RANGITIKEI DISTRICT COUNCIL

CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

MARTON RAIL HUB, MARTON

AUGUST 2021

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Construction Noise and Vibration Assessment
Marton Rail Hub, Marton

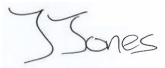
Rangitikei District Council

Reference: *210802-5-WT696-GvH-R2-MRH Construction Noise and Vibration Assessment*

WSP
12 Moorhouse Avenue
Christchurch, 8011

Phone: +64 3 343 9860
wsp.com

REV	DATE	DETAILS

	NAME	DATE	SIGNATURE
Prepared by:	George van Hout	10 August 2021	
Reviewed by:	Jon Jones	10 August 2021	
Approved by:	Chris Bradley	10 August 2021	

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EXECUTIVE SUMMARY

WSP has undertaken an acoustic review of the expected noise and vibration associated with the construction of Marton Rail Hub, in Marton in line with the Rangitikei District Council's District Plan.

Each area within Marton Rail Hub has the potential to be constructed either concurrently or separately from other areas.

The Rangitikei District Plan references New Zealand Construction noise Standard NZS 6803:1999 with regard to assessing construction noise. There is no requirement to assess vibration from construction activities under the Rangitikei District Plan. We have therefore developed vibration criteria based on DIN 4150-3 and BS 5228-2.

Due to a contractor not being onboard with the project at this stage of design, there is limited detailed information around the construction methodology available. Therefore, based on previous experience of WSP, we have predicted the stand-off distance required by different, high noise generating equipment and processes individually. The stand-off distance is the minimum distance where an activity would comply with the relevant noise and/or vibration limits.

High construction noise sources include excavation, piling, concrete activities, roading works, cranage and installation of steel structures, and landscaping. Based on typical sound powers of this equipment from a database, and previous noise measurements by WSP, 1066 State Highway 1 is the only property that would fall within the stand-off distance for piling activities only. All other properties would comply with the District Plan limits.

High vibration construction sources including excavation, piling, and vibratory compaction. Based on typical vibration levels of this equipment, it is predicted that there will be no properties that receive vibration levels which would result in intolerable vibration levels if prior warning and explanation has not been given to residents.

To minimise the impact of construction noise and vibration on adjacent properties, it is recommended that a Construction Noise and Vibration Management Plan is adopted by the contractor for each area. This will refine the construction methodology, predict the noise and vibration levels at surrounding properties, and both from multiple equipment occurring on site, and from multiple sites being construction at once (if necessary), outline acoustic mitigation, provide a framework for noise and vibration monitoring and community consultation.

With the adoption of a Construction Noise and Vibration Management Plan, noise and vibration are predicted to be acceptable based on the District Plan noise limits and developed vibration criteria.

1 INTRODUCTION

It is proposed that an area of approximately 60 hectares of land near Marton is rezoned from a rural zone designation to a new industrial zone under a proposed Plan Change (1165, 1151 and 1091 State Highway 1). The site is known as the "Marton Rail Hub".

WSP has been appointed to provide acoustic consultancy services to compare the expected noise and vibration levels associated with the construction of Marton Rail Hub to the relevant noise and vibration criteria.

The proposed Marton Rail Hub site is to include:

- Operation of a rail siding;
- Log yard;
- Container storage;
- Plastic manufacturing;
- Food processing.

This report provides an overview of the proposed site, expected construction activity, and predicted stand-off distances to achieve the relevant noise and vibration criteria.

WSP have undertaken an assessment of the operational noise of the Marton Rail Hub development, which is contained within the report titled *Marton Rail Hub, Comprehensive Development Plan; Acoustic Assessment* (reference: 20210810-5-WT696-GvH-R1-Comprehensive Development Plan, dated 10 August 2021).

1.1 DOCUMENTATION

This assessment is based on our correspondence with the design team, disc and the following documentation:

- Development plan area, titled *Marton Rail Hub*, sheet number SK32(A)-OPT5-CDP, received by email on 3 June 2021
- Site layout drawing titled *Marton Rail Hub; Proposed layout*, sheet number SK30(A)-OTP6, received by email on 21 May 2021

2 SITE DESCRIPTION

2.1 SITE LOCATION

The location of the proposed Marton Rail Hub and surrounding area is shown in Figure 2.1. The site is located between Makirikiri Road to the south, State Highway 1 to the east, Wings Line further to the north, the North Island Main Trunk Line (NIMTL) and Marton to the west.

The proposed site and majority of the surrounding area is designated as rural zoned land. Marton, to the northwest, is designated as Residential, and there is an area of land to the southeast of Marton designated as Industrial Zoned land. This industrial area contains the Malteurop production facility.

Figure 2.1 Location of the proposed rezoned land and surrounds (Google Earth accessed May 2021)

2.2 PROPOSED SITE LAYOUT

The site plan for Marton Rail Hub sites includes multiple industrial areas, a new rail siding, and internal roads. Access into the proposed Marton Rail Hub site is solely from Makirikiri Road to the south. The proposed layout of the development is provided in Figure 2.2.

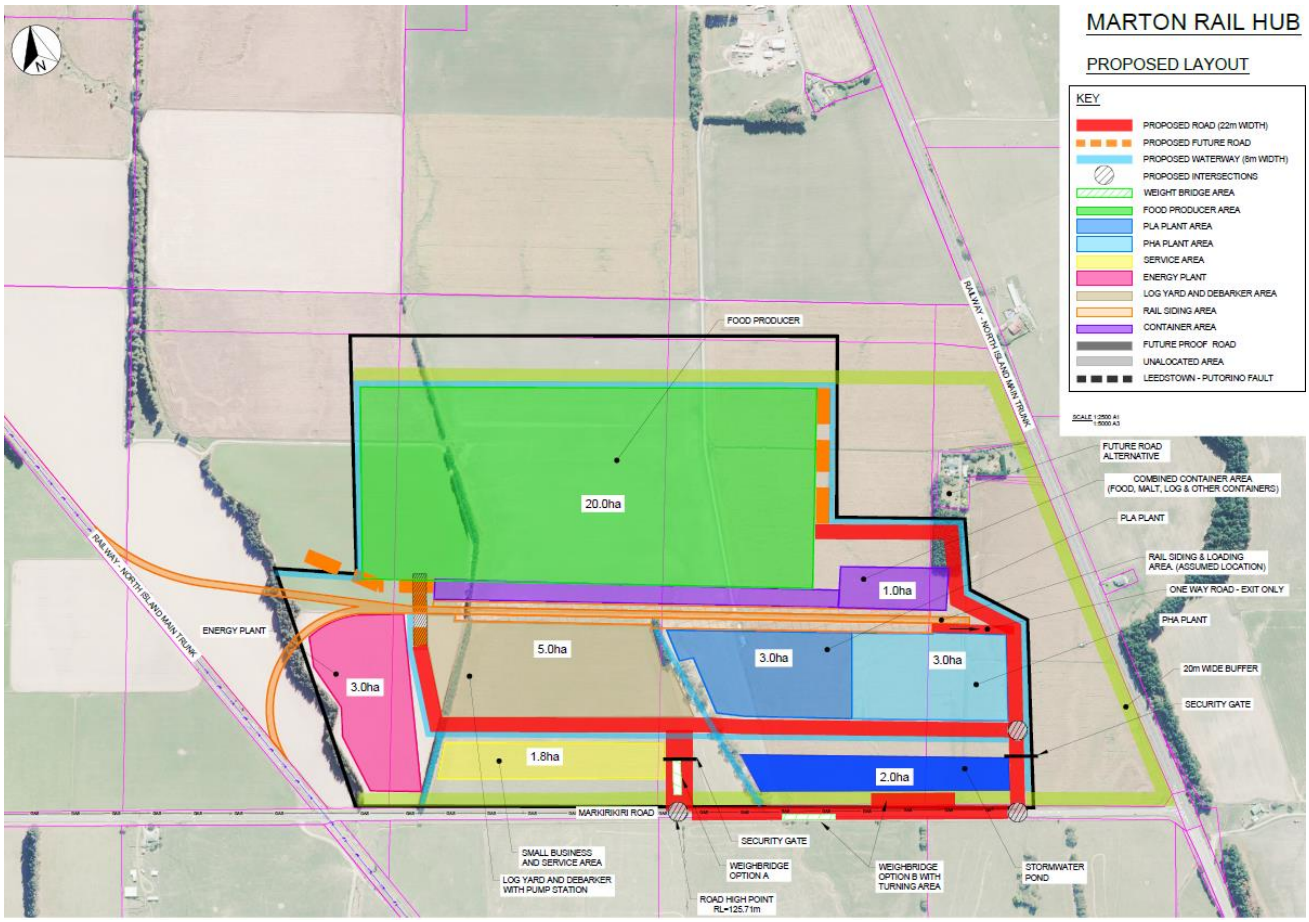

Figure 2.2 Marton Rail Hub site layout and location

The internal roads, utilities, landscaping, and other general areas will be constructed first, with the specific activity areas being constructed at different times once tenants are confirmed. Construction on each area may occur concurrently or sequentially. Construction activities for both the general site development and each area is expected to take longer than 20 weeks (both individually and cumulatively).

2.3 SURROUNDING PROPERTIES

The surrounding properties which may be affected by construction noise and vibration associated with Marton Rail Hub are outlined in Table 2.1.

Table 2.1 Surrounding properties

PROPERTY	APPROXIMATE DISTANCE TO MARTON RAIL HUB
73 Wings Line (Fraser Auret Racing)	1000 – 1400 metres
76 Wings Line	950 metres
Malteurop	700 metres
19 Goldings Line	950 metres
33 Goldings Line	970 metres
67/77 Goldings Line	990 metres
45 Stantialls Road	860 metres
74 Stantialls Road	660 metres
1020 State Highway 1	330 metres
1066 State Highway 1	150 metres
1091 State Highway 1	60 metres
1108 State Highway 1	260 metres
1165 State Highway 1	340 metres
157 Makirikiri Road	300 metres
97 and 104 Alexandra Street	1150 metres

The properties at 1165 and 1091 State Highway 1 are to be acquired as part of this proposal for land development. Therefore, noise and vibration impacts at these properties are not further considered.

The above properties in relation to the proposed rezoned industrial land are shown in Figure 2.3 below.

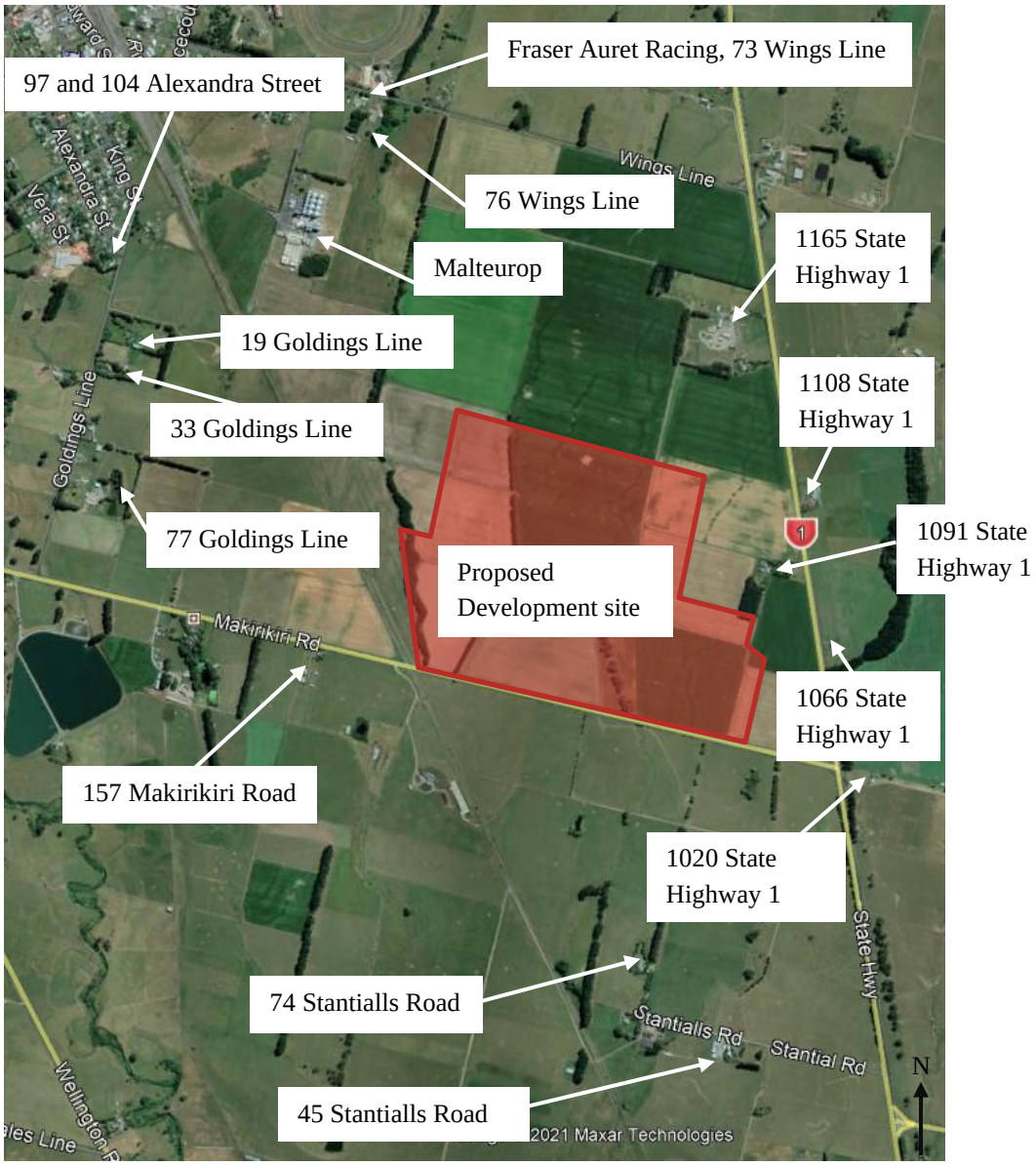

Figure 2.3 Location of surrounding properties

3 ACOUSTIC CRITERIA

Section 16 of the Resource Management Act (RMA) requires occupiers of land to ensure any noise generated is of a reasonable level. Guidance as to a reasonable level of noise received at adjacent noise sensitive receptors is provided in a number of national and international sources as outlined below.

3.1 CONSTRUCTION NOISE CRITERIA

3.1.1 RANGITIKEI DISTRICT PLAN

The noise limits for any construction activities within the Rangitikei District are outlined in Part B *Rules*, Section B1.7 *Noise*, part B1.7-6 of the Rangitikei District Plan, which states:

All noise emitted in the course of construction work must comply with NZS 6803:1999 Acoustic – Construction Noise.

3.1.2 NEW ZEALAND STANDARD NZS 6803:1999

New Zealand Standard NZS 6803:1999 *Acoustics – Construction Noise* is the most appropriate standard to assess construction noise against.

The 'long-term duration' guidance noise limits outlined in Table 2 of NZS 6803 are applicable, and have been reproduced in Table 3.1. These noise levels apply at 1 metre from the most exposed façade of an occupied building.

Table 3.1 Recommended construction noise limits at residential receptors

TIME OF WEEK	TIME PERIOD	LONG-TERM DURATION (DBA)	
		L_{eq}	L_{max}
RESIDENTIAL AND RURAL			
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
COMMERCIAL AND INDUSTRIAL			
At all times	0730 – 1800	70	-
	1800 – 0730	75	-

We note that NZS 6803:1999 states that all practicable options must be explored to avoid or mitigate noise from construction activities. However, if all practicable options are adopted and the noise limits are still not met, exceedance of these noise limits is acceptable. Nevertheless, compliance with the 'long-term duration' construction noise limits are in line with good practice.

3.2 CONSTRUCTION VIBRATION CRITERIA

There is no operational or construction vibration criteria set out in the Rangitikei District Plan. Therefore, guidance as to an acceptable construction vibration limit has been sourced from other Standards.

3.2.1 SUBJECTIVE RESPONSE TO VIBRATION

British Standard BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*, provides guidance's as to the subjective perception of vibration levels on occupants of buildings. Table B.1 (and reproduced in Table 3.3 below) is built on the levels in British Standard BS 6472, however converted into Peak Particle Velocity (PPV), which is in line with other standards for assessing construction vibration

Table 3.2 BS 5228 Table B.1 Guidance on effects of vibration levels

VIBRATION LEVEL [A, B, C]	**EFFECT**
0.14 mm s^{-1}	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 mm s^{-1}	Vibration might be just perceptible in residential environments.
1.0 mm s^{-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.
10 mm s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments

A. The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient

B. A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.

C. Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.

3.2.2 BUILDING DAMAGE

German Standard DIN 4150-3:1999 *Structural Vibration – Part 3: Effects of Vibration on Structures* provides guidance on vibration impact on building structures. The Standard states that compliance with short term guidance vibration values within the Standard will avoid any structural and/or cosmetic damage. Table 1 in DIN 4150-3 is reproduced in Table 3.3.

Table 3.3 Guideline velocity vibration values, Table 1 of DIN 4150-3:1999

LINE	TYPE OF STRUCTURE	GUIDELINE VALUES FOR VELOCITY, V_i IN MM/S			
		VIBRATION AT THE FOUNDATION AT A FREQUENCY OF			VIBRATION AT HORIZONTAL PLANE OF HIGHEST FLOOR AT ALL FREQUENCIES
		1 HZ TO 10 HZ	10 HZ TO 50 HZ	50 HZ TO 100 HZ *	
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic values (e.g. buildings under a preservation order).	3	3 to 8	8 to 10	8
* at frequencies above 100 Hz, the values given in this column may be used as minimum values.					

British Standard BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*, provides a brief review of vibration standards and response levels to buildings and humans. Table B.2 of BS 5228-2 outlines the short-term vibration threshold values which have been shown to start to cause cosmetic damage. Table B.2 of BS 5228-2 is reproduced below.

Table 3.4 BS 5228-2 Table B.2 Guideline vibration levels at which cosmetic damage starts to occur

LINE	TYPE OF BUILDING	PEAK COMPONENT PARTICLE VELOCITY IN FREQUENCY RANGE OF PREDOMINANT PULSE	
		4 HZ TO 15 HZ	15 HZ AND ABOVE
1	Reinforced or framed structures; Industrial and heavy commercial buildings	50 mm/s at all frequencies	
2	Unreinforced or light framed structures Residential or light commercial buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above.

Minor structural damage is possible at vibration magnitudes which are greater than twice the vibration levels presented in the table above. This shows that significant vibration levels are required before structural damage will occur.

BS 5228-2 provides a database of measured vibration levels of multiple vibration activities.

3.2.3 PROPOSED CONSTRUCTION VIBRATION CRITERIA.

Where vibration from construction activities is below the values outlined in DIN 4150-3:1999, vibration is not expected to result in cosmetic or structural damage. Where the predicted vibration levels are above these values, management of vibration activities will be required and mitigation implemented to reduce the impacts.

In addition to the avoidance of building damage, construction vibration can be perceived at a much lower level. We therefore recommend that where a daytime vibration level of 1 mm/s PPV or higher is predicted, building occupiers are communicated with prior to the works occurring. This shall be adopted as part of a Construction Noise and Vibration Management Plan.

Since people can perceive vibration at levels well below those required to cause damage to buildings, it is important to communicate that the vibration that can be felt may not be at a level to affect the building structure.

4 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

4.1 ASSESSMENT METHODOLOGY

At the time of writing, a contractor has not been engaged for the project and so a detailed construction methodology has not been developed. Therefore, there is limited information on the construction staging, process, and details of the specific equipment to be used on site.

We have therefore undertaken an assessment of typical high-noise generating equipment such as excavation, piling, concrete works, road construction, and installation of structures) that is expected to be used during construction based on our experience on similar projects. A full list of the equipment used for assessment is included in Table 4.1.

For the purposes of this assessment a stand-off distance has been established. Where construction activities occur at a distance greater than the stand-off distance to any adjacent property, the acoustic criteria will be achieved. This provides an indication of whether it is feasible for construction activity to achieve the relevant construction limits.

Noise from construction activities have been predicted by the methodology outlined in the New Zealand Construction Noise Standard NZS 6803:1999. Each item of equipment has been assessed individually, as the construction methodology has not been developed.

Vibration velocity estimates have been calculated for different pieces of construction equipment, using principles from Waka Kotahi Research Report 485. For these vibration estimates, existing soils have been assumed to be competent in nature.

The noise and vibration levels of equipment are based on a database of standard construction equipment, along construction equipment measured by WSP. On-site measurements of the specific plant and/or use of equipment which generates lower noise and/or vibration levels may reveal that equipment can be used closer to houses without exceeding the relevant noise and/or vibration limits.

For the propagation of construction noise and vibration, spreadsheet calculations have been used. The noise levels predicted are expected to be conservative as they do not allow for screening, air or ground absorption, and reduction due to terrain. They also do not allow for any physical mitigation that may be implemented by the contractor.

It is assumed that any high noise and vibration generating equipment would only occur on site between 0730 and 1800 hours Monday to Sunday, where a 70 dB L_{Aeq} cumulative noise limit applies.

Once a contractor is on board, the construction methodology can be developed, and a Construction Noise and Vibration Management Plan can be adopted to predict the noise and vibration emissions from specific construction methodologies and where necessary develop specific mitigation measures to control noise.

Based on our experience, lower noise activities, such as contractors arriving on site, toolbox talks, and light handheld tools are not noise generating, and therefore are expected to comply with the relevant noise limits. We have excluded these noise sources from this analysis.

These assessments are indicative only, and relate to specific equipment operating solely. Where multiple pieces of equipment operate concurrently, the stand-off distances may increase. A specific Construction Noise and Vibration Management Plan should be developed by the contractor which will assess cumulative noise impact and manage the potential noise impacts from construction activity.

4.2 CONSTRUCTION NOISE LEVELS

Table 4.1 provides the stand-off distance at which the daytime construction noise criteria would be achieved. Therefore, construction activities occurring at a distance equal or greater to the stand-off distance to an adjacent property are expected to comply with the noise requirements.

Table 4.1 Predicted noise emissions and stand-off distance for construction activities expected at Marton Rail Hub

ACTIVITY	SOUND PRESSURE LEVEL AT 10 METRES (dB)	STAND-OFF DISTANCE AT WHICH THE DAYTIME NOISE CRITERIA (70 dB) WOULD BE ACHIEVED (METRES)
Excavator	78	60
Wheeled Loader	82	95
Vibratory Piling	94	220
Driven Piling	94	220
Grader	83	110
Watercart	81	90
Asphalt paver and truck	77	55
Concrete pump and agitator	80	75
Vibratory Roller	75	45
Vibratory compactor	82	100
20 truck and trailer movements	71	28
Water Pump	65	15
Generator	66	20
Angle Grinder of steel	80	75
Rattle guns	77	55
Crane	77	60

The majority of properties are outside of the stand-off distances, and therefore no further mitigation would be required to control noise whilst complying with the district plan requirements.

4.2.1 DISCUSSION

The dwelling at 1066 State Highway 1 is approximately 150 metres away from the boundary of the Marton Rail Hub site. Therefore, there is a small area of the site where, if piling activities occur, may result in exceedances of the noise limits.

Any exceedances would only occur if/when piling work occurs 220 metres or less away from 1066 State Highway 1. When considering the dwelling at 1066 State Highway 1 is 150 metres from the site boundary at the closest point. An area of approximately 70 metres from the site boundary near 1066 State Highway 1 into the site would therefore potentially result in levels greater than 70 dB L_{Aeq} at 1066 State Highway 1. The proposed PHA plant site is within this area. If piling was required in this area, it would only be for a limited duration.

It is likely that with good site management, communication with adjacent neighbours, and (where practicable) the use of physical mitigation, the impact of construction noise can be appropriately managed. A Construction Noise and Vibration

Management Plan should be developed by the contractor of any site to manage noise to adjacent properties, especially for construction of the PHA Plant site if piling is required.

4.3 CONSTRUCTION VIBRATION LEVELS

Assessment of the Peak Particle Velocity (PPV) has been undertaken for the main vibration generating activities. Table 4.2 provides the expected vibration emissions for the significant vibration generating machinery, along with the stand-off distances to achieve the vibration criteria discussed in Section 3.2.

Table 4.2 Predicted vibration levels and stand-off distance for typical worst-case construction activities

EQUIPMENT	EQUIPMENT VIBRATION LEVEL AT 10 METRES (mm/s PPV)	REQUIRED STAND-OFF DISTANCE TO ACHIEVE VIBRATION CRITERIA (METRES)			
		20 mm/s PPV	5 mm/s PPV	3 mm/s PPV	1 mm/s PPV
Excavator breaking hard ground	4.1	5	12	15	30
Piling – Vibratory method	31.0	15	38	55	110
Piling – Impact method	30.0	15	35	50	110
Vibratory roller	6.0	7	15	20	40

4.3.1 DISCUSSION

All surrounding properties that are not being procured as part of the development are predicted to receive vibration levels less than 1 mm/s.

Vibration measurements should be undertaken on specific high-vibration generating machinery to determine the specific stand-off distances on site. This would be captured within a Construction Noise and Vibration Management Plan.

5 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

A Construction Noise and Vibration Management Plan (CNVMP) is should be adopted for each construction area on site. A Construction Noise and Vibration Management Plan shall developed by the Consent Holder and reviewed by a suitably qualified acoustic specialist. The CNVMP be developed in line with Annex E2 of NZS 6803:1999 including:

- Proposed construction methodology to construct each site
- The predicted noise levels from the developed construction methodology that will occur on site. This includes where multiple pieces of equipment operate or if multiple areas are constructed concurrently,
- Any practicable physical noise control measures available. This could include:
  - Site hoardings and/or specific acoustic enclosures used around noise generating equipment,
  - Equipment selection (use of low noise equipment) and maintenance (regular maintenance schedules)
  - Plan worksites and activities to minimize noise and vibration
  - Not using compression brakes and fitting equipment with Non-tonal reversing alarms
- Managerial mitigation measures which can include:
  - Site inductions specific for noise and vibration control
  - Behavioural practices
  - Hours of operation
  - Control of set-back distances from properties
- A Community Communication Plan which outlines:
  - Communication by the consent holder about piling and other construction works expected to exceed the noise levels, including scheduling/timing of works and potential temporary nuisance effects.
  - Communication with local residents, including responding to any enquiries or complaints about construction activities. Procedures for timing and direct notification to potentially affected sensitive receivers to be given at least 10 working days prior to high impact events such as piling
  - Alternative (non-electronic) means of communicating key information (including mail drops).
- The contact details for the lead contractor/project manager and a representative of the consent holder.
- Complaints handing procedure
- Noise and vibration monitoring procedures.

6 CONCLUSIONS

It is proposed that an area of approximately 60 hectares of land near Marton is rezoned from a rural zone designation to a new industrial zone under a proposed Plan Change (1165, 1151 and 1091 State Highway 1). WSP has undertaken an assessment of the construction noise and vibration associated with the construction of the proposed Marton Rail Hub development.

Each area within Marton Rail Hub has the potential to be constructed either concurrently or separately from other areas.

The Rangitikei District Plan references New Zealand Construction noise Standard NZS 6803:1999 with regard to assessing construction noise. There is no requirement to assess vibration from construction activities under the Rangitikei District Plan. We have therefore developed vibration criteria based on DIN 4150-3 and BS 5228-2.

At the time of writing, a contractor has not been engaged, and therefore a detailed construction methodology cannot be developed. Instead, an assessment of the stand-off distance (distance at which activities would achieve the noise or vibration limits) by various construction activities has been undertaken.

Noise from construction activities are predicted to achieve the noise limits outlined in the New Zealand Construction Noise Standards NZS 6803:1999, assuming that the activities are setback from the dwelling of any adjacent property by the distances outlined in Table 4.1.

1066 State Highway 1 may receive noise greater than the District Plan noise limits from piling activities if these occur within 70 – 80 metres of the Marton Rail Hub site boundary near 1066 State Highway 1.

Vibration stand-off distances have also been predicted to provide an indication of whether adjacent residential properties will receive vibration levels greater than those outlined in DIN 4150-3 and BS 5228-2. All adjacent dwellings are outside of the stand-off distance for vibration and will therefore meet with the design criteria.

There is limited information available about the construction methodology, and therefore it is recommended that a Construction Noise and Vibration Management Plan is adopted by the contractor during the construction of each site. This will predict the noise at surrounding properties, cumulative noise from multiple equipment on each area and if multiple areas are being constructed concurrently, and adoption of construction best-practices..

With the development of a Construction Noise and Vibration Management Plan, noise and vibration associated with Marton Rail Hub is predicted to be reasonable.