MARSHALL DAY Acoustics

TAURIKO WEST – TUPENGA CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

Rp 002 20250591 | 13 July 2026

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Project: **TAURIKO WEST - TUPENGA**

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1.0 QUALIFICATIONS AND EXPERIENCE

My name is Siiri Wilkening. I am an acoustics consultant, and a Director of Marshall Day Acoustics Ltd (MDA). MDA is a specialist acoustics consultancy of about 100 professional acoustics consultants, founded in 1981, with offices in New Zealand, Australia, Hong Kong/China, and France. I have worked at MDA for 27 years.

I hold a Master's degree in Engineering (Land Improvement and Environmental Protection) (University of Rostock, Germany). I have nearly 30 years' experience as an acoustics consultant and am a Fellow of the Acoustical Society of New Zealand. I am also a member of the Resource Management Law Association and the Institute of Directors (New Zealand).

My experience relevant to this Application includes:

- I was the expert witness on many Roads of National Significance, including SH1 East West Link, SH1 Northern Corridor Improvements, SH16 Waterview Connections, SH1 MacKays to Peka Peka (Kāpiti Expressway) and SH1 Puhoi to Warkworth, all of which were designated through Boards of Inquiry. For each of these projects, my role involved all aspects of acoustics, noise and vibration effects from construction and traffic and (where relevant) underwater effects, and I presented expert evidence at the hearings.
- The SH1 Southern Corridor Improvements (Manukau to Papakura and Papakura to Drury) involves considerable challenges due to the high population density close to the road. The widening of the Southern Motorway, the busiest State highway in New Zealand, would affect a large number of people, both during construction and following completion. I am the lead acoustical consultant on these projects and am responsible for all works relating to noise and vibration effects. This includes ambient noise level surveys, computer noise modelling, extensive meetings and engagement with residents and Council, noise mitigation design and the formulation of noise management plans. The various stages were consented through a mixture of conventional Council hearings and the Covid Fast Track process. I appeared as an expert witness at the hearings and prepared the assessments for the Fast Track process.
- I was engaged as principal acoustic consultant of the Te Tupu Ngātahi Supporting Growth Alliance, with a programme providing for the planning and consenting of transport infrastructure (active modes, rapid transit and roading) for the growth areas surrounding Auckland, with projects extending from Warkworth in the north to Drury and Pukekohe in the south to Huapai in the West. My role was to provide oversight and peer reviews of the assessments. The role changed to include the assessment of a number of the projects (Takaanini Level Crossings, North (Strategic), North West (Strategic), Pukekohe, and Airport to Botany Rapid Transit), which involved everything from route selection to assessment and expert witness appearance at several of the combined Council hearings.

I have undertaken many acoustic assessments for a variety of projects ranging from transportation and power generation to educational facilities, residential and commercial subdivisions, mining and plan changes. I have appeared as an expert witness at many Council hearings, before numerous Environment Courts, the Arbitration Court and five Boards of Inquiry. I have also taken part in Environment Court mediation.

Although this Application is not before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses as contained in section 9 of the Environment Court Practice Note 2023. I agree to comply with that Code. My qualifications as an expert are set out above. I am satisfied that the matters which I address in this Assessment of Acoustic Effects are within my area of expertise, except where I state that I am relying on information provided by another person or expert. I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

2.0 SUMMARY

This report presents an assessment of potential noise and vibration effects from the construction of the Tauriko West - Tupenga project (the Project). The assessment establishes the existing acoustic environment, identifies relevant criteria from New Zealand standards and guidelines, predicts effects from indicative construction activities, and recommends a framework for managing potential impacts.

This assessment has deliberately used conservative predictions to establish appropriately large effects areas. This is to inform proactive engagement with the wider community rather than to imply inevitable construction outcomes.

Baseline monitoring has confirmed the existing environment is typical of suburbs near a busy road, with ambient noise and vibration dominated by road traffic. Using that baseline, our assessment draws its criteria from NZS 6803:1999 for construction noise and the NZTA State Highway Construction and Maintenance Noise and Vibration Guide for vibration, which uses a two-tiered (Category A and Category B) system for management and compliance.

The conservative noise modelling indicates that without mitigation, high-impact activities such as earthworks and sheet piling will likely exceed the 70 dB L_{Aeq} daytime criterion at around 100 residential properties. While most exceedances are marginal, receivers in close proximity to works (e.g., on Dumfries Place/Galloway Crescent and Cameron Road) could experience noise levels up to 90 dB L_{Aeq} for short periods, which may be intolerable without intervention.

A risk-based assessment for vibration has identified High, Medium, and Low risk zones, based on proximity to activities like vibratory rolling and dynamic compaction. Nineteen properties, particularly near the Pyes Pa / Cameron Road / SH29A intersection, fall within the High and Medium Risk categories, indicating a potential for exceeding both the amenity-based (Category A) and building-damage protection (Category B) criteria.

To manage these effects, we recommend a process and management and mitigation through a Construction Noise and Vibration Management Plan (CNVMP). The CNVMP will be prepared by the contractor and certified by Council as set out in the designation conditions.

The CNVMP will contain general mitigation and management measures, information about the construction methodology, equipment, timing and complaints responses as well as noise and vibration predictions and measurement procedures.

Where compliance with the relevant noise or vibration criteria is not practicable, a Schedule to the CNVMP will be prepared (as required by the designation conditions). This is current best practice and allows a proactive and agile response to potential noise and vibration issues as they arise throughout the overall construction period. The Schedules are attached in Appendix D of this CNVMP and deal specifically with the offending activity, consultation with the affected parties, and mitigation and management specific to the works.

This assessment concludes that with the implementation of the recommended management framework, the project can appropriately manage construction noise and vibration effects to meet regulatory requirements and industry best practice.

TABLE OF CONTENTS

3.0 INTRODUCTION

NZ Transport Agency Waka Kotahi (NZTA) has engaged MDA to undertake a detailed assessment of potential noise and vibration effects associated with the construction of the Tauriko West - Tupenga project. Construction activities for large-scale infrastructure projects can generate noise and vibration levels that have the potential to adversely affect nearby residents and other sensitive receivers such as schools.

This report aims to identify properties that construction activities may affect and to establish a robust framework for managing these effects to an acceptable level, in line with the Best Practicable Option (BPO).

The scope of this assessment includes:

- Characterising the existing ambient noise and vibration environment through baseline monitoring;
- Establishing project-specific performance criteria based on relevant New Zealand standards, local authority plans, and national guidelines;
- Predicting and assessing construction noise impacts from key activities such as earthworks and piling;
- Predicting and assessing construction vibration impacts using a risk-based methodology; and
- Recommending a comprehensive management and mitigation framework to ensure compliance and minimise adverse effects.

4.0 THE EXISTING NOISE ENVIRONMENT

We undertook an assessment of the existing noise and vibration environment to provide a baseline for the project. This baseline is essential for evaluating the potential impacts of construction activities and for understanding the character of the local acoustic environment.

For details of the measurement data, please refer to Section 3 of the Operational Noise Report[1].

Baseline monitoring confirmed the existing environment is typical of a suburb near a busy road, with ambient noise and vibration dominated by road traffic.

5.0 ASSESSMENT OF CONSTRUCTION NOISE AND VIBRATION EFFECTS

This section outlines the performance standards and methodology this assessment uses to assess the potential effects of construction noise and vibration. While construction activities can generate higher ambient levels, we consider these effects acceptable when managed in accordance with industry standards and the principle of BPO.

5.1 Acoustic Performance Standards

5.1.1 Construction Noise Criteria

Several key documents contain the relevant criteria for construction works. These are:

- NZS 6803:1999 "Acoustics – Construction Noise"
- NZTA State Highway Construction and Maintenance Noise and Vibration Guide (Version 1.1, August 2019)
- Tauranga City Plan (Rule 4E.2.14)

[1] Rp 001 20250591 AZ (Tauriko West Operational Noise and Vibration Assessment)

- The Western Bay of Plenty District Plan which specifies that construction noise is to be measured and assessed in accordance with NZS 6803:1999

All four documents reference NZS 6803:1999 as the primary standard, providing a consistent regulatory framework. As the project expects construction works to exceed 20 weeks, this assessment has adopted the "long duration" criteria from NZS 6803. Table 1 summarises the relevant noise limits.

Table 1: Construction noise criteria at occupied buildings

Day of week	Time period	Noise criteria	
		dB L_{Aeq}	dB L_{AFmax}
Dwellings and other buildings containing activities sensitive to noise			
Weekdays	0630 – 0730	55	75
	0730 – 1800	70	85
	1800 – 2000	65	80
	2000 – 0630	45	75
Saturdays	0630 – 0730	45	75
	0730 – 1800	70	85
	1800 – 2000	45	75
	2000 – 0630	45	75
Sundays and public holidays	0630 – 0730	45	75
	0730 – 1800	55	85
	1800 – 2000	45	75
	2000 – 0630	45	75
Other occupied buildings			
All days	0730 – 1800	70	n/a
	1800 – 0730	75	n/a

5.1.2 Construction Vibration Criteria

Neither the Tauranga City Plan, nor the Western Bay of Plenty District Plan contain vibration limits for construction. Therefore, this assessment adopts the criteria from the NZTA Guide, which are derived from two international standards:

- German Standard DIN 4150-3:1999, for the prevention of building damage.
- British Standard BS 5228-2:2009, for the management of human response (amenity).

The Guide establishes a two-tiered framework using Category A as a management trigger and Category B as a firm compliance limit (subject to implementing the BPO). Table 2 summarises the criteria.

Category A (Management Trigger): These criteria should be met wherever practicable. An exceedance requires a review of methods and mitigation, and consultation with affected parties.

Category B (Compliance Limit): These criteria represent the maximum acceptable vibration level and must not be exceeded (subject to BPO).

Table 2: NZTA Construction Vibration Criteria (PPV, mm/s)

Receiver	Location	Details	Category A	Category B
Occupied PPFs	Inside the building	Night-time 2000h-0630h	0.3 mm/s PPV	1mm/s PPV
		Daytime 0630h-2000h	1mm/s PPV	5mm/s PPV
Other occupied buildings	Inside the building	Daytime 0630h-2000h	2mm/s PPV	5mm/s PPV
All other buildings	Building foundation	Vibration – transient[1]	5mm/s PPV	BS 5228-2 Table B.2*
		Vibration – continuous[2]		BS 5228-2 50% of Table B.2 values*

[1] *Transient vibration sources include impact piling, rock breaking, and blasting.*
[2] *Continuous vibration sources include vibratory rollers, vibratory piling, and tunnelling.*
** The limits in Table B.2 of BS 5228-2 are based on the type of structure and are designed to prevent cosmetic damage (e.g., cracking in plaster).*

In general terms, the Category A criteria of the NZTA Guide aims to avoid annoyance on receivers. Because these criteria are conservative, there is a provision in the Guide to relax them if they cannot be practicably met. Relaxations are possible if a vibration expert is engaged to assess and manage construction vibration to comply with the Category A criteria as far as practicable.

If Category A is not achievable, the focus is then shifted to avoiding building damage rather than annoyance by applying the Category B criteria. If the Category B criteria are achieved, then building damage is unlikely to occur. If Category B criteria are predicted to be exceeded, then (prior to the relevant construction commencing) a building condition survey must be carried out and (during construction) monitoring of vibration levels must occur. The monitoring records, and enables a response to, construction vibration.

The DIN Standard, which the 5mm/s PPV Category B criteria are taken from, is a conservative standard, which states: “Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur.” Damage is defined as “Any permanent effect of vibration that reduces the serviceability of a structure or one of its components”. Therefore, the criteria of the DIN Standard are designed to avoid damage (including cosmetic) to buildings, e.g. superficial damage like cracking in plaster. Significantly higher limits would be applied if damage to structural foundations was the only consideration.

5.2 Assessment Methodology

We assessed construction effects through a systematic process:

1. Establish Source Levels: Establish noise and vibration emission levels for key construction activities based on a measurement database and relevant technical standards for similar activities.
2. Define Existing Environment: Characterise the ambient noise and vibration environment through monitoring, as detailed in Section 4.0.
3. Predict Potential Effects: Predict noise and vibration levels at sensitive receiver locations based on an indicative construction methodology and determined setback distances where the relevant noise and vibration criteria can be achieved.

4. Assess Against Criteria: Compare predicted levels against the criteria in Section 5.1 to identify potential non-compliance.
5. Recommend Mitigation: Develop management and mitigation measures where a risk of exceeding the criteria is identified, to be implemented via a CNVMP as detailed in Section 5.1.

5.3 Construction noise effects assessment

This section presents the predicted noise effects from construction activities. The assessment identifies the equipment and activities likely to generate significant noise, models the propagation of that noise across the project area, and assesses the potential for impacts at sensitive receiver locations. The noise prediction models and the equipment inventories used in this assessment are based on our professional experience with projects of a similar nature and in comparable circumstances.

5.3.1 Indicative Construction Noise Sources

We predicted noise levels for key construction activities based on a database of sound power level (L_{WA}) measurements from similar infrastructure projects. Table 3 lists the indicative plant and equipment anticipated for the Project.

While the appointed contractor may use different equipment, we expect the noise emissions to be broadly similar to those presented. We used these values to calculate a composite "activity sound power level" for different construction phases, which accounts for multiple machines operating concurrently.

Based on these activity levels, we have calculated the indicative distance at which the project would meet the daytime noise limit (70 dB L_{Aeq}). These calculations are conservative as they do not account for shielding from temporary noise barriers or existing structures, which could reduce the compliance distance.

Actual noise levels and compliance distances will be addressed at the time of detailed design and construction when the CNVMP is prepared with input from the construction contractor.

Table 3: Indicative Construction Activities, Noise Levels, and Unmitigated Compliance Distances

Activity	Indicative Plant/Equipment	Sound power level (dB L_{WA})	Activity sound power level (dB L_{WA})	Indicative compliance distance (m) to meet 70 dB L_{Aeq} (Daytime)[1]
Site establishment (clearance, demolition, compound construction)	Chainsaw	114	111	83
	Chipper	117		
	Dump trucks	106		
	Hydraulic excavator	103		
	Vibratory roller	103		
Earthworks (alignment works, drainage and culvert construction)	Dump truck	106	109	44
	Hydraulic excavator	103		
	Bulldozer	109		
	Compactor	108		
	Water truck	105		
Retaining wall construction	Vibration piling rig	116	116	83

Activity	Indicative Plant/Equipment	Sound power level (dB L_{WA})	Activity sound power level (dB L_{WA})	Indicative compliance distance (m) to meet 70 dB L_{Aeq} (Daytime)[1]
	Rotary piling rig	111		
	Concrete trucks	103		
	Crane	98		
	On-road trucks	100		
Bridge foundations (piling)	Sheet piling rig	116	111	83
	Concrete trucks	103		
Rock excavation	Rock breaker	116	116	83
Foundations and structures (bridge construction)	Crane	106	108	40
	Concrete pump	103		
	Vibratory pokers	114		
	Concrete trucks	103		
Pavement preparation	Vibratory roller	103	108	40
	Water trucks	105		
Surfacing	Paving machine	103	103	25
	Road rollers	103		
	Asphalt delivery trucks	105		
Staging area/ construction yard	Vehicle movements	102	100	18
	Material handling	105		
	Administration area	50		
	Workshop	80		

1. Distance assumes hemispherical sound propagation over hard ground and excludes shielding from terrain, temporary barriers, or other buildings. Effective noise barriers can reduce this distance by up to two-thirds.

5.3.2 Construction noise compliance envelope

To assess the potential for noise exceedances, we developed compliance envelopes for two representative "worst-case" scenarios:

- Earthworks: Machinery working along the entire project alignment. Includes cutting and filling, drainage, services installation and road paving.
- Sheet Piling: A localised but high-noise activity required for bridge foundations.

These envelopes, shown in Appendix B, illustrate the areas where noise may exceed the daytime criteria (70 dB L_{Aeq}) without specific mitigation in place. We assume that buildings within the proposed designation will be removed (except for properties at Dumfries Pl, Galloway Cres, and Fairfax Cres adjacent to SH29A) and have therefore excluded them from this assessment.

Table 4 summarises the number of buildings outside the designation that fall within these compliance envelopes. The predicted noise levels indicate that most potential infringements will be marginal; however, the noise will be noticeable and will require active management. The developed compliance envelope is conservative, as it does not account for shielding from temporary noise barriers or existing structures.

Table 4: Summary of Buildings Predicted to Exceed Daytime Noise Criteria (Unmitigated)

Location	Number of buildings potentially receiving noise levels above 70 dB L_{Aeq}		Likely noise level range (average/maximum) dB L_{Aeq}	
	Earthworks	Sheet-piling	Earthworks	Sheet-piling
Arrowfield Drive	3	0	55-60 / 70-75	
Belk Road	1	0	55-60 / 70-75	
Cameron Road	8	1	65-70 / 85-90	65-70 / 70-75
Cheyne Road	2	0	55-60 / 70-75	
Dumfries Place	6	0	75-80 / 90-95	
Elderton Avenue	5	0	55-60 / 70-75	
Fairfax Crescent	13	0	65-70 / 85-90	
Galloway Crescent	5	0	65-70 / 80-90	
Hastings Road	1	0	55-60 / 70-75	
Havenbrook Way	7	2	65-70 / 85-90	65-70 / 70-75
Maleme Street	13	0	55-60 / 75-80	
Marshall Avenue	5	0	60-65 / 75-80	
Pyes Pa Road	8	0	55-60 / 75-80	65-70 / 70-75
Rosewood Lane	2	0	55-60 / 70-75	
Stableford Drive	1	0	55-60 / 70-75	
State Highway 29	3	0	55-60 / 70-75	
State Highway 29A	1	0	55-60 / 70-75	
Taurikura Drive	2	0	55-60 / 70-75	
Whiore Avenue	9	3	55-60 / 70-75	65-70 / 70-75

A detailed Construction Noise and Vibration Management Plan (CNVMP) will be prepared following the detailed design stage, once the construction methodology and equipment are confirmed. At that time, the preliminary assessment in the table above will be finalised.

Night works

A key requirement of the CNVMP will be the development of Site-Specific Noise Management Schedules prior to any night-time construction. These schedules will identify activity-specific noise and vibration risks and establish the mitigation procedures to be implemented in each area. Such procedures may include installing temporary noise barriers, utilising quieter equipment, or rescheduling activities to daytime hours. Further detail on noise management plans is provided in Section 6.1.

5.3.3 Construction Noise Effects

Noise levels affect people in their place of residence of work. Construction noise is inherently higher than ongoing operation noise but is generally reasonable because of its limited duration.

We primarily assess effects based on the impacts on people inside buildings. People generally choose not to spend extended periods outdoors near construction. People will also often keep their windows and doors closed which reduces internal noise levels. Generally, New Zealand dwelling facades reduce noise levels by 20 to 25 decibels. We have assumed conservatively a noise level reduction of 20 decibels, though any new dwellings would achieve 25 to 30 decibels noise level reduction because of modern building construction.

Table 5 provides a guide to how external noise levels translate to internal effects (i.e. how people experience noise inside or outside a building).

Table 5: Potential Subjective Effects of Construction Noise

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	Phone conversations would become difficult. Personal conversations would need slightly raised voices. Office work can generally continue, but 55 dB is considered by the experts to be a tipping point for offices. For residential activity, TV and radio sound levels would need to be raised.
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	Continuing office work would be very difficult and become unproductive. In a residential context, people would actively seek respite.
80 to 90	Hearing protection would be required for prolonged exposure (8 hours at 85 dB) to prevent hearing loss.	60 to 70	Untenable for both office and residential environments. Unlikely to be tolerated for any extent of time.

Daytime Effects

High Impact Receivers: For the few receivers located very close to the works (e.g., within 10m of piling), predicted noise levels of up to 90 dB L_{Aeq} would be intolerable for any extended duration.

Mitigation will be required. Also, consultation with the residents will be required to determine whether temporary relocation is feasible to address the noise effects. Any of these measures will only be required if residents will be at home while the works occur. The magnitude of mitigation will be dependent on the total duration of works near these dwellings.

Moderate Impact Receivers: For most other affected receivers, noise levels are predicted to be in the 70–75 dB L_{Aeq} range. While these levels are unlikely to cause disruption outdoors, they will be clearly audible inside buildings and may interfere with activities requiring concentration. This can typically be managed by keeping windows and doors closed and, where practicable, through the installation of temporary noise barriers, which can reduce received levels by up to 10 dB.

Night-time Effects

Internal noise levels in sensitive spaces (e.g., bedrooms) are determined by the external noise level, the acoustic insulation of the building façade (particularly glazing), and the room's acoustic properties (such as dimensions and surface finishes). These factors can vary significantly between properties.

Night-time construction works may be required at times during the project. Ambient noise levels in the area are low at night, so construction noise will be more prominent and has the potential to disturb sleep. Where proposed night works have the potential to exceed the internal noise criteria in Appendix B, a Site-Specific Noise Management Schedule should be prepared to manage that activity. It will identify the affected receivers, the mitigation to be applied, monitoring to be undertaken, and a process for notifying and consulting with those residents in advance of the works.

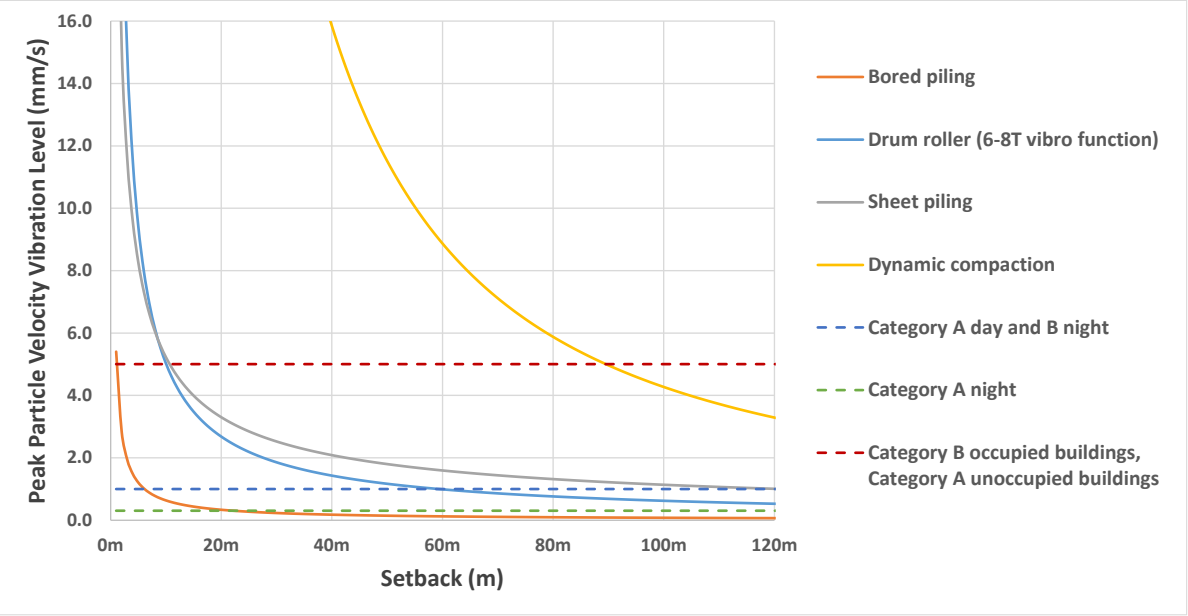
5.4 Construction vibration effects assessment

This section provides a detailed assessment of potential vibration effects. It outlines the methodology for predicting vibration, followed by a risk-based analysis to identify potentially affected properties and the corresponding mitigation and management strategies required.

5.4.1 Key Activities and vibration data

The assessment focuses on activities with the highest vibration potential: vibratory rolling, sheet piling, and dynamic compaction. Predictions use regression curves (see Figure 1) derived from industry data (BS 5228-2, Transport Research Laboratory (UK) Reports, and prior measurements we have carried out). We applied a 100% safety factor to the analysis to produce a conservative prediction. The recession curves are indicative and will be confirmed through on-site testing. Such surveys will be required by the CNVMP.

Figure 1: Vibration Regression Curves



5.4.2 Construction vibration compliance envelope

We developed a risk-based framework to assess potential impacts against the NZTA criteria. The framework categorises buildings based on their distance from vibration-generating activities. The risk categories are defined as follows:

- High Risk: Predicted vibration may exceed the Category B (compliance limit).
- Medium Risk: Predicted vibration may exceed the Category A (management trigger) but is expected to comply with Category B.
- Low Risk: Predicted vibration is expected to comply with both Category A and B criteria.

Table 6 defines the risk zone distances for each key activity. These are based on the indicative equipment and represent a reasonable worst-case scenario for the equipment assumed. The contractor will update these zones within the CNVMP if they propose different equipment. The "Unoccupied Structures" category assumes lightweight structures.

Most dwellings are located more than 15 metres from the closest extent of the Project construction works. However, several buildings are within the Medium or High Risk zones, particularly near the Pyes Pa / Cameron Road / SH29A intersection. We did not identify any buildings within the risk zones for sheet piling activities.

Table 6: Activity and risk zones

Equipment	Risk Zones		
	Occupied Dwellings (Residential)	**Other Occupied Buildings (Commercial)**	**All Other Buildings[1]**
Dynamic compaction	High: <90m Med: 90-165m Low: >165m	High: <90m Med: 90-105m Low: >105m	High: <40m Med: 40-90m Low: >90m
Vibratory Roller	High: <15m Med: 15-40m Low: >40m	High: <15m Med: 15-25m Low: >25m	High: <5m Med: 5-15m Low: >15m

Equipment	Risk Zones		
	Occupied Dwellings (Residential)	Other Occupied Buildings (Commercial)	All Other Buildings[1]
Sheet-piling	High: <10m Med: 10-45m Low: >45m	High: <10m Med: 10-15m Low: >15m	High: <5m Med: 5-10m Low: >10m

1.Assumes lightweight structures. Limits for other structure types would be confirmed in the CNVMP.

Table 7 summarises the number of buildings within each risk category. A building in the "High Risk" category will, by definition, also exceed the "Medium Risk" trigger. Figures showing the locations of these receivers are included in Appendix C.

Table 7: Indicative number of buildings in each vibration risk category

Location	Approx. number of buildings potentially receiving vibration levels exceeding	
	Category A	Category B
Arrowfield Drive	7	0
Cameron Road	10	6
Dumfries Place	5	0
Elderton Avenue	12	1
Fairfax Crescent	12	0
Galloway Crescent	5	0
Havenbrook Way	5	2
Maleme Street	9	0
Marshall Avenue	34	7
Millridge Way	6	0
Pyes Pa Road	19	2
Redwood Lane	2	0
Stableford Drive	1	0
State Highway 29	1	0
State Highway 29A	2	1

The vibration criteria for dwellings are significantly lower at night. During night-time hours, the Medium Risk zone would extend to over 200m for general works and 400m for dynamic compaction. On this basis, vibration-intensive activities in the vicinity of dwellings should be scheduled for the daytime wherever practicable.

For buildings located within the High and Medium Risk zones, the contractor must investigate and implement low-vibration construction methods wherever practicable. These methods, which include screw piling, non-vibrating rollers, and pre-drilling piles, are intended to achieve compliance with the Category A vibration criteria.

If the contractor determines that low-vibration methods are not practicable, they must implement the mitigation measures outlined in Table 8 before construction begins. The contractor will also finalize the specific risk zones at that time.

Table 8: Recommended mitigation of construction vibration

For buildings in the High Risk zone	For buildings in the Medium Risk Zone
Engage with the building owner and occupier to discuss the proposed construction activities and likely vibration effect	Notify occupiers of the works in advance via a letter drop. The letter should outline the proposed construction activities and likely vibration effects.
Undertake a pre-construction building condition survey; and	Undertake a pre-construction building condition survey.
Monitor vibration levels during the construction activities which are within the High Risk distance	

The project team will likely include buildings outside the Medium Risk Zone in their communications to ensure residents do not worry about building damage or similar issues. The CNVMP will define the exact mitigation measures and identify the affected buildings. By that time, the team will know the construction equipment, timing, and methodology, allowing them to take on-site measurements to determine the regression curves for the Project locations.

Mitigation strategies will feature communication and engagement, alongside the careful selection of construction methods and timing. Finally, the project team will likely need to prepare a specific Schedule for houses located in either the High or Medium Risk zones.

5.4.3 Construction Vibration Effects

People can feel vibration at levels well below those that cause cosmetic building damage. For structural damage to occur, vibration levels would need to be magnitudes higher than perceptible levels. People tend to react with concern at low vibration levels. It is therefore important to inform residents that construction vibration may be perceptible but that the project will manage it to levels that do not pose a risk to property. Table 9 describes the likely human response to various vibration levels.

Table 9: Vibration effects

Vibration level (mm/s PPV)	Potential effects indoors
0.14	The threshold of perception for stationary people.
0.3	Can be perceptible during normal residential activities, particularly for more sensitive receivers. Levels above this would wake most people from their sleep. This is the Category A criterion for construction vibration generated at night-time for sensitive receivers.
1	Is generally tolerable, but complaint or adverse reaction is likely if there is no warning in office or residential environments. What people actually feel would be subject to the source 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, either of which could rattle crockery and glassware. Sleep disturbance would be almost certain for most people. This is the Category A criterion for construction vibration generated during daytime for sensitive receivers, and the Category B criterion for sensitive receivers during night-time.

Vibration level (mm/s PPV)	Potential effects indoors
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. Effects experienced would be somewhere between levels of 1 and 5 mm/s. This is the Category A criterion for construction vibration during daytime for other occupied buildings.
5	Unlikely to be tolerable in a workplace. Highly unsettling for both the workplace and residential. If exposure was prolonged, some people could want to leave the building affected. Computer screens would shake, and light items could fall off shelves. This is the threshold below which no cosmetic damage will occur according to the DIN4150-3 standard. This is the Category B criterion for construction vibration during daytime for all occupied buildings, and the Category A criterion for unoccupied buildings.
10	Likely to be intolerable for anything other than a very brief exposure.

6.0 MANAGEMENT AND MITIGATION FRAMEWORK

Effective management and mitigation are essential for minimising adverse noise and vibration effects to the BPO. A robust management framework, led by a CNVMP, provides the primary mechanism for achieving this.

6.1 Construction Noise and Vibration Management Plan (CNVMP)

The most effective way to control construction noise and vibration is through good on-site management and communication between managers and other staff as well as potentially affected parties. Management and mitigation measures are most appropriately set out in a CNVMP.

The construction contractor will accordingly develop a project-specific CNVMP before works commence. The CNVMP will serve as the core document for managing all on-site activities and for outlining the interaction protocols with potentially affected parties.

The contractor will prepare the CNVMP in accordance with the NZTA State Highway Construction and Maintenance Noise and Vibration Guide[2]. The Guide contains detailed information on how NZTA manages construction noise and vibration, the hierarchy of measures to be implemented and the documentation to be prepared. In our opinion, if implemented, these measures will avoid, remedy, or mitigate adverse effects where appropriate.

The Guide anticipates that:

- A suitably qualified expert independently peer-reviews the CNVMP prior to implementation.
- The CNVMP includes a comprehensive, risk-based quality assurance programme to ensure all management procedures are correctly implemented and remain effective.

6.1.1 CNVMP Content

In line with NZS 6803:1999 "Acoustics – Construction Noise", the CNVMP will include the following content:

[2] https://www.nzta.govt.nz/assets/resources/sh-construction-maintenance-noise/docs/State-highway-construction-and-maintenance-noise-and-vibration-guide.pdf

- The noise and vibration criteria as established in this assessment.
- A summary of the predicted noise and vibration levels from this assessment.
- A description of the general construction practices, management procedures, and mitigation measures to be applied across the project.
- Details of specific noise and vibration mitigation measures for high-risk activities, sensitive receiver locations, and all night-time works.
- Protocols for noise and vibration monitoring.
- A clear procedure for handling complaints.
- Training of staff regarding noise and vibration issues.
- A process for the review and updating of the CNVMP throughout the Project works.

The CNVMP should be implemented on site for each specific area of work, should be prepared once the construction method is established, and kept up to date as the methodology develops

6.2 Site-Specific Management Schedules

For activities or locations where the assessment predicts noise or vibration will exceed the criteria, the contractor must develop Site-Specific Management Schedules[3]. These Schedules are operational tools that function as detailed appendices to the CNVMP.

The purpose of a Schedule is to define the specific management approach for a high-risk task or area, including:

- Identifying the specific activities, plant, and equipment involved.
- Listing all potentially affected parties who require targeted communication.
- Detailing the specific mitigation measures to be used (e.g., temporary barriers, alternative construction methods, time restrictions).
- Outlining the specific monitoring and reporting procedures for that task.

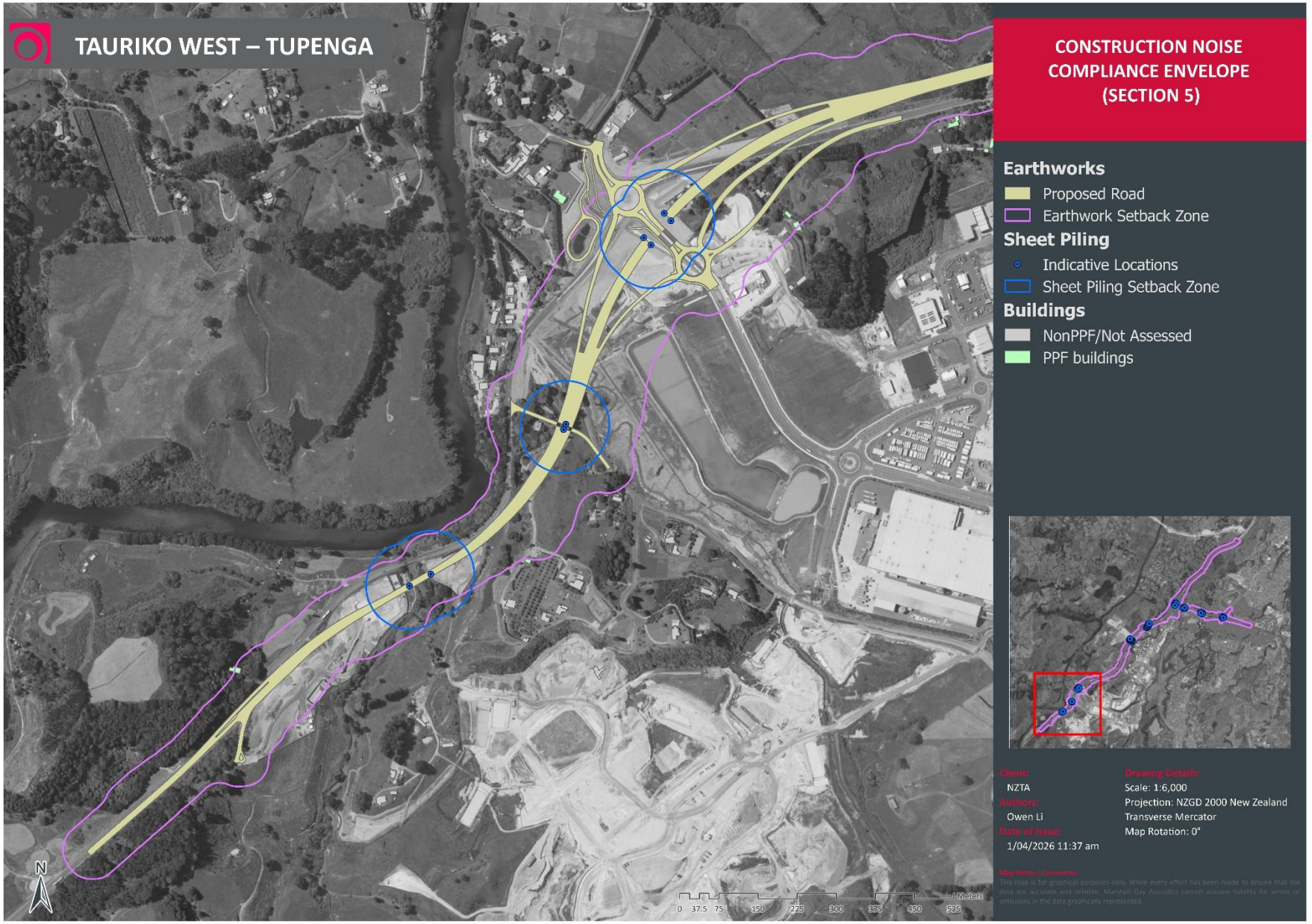
The implementation of this management framework, comprising the overarching CNVMP and task-specific Schedules, will ensure that adverse effects from construction noise and vibration are avoided, remedied, or mitigated in accordance with statutory requirements and industry best practice.

[3] https://www.nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Noise-and-vibration/Standards/Templates/Construction-noise-and-vibration/NZTA-Construction-noise-and-vibration-management-schedule-v1.2.doc

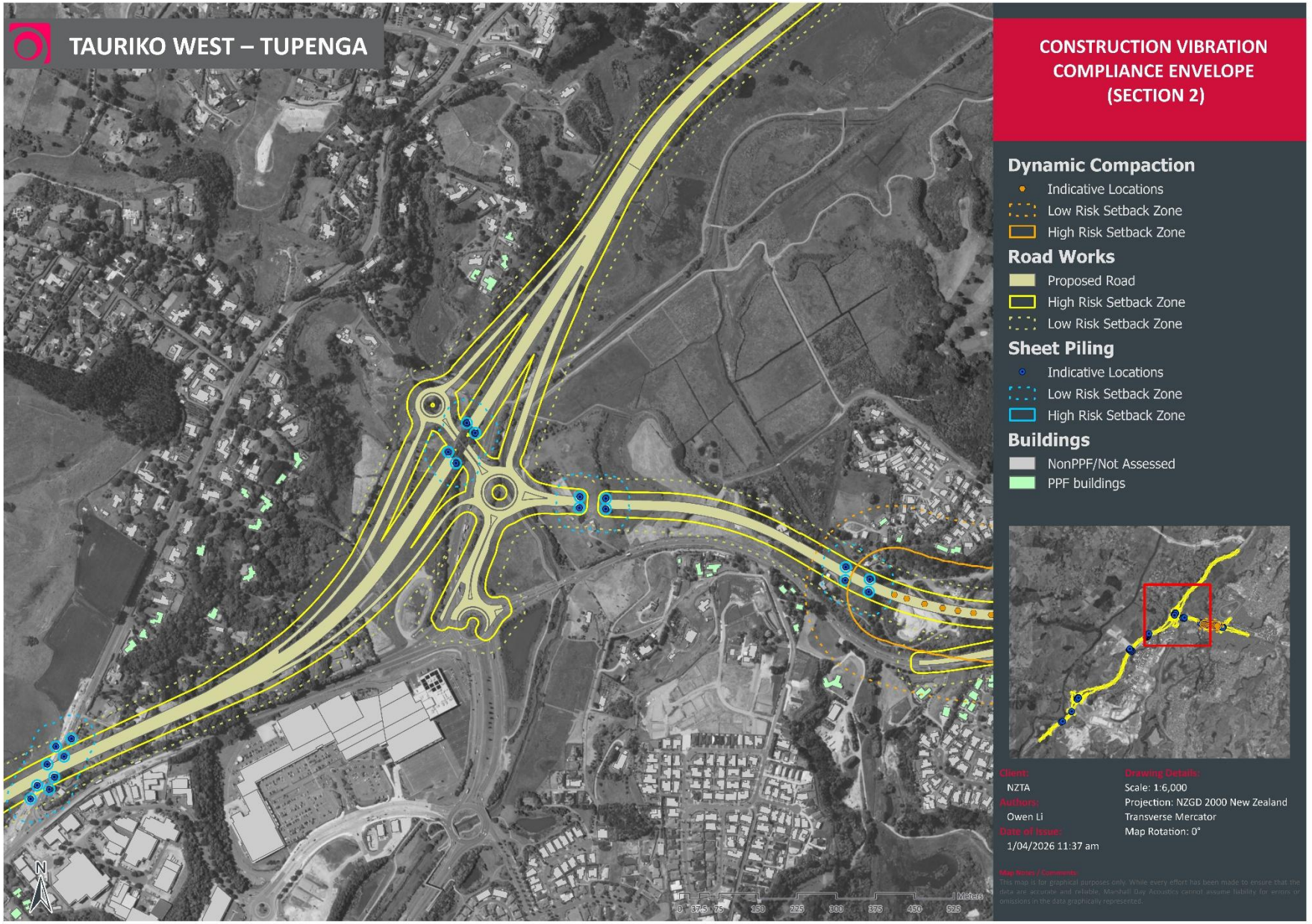
APPENDIX A GLOSSARY OF TERMINOLOGY

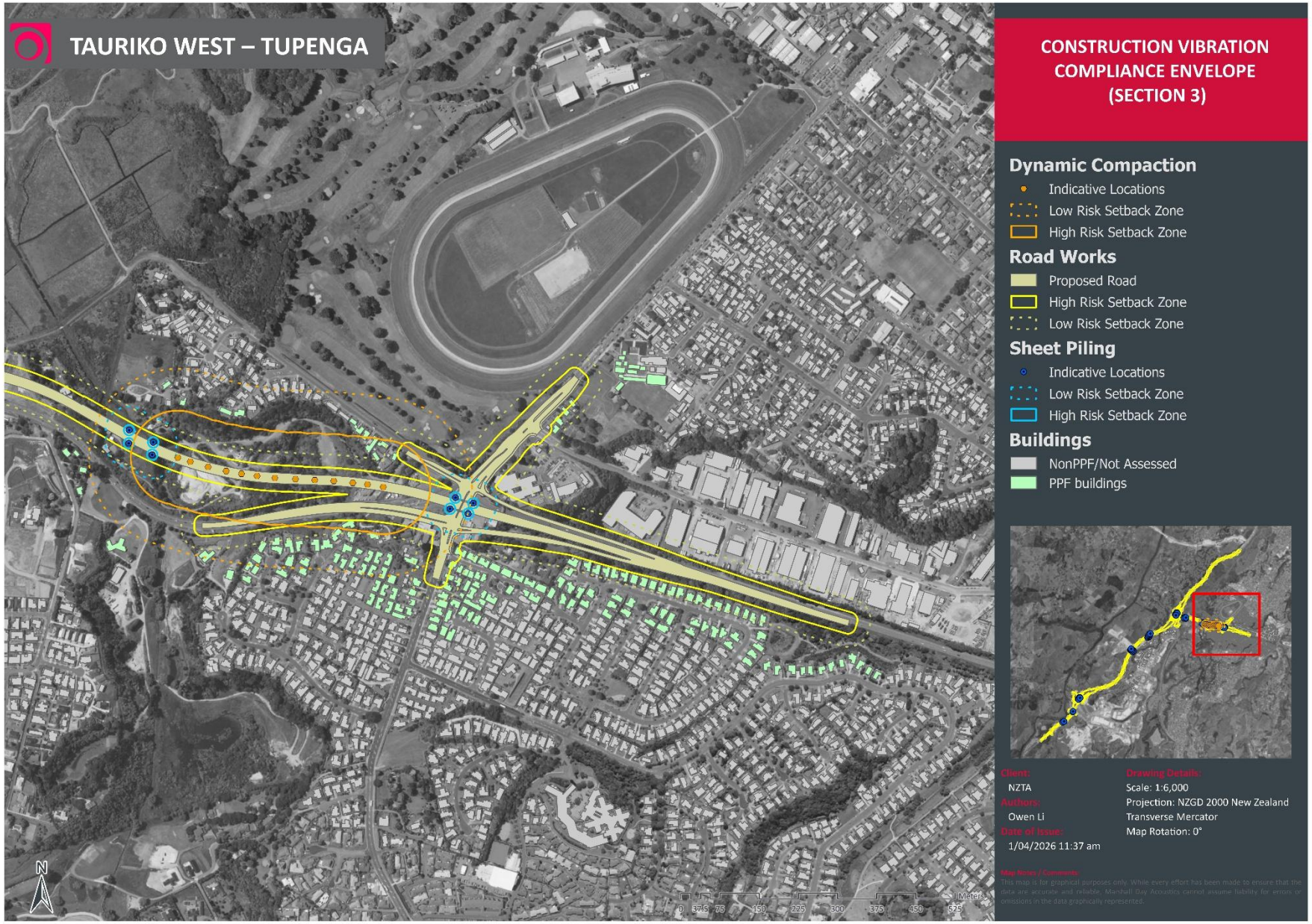
Glossary of terms / abbreviations	
Term	**Definition**
BPO	Best Practicable Option
BS 5228-2	British Standard 5228-2:2009: "Code of practice for noise and vibration control on construction and open sites"
CNVMP	Construction Noise and Vibration Management Plan
dB	Decibel: The standard unit for measuring sound pressure level.
DIN 4150-3	Deutsches Institut für Normung (German Institute for Standardization) Standard 4150-3:1999: "Structural vibration - Effects of vibration on structures"
L_{A90}	The A-weighted sound level exceeded for 90% of the measurement time, commonly used to represent the background sound level.
L_{Aeq}	The A-weighted equivalent continuous sound level; the average sound energy over a specified period. The 'A-weighting' adjusts sound levels to approximate human hearing.
LAFmax	The A-weighted maximum sound level recorded with a 'Fast' time weighting.
LWA	Sound Power Level: An intrinsic measure of the total sound energy radiated by a source, independent of distance.
MASNZ	Member of the Acoustical Society of New Zealand.
MDA	Marshall Day Acoustics
MEng	Master of Engineering.
mm/s	Millimetres per second: The unit of measurement for particle velocity in vibration.
NZS 6803	New Zealand Standard 6803:1999: "Acoustics – Construction Noise".
NZTA	New Zealand Transport Agency (Waka Kotahi).
PPV	Peak Particle Velocity: The maximum instantaneous speed of particle movement as it oscillates from its resting position due to vibration. It is the primary metric for assessing vibration effects.
RMA	Resource Management Act 1991.
TRL	Transport Research Laboratory (UK).

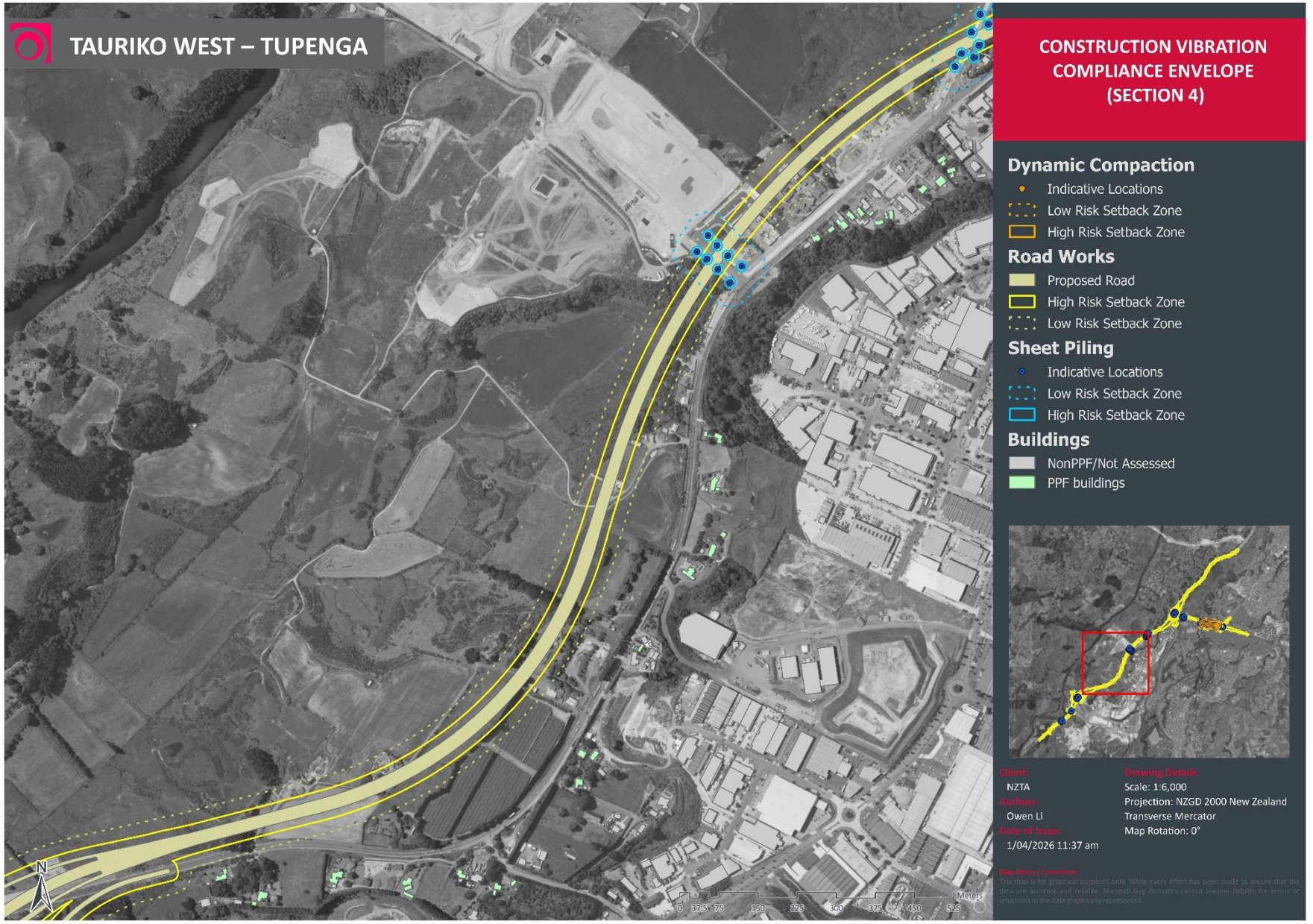
APPENDIX B CONSTRUCTION NOISE COMPLIANCE ENVELOPE



APPENDIX C CONSTRUCTION VIBRATION COMPLIANCE ENVELOPE







APPENDIX D SCHEDULES TO THE CNVMP

To be attached here, once completed.