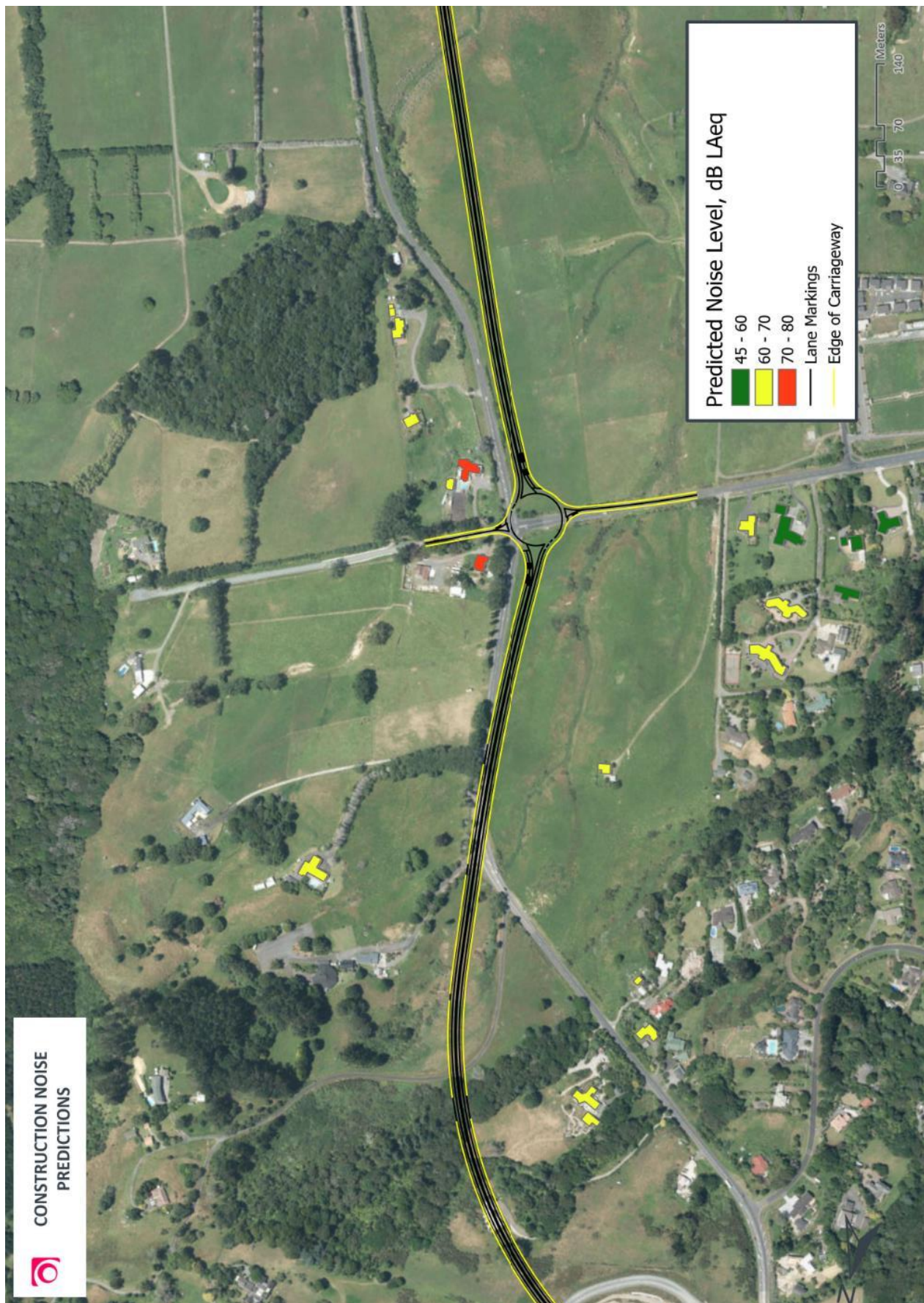
APPENDIX C INDICATIVE NOISE LEVEL PREDICTIONS

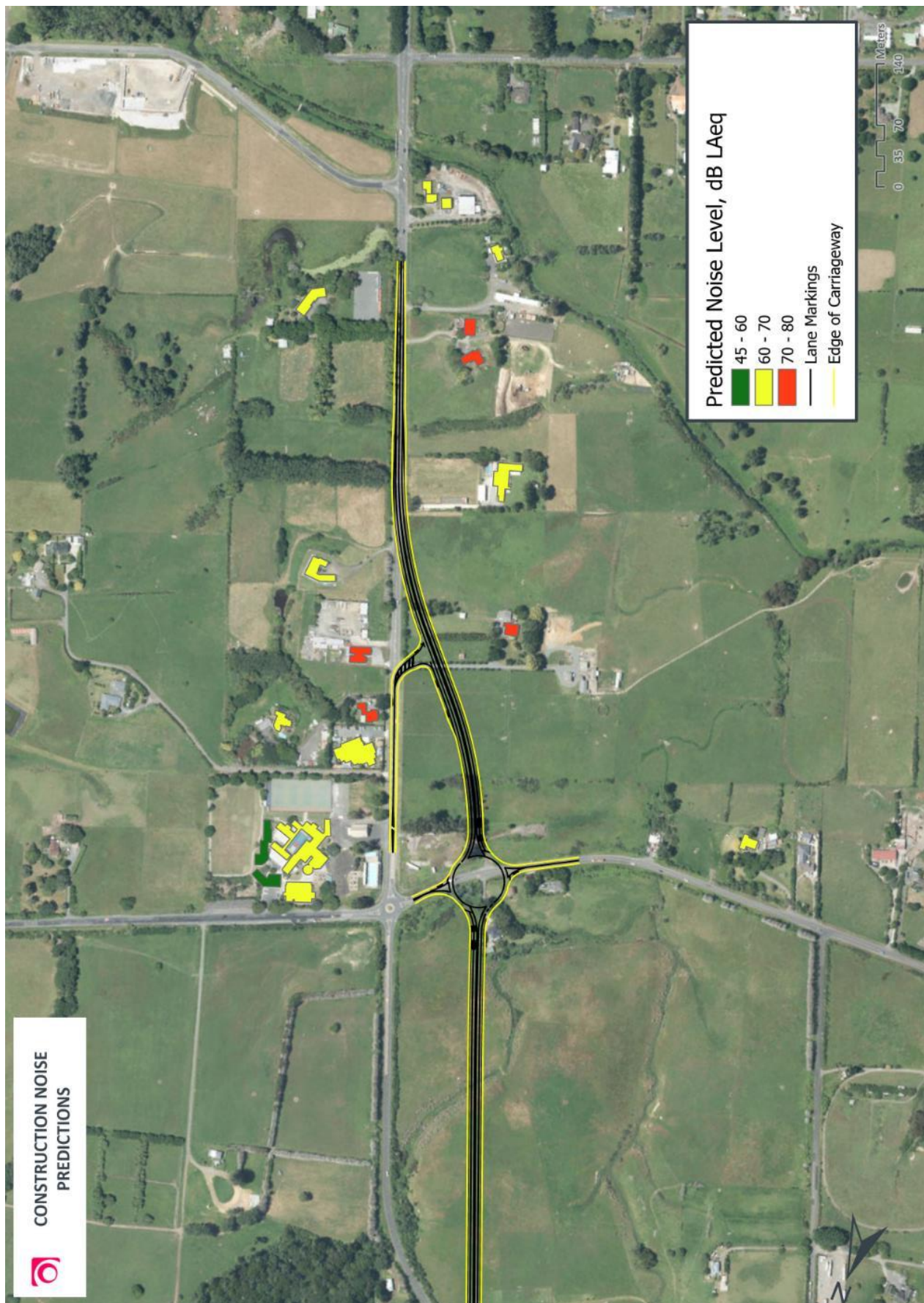




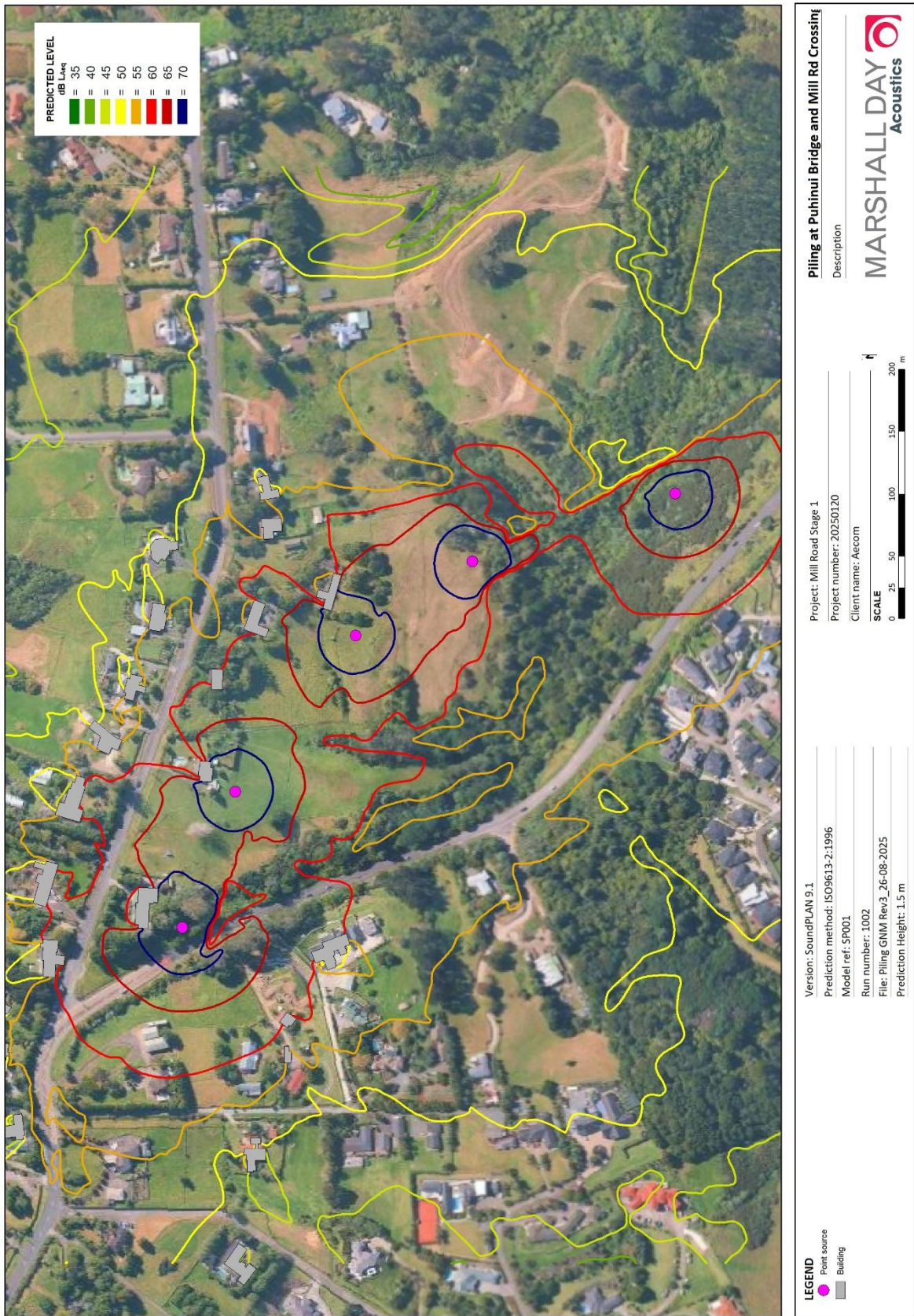


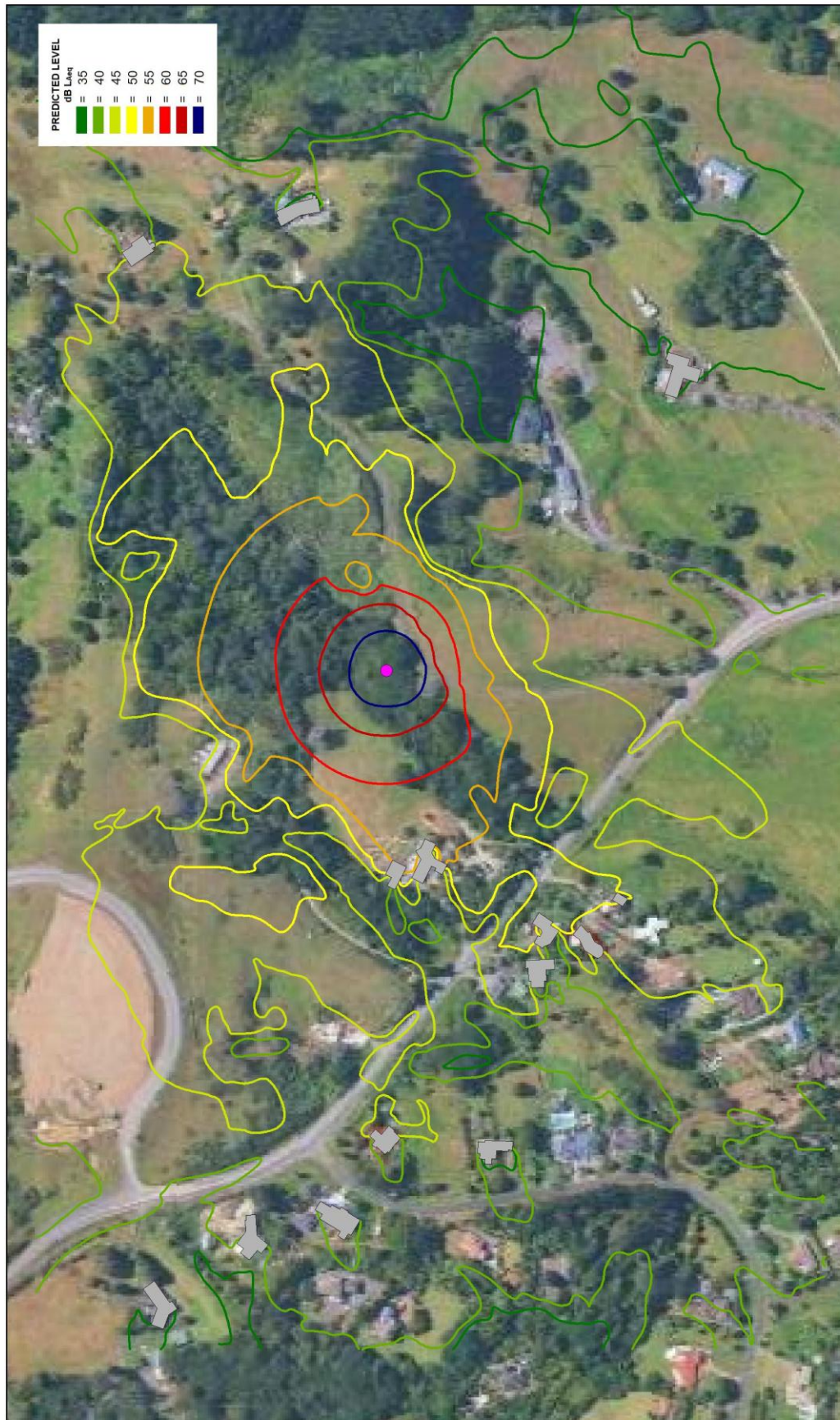






APPENDIX D PILING NOISE MAPS (INDICATIVE)





Piling at Cheeseman's Bush Bridge

Version: SoundPLAN 9.1

Prediction method: ISO9613-2:1996

Model ref: SP001

Run number: 1001

File: Piling2 GNM Rev3_25-08-2025

Prediction Height: 1.5 m

Project: Mill Road Stage 1

Project number: 20250120

Client name: Aecom

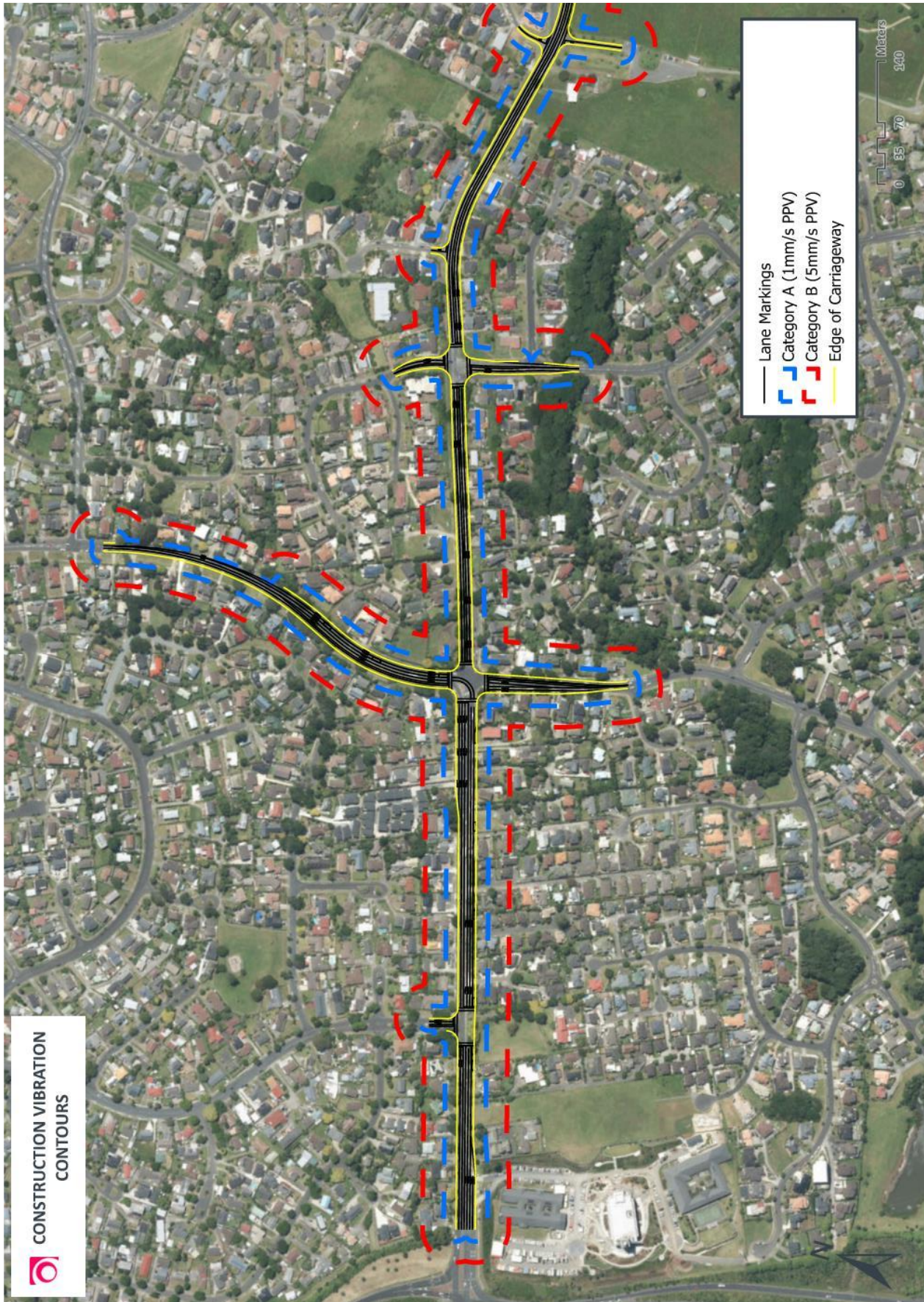
SCALE

0 25 50 100 150 200 m

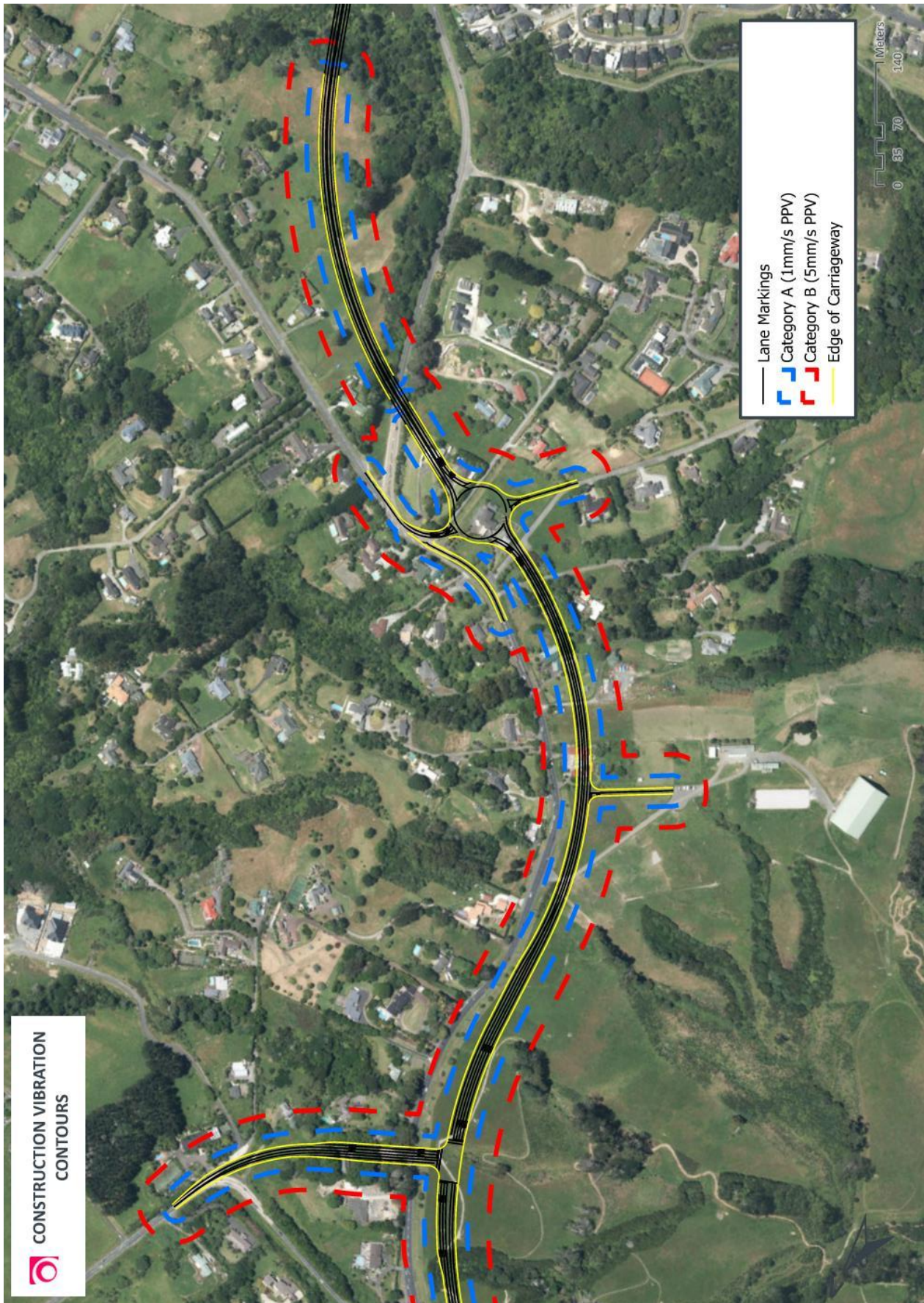
MARSHALL DAY

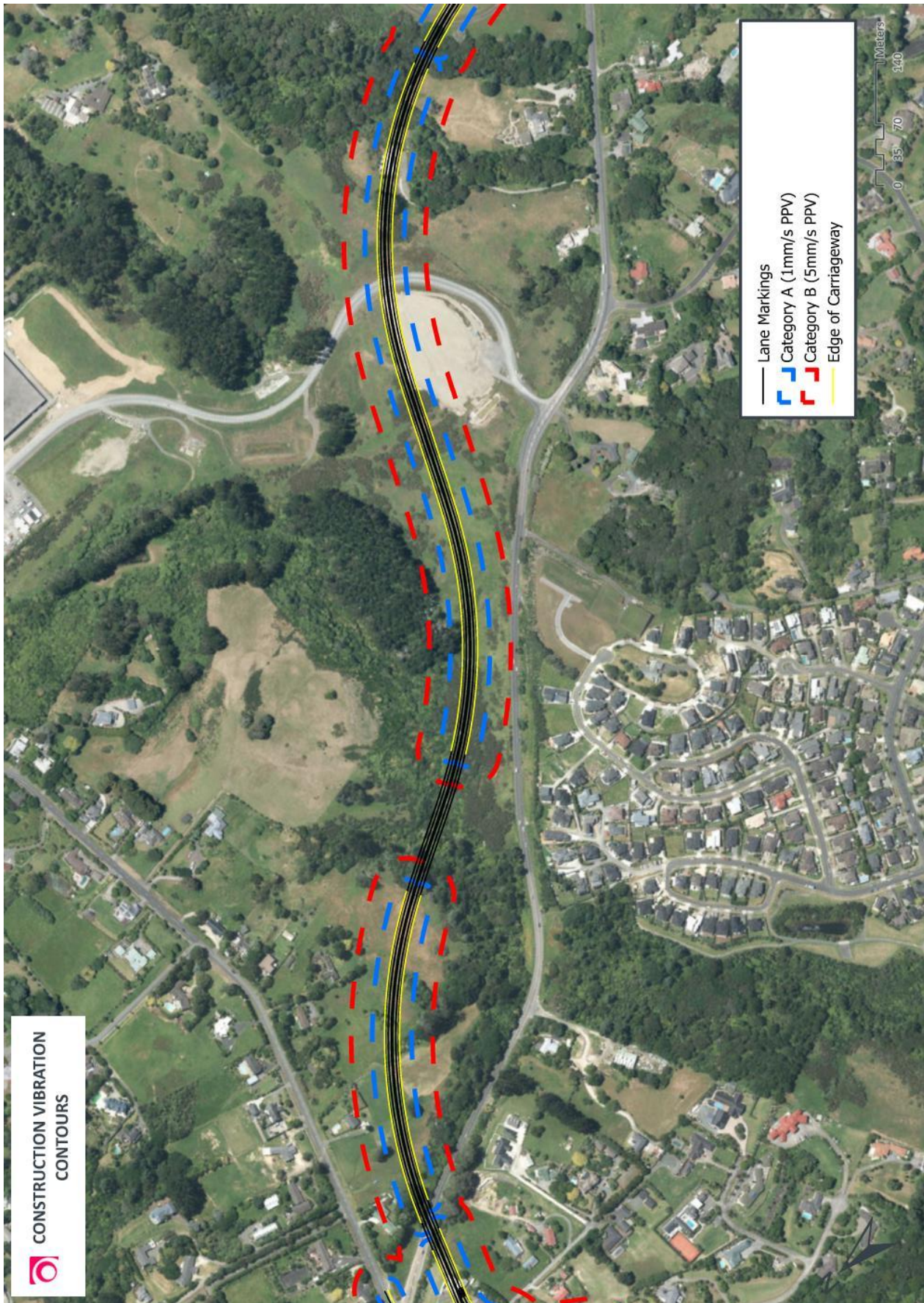
Acoustics

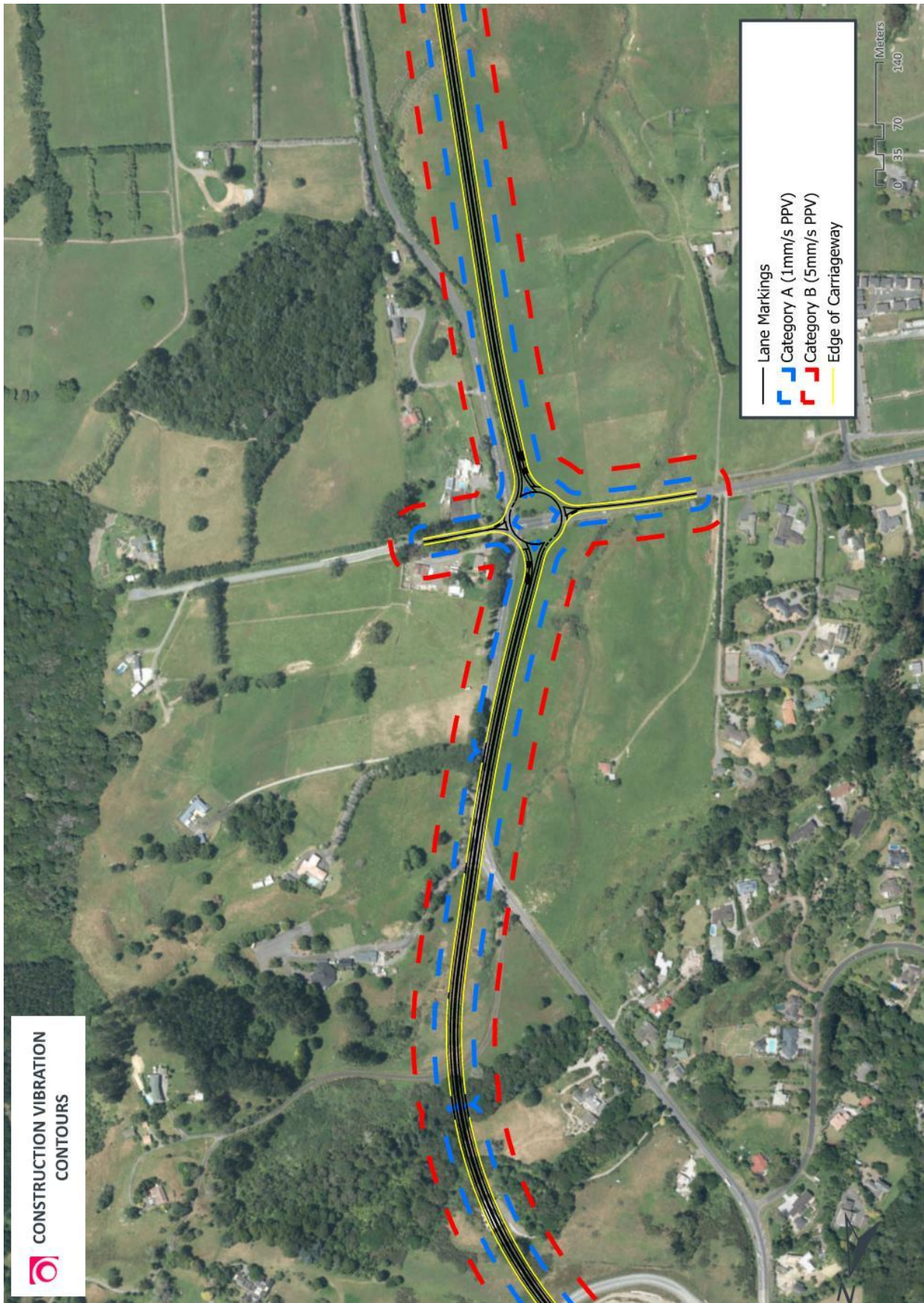
APPENDIX E INDICATIVE VIBRATION ENVELOPES

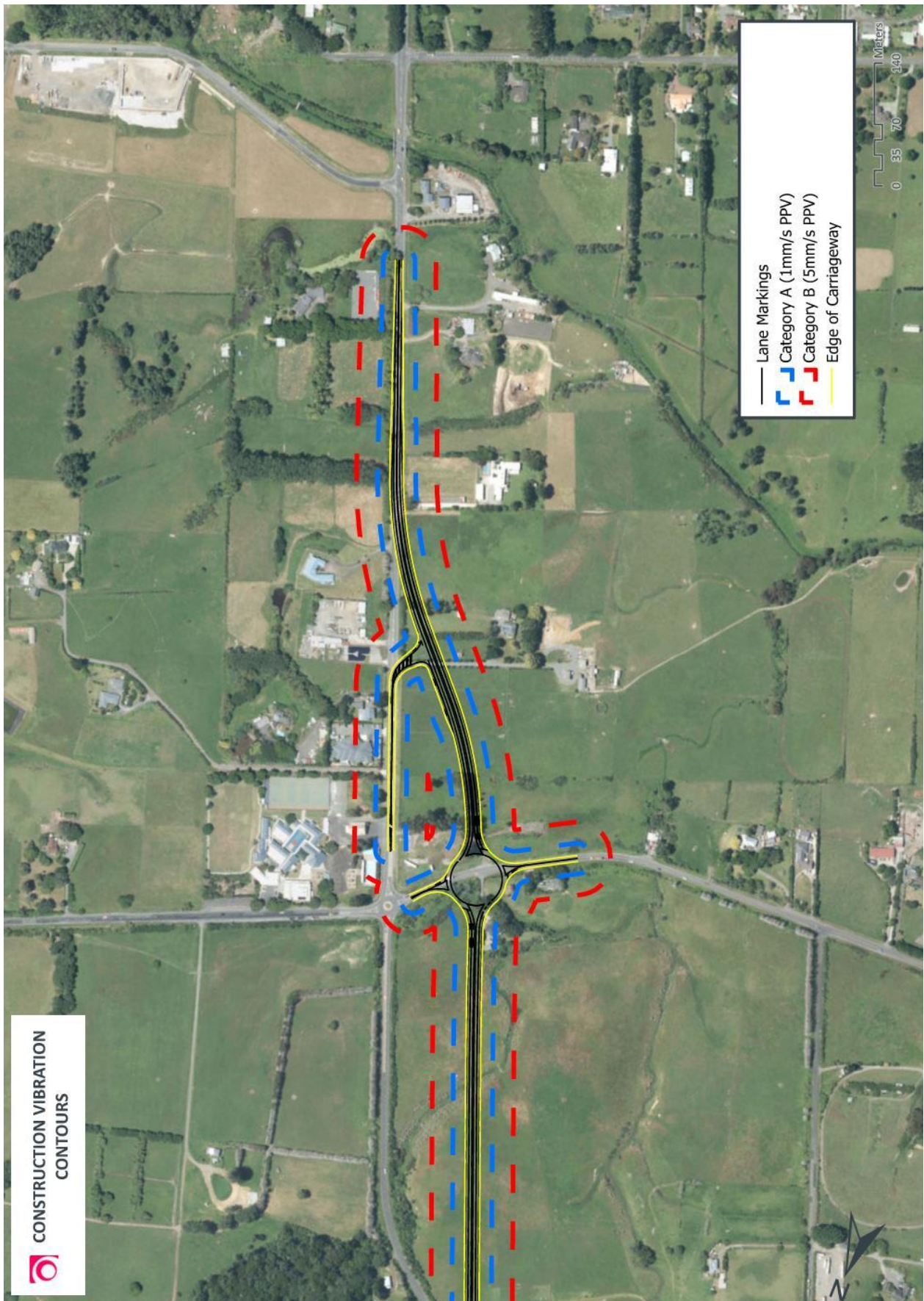












APPENDIX F BUILDING CONDITION SURVEYS

Address	Building type
2A Redoubt Road, Goodwood Heights, Auckland	Residential
4 Redoubt Road, Goodwood Heights, Auckland	Residential
6 Redoubt Road, Goodwood Heights, Auckland	Residential
1/10 Redoubt Road, Goodwood Heights, Auckland	Residential
12A Redoubt Road, Goodwood Heights, Auckland	Residential
14 Redoubt Road, Goodwood Heights, Auckland	Residential
16 Redoubt Road, Goodwood Heights, Auckland	Residential
18 Redoubt Road, Goodwood Heights, Auckland	Residential
2 Diorella Drive, Clover Park, Auckland	Residential
2 Sikkim Crescent, Clover Park, Auckland	Residential
2/3 Monde Place, Clover Park, Auckland	Residential
22 Redoubt Road, Goodwood Heights, Auckland	Residential
24 Redoubt Road, Goodwood Heights, Auckland	Residential
26 Redoubt Road, Goodwood Heights, Auckland	Residential
1/28 Redoubt Road, Goodwood Heights, Auckland	Residential
2/28 Redoubt Road, Goodwood Heights, Auckland	Residential
1/30 Redoubt Road, Goodwood Heights, Auckland	Residential
32 Redoubt Road, Goodwood Heights, Auckland	Residential
34 Redoubt Road, Goodwood Heights, Auckland	Residential
36 Redoubt Road, Goodwood Heights, Auckland	Residential
1/38 Redoubt Road, Goodwood Heights, Auckland	Residential
40 Redoubt Road, Goodwood Heights, Auckland	Residential
46 Redoubt Road, Goodwood Heights, Auckland	Residential
78 Redoubt Road, Goodwood Heights, Auckland	Residential
80 Redoubt Road, Goodwood Heights, Auckland	Residential
10A Rosewood Place, Goodwood Heights, Auckland	Residential
10 Rosewood Place, Goodwood Heights, Auckland	Residential
8A Rosewood Place, Goodwood Heights, Auckland	Residential
8B Rosewood Place, Goodwood Heights, Auckland	Residential
6 Rosewood Place, Goodwood Heights, Auckland	Residential
4 Rosewood Place, Goodwood Heights, Auckland	Residential
2 Rosewood Place, Goodwood Heights, Auckland	Residential
1 Santa Monica Place, Goodwood Heights, Auckland	Residential
3 Santa Monica Place, Goodwood Heights, Auckland	Residential
104 Redoubt Road, Goodwood Heights, Auckland	Motel
2 Bartells Drive, Goodwood Heights, Auckland	Residential
1 Bartells Drive, Goodwood Heights, Auckland	Residential
3 Bartells Drive, Goodwood Heights, Auckland	Residential
4 Bartells Drive, Goodwood Heights, Auckland	Residential

Address	Building type
116 Redoubt Road, Goodwood Heights, Auckland	Residential
120 Redoubt Road, Goodwood Heights, Auckland	Residential
128 Redoubt Road, Goodwood Heights, Auckland	Residential
134 Redoubt Road, Goodwood Heights, Auckland	Residential
6 Alexia Place, Flat Bush, Auckland	Residential
8 Alexia Place, Flat Bush, Auckland	Residential
1 Alexia Place, Flat Bush, Auckland	Residential
3 Alexia Place, Flat Bush, Auckland	Residential
142 Redoubt Road, Flat Bush, Auckland	Residential
170 Redoubt Road, Flat Bush, Auckland	Residential
206 Redoubt Road, Flat Bush, Auckland	Residential
304 Redoubt Road, Tōtara Park, Auckland	Residential
314 Redoubt Road, Tōtara Park, Auckland	Residential
353 Redoubt Road, Tōtara Park, Auckland	Residential
140 Ranfurly Road, Alfriston, Auckland	Residential
310 Mill Road, Takanini, Auckland	Residential
314 Mill Road, Takanini, Auckland	Residential
41B Redoubt Road, Goodwood Heights, Auckland	Residential
43A Redoubt Road, Goodwood Heights, Auckland	Residential
45A Redoubt Road, Goodwood Heights, Auckland	Residential
47A Redoubt Road, Goodwood Heights, Auckland	Residential
4 Everglade Drive, Goodwood Heights, Auckland	Residential
6 Everglade Drive, Goodwood Heights, Auckland	Residential
10 Flamingo Court, Goodwood Heights, Auckland	Residential
18 Flamingo Court, Goodwood Heights, Auckland	Residential
1 Goodwood Drive, Goodwood Heights, Auckland	Residential
3 Goodwood Drive, Goodwood Heights, Auckland	Residential
5 Goodwood Drive, Goodwood Heights, Auckland	Residential
1 Elsted Place, Goodwood Heights, Auckland	Residential
4 Goodwood Drive, Goodwood Heights, Auckland	Residential
119A Redoubt Road, Goodwood Heights, Auckland	Residential
133A Redoubt Road, Goodwood Heights, Auckland	Residential
135 Redoubt Road, Goodwood Heights, Auckland	Residential
11 Everglade Drive, Goodwood Heights, Auckland	Residential
13A Everglade Drive, Goodwood Heights, Auckland	Residential
15 Everglade Drive, Goodwood Heights, Auckland	Residential
1 Flamingo Court, Goodwood Heights, Auckland	Residential
10 Everglade Drive, Goodwood Heights, Auckland	Residential
54B Redoubt Road, Clover Park, Auckland	Residential
37 Derrimore Heights, Clover Park, Auckland	Residential

Address	Building type
39 Derrimore Heights, Clover Park, Auckland	Residential
1/43 Derrimore Heights, Clover Park, Auckland	Residential
45 Derrimore Heights, Clover Park, Auckland	Residential
47 Derrimore Heights, Clover Park, Auckland	Residential
49 Derrimore Heights, Clover Park, Auckland	Residential
51 Derrimore Heights, Clover Park, Auckland	Residential
20 Hollyford Drive, Clover Park, Auckland	Residential
22 Hollyford Drive, Clover Park, Auckland	Residential
24 Hollyford Drive, Clover Park, Auckland	Residential
26 Hollyford Drive, Clover Park, Auckland	Residential
28 Hollyford Drive, Clover Park, Auckland	Residential
30A Hollyford Drive, Clover Park, Auckland	Residential
32 Hollyford Drive, Clover Park, Auckland	Residential
36 Hollyford Drive, Clover Park, Auckland	Residential
1/38 Hollyford Drive, Clover Park, Auckland	Residential
1/40 Hollyford Drive, Clover Park, Auckland	Residential
7 Hollyford Drive, Clover Park, Auckland	Residential
9 Hollyford Drive, Clover Park, Auckland	Residential
68 Redoubt Road, Clover Park, Auckland	Residential
70 Redoubt Road, Clover Park, Auckland	Residential
72 Redoubt Road, Clover Park, Auckland	Residential
35 Santa Monica Place, Goodwood Heights, Auckland	Residential
17 Hollyford Drive, Clover Park, Auckland	Residential
19 Hollyford Drive, Clover Park, Auckland	Residential
1/21 Hollyford Drive, Clover Park, Auckland	Residential
23 Hollyford Drive, Clover Park, Auckland	Residential
1/25 Hollyford Drive, Clover Park, Auckland	Residential
2/25 Hollyford Drive, Clover Park, Auckland	Residential
1/27 Hollyford Drive, Clover Park, Auckland	Residential
29 Hollyford Drive, Clover Park, Auckland	Residential
31 Hollyford Drive, Clover Park, Auckland	Residential
1A Aspiring Avenue, Clover Park, Auckland	Residential
2 Timo Way, Flat Bush, Auckland	Residential
4 Timo Way, Flat Bush, Auckland	Residential
6 Timo Way, Flat Bush, Auckland	Residential
8 Timo Way, Flat Bush, Auckland	Residential
19 Timo Way, Flat Bush, Auckland	Residential
21 Timo Way, Flat Bush, Auckland	Residential