Appendix F of the CEMP

Construction Noise and Vibration Management Plan

NZ TRANSPORT AGENCY
WAKA KOTAHI

1 MacKays to Peka Peka Expressway

Revision History

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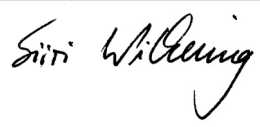
Document Acceptance

Action	Name	Signed	Date
Prepared by	Siiri Wilkening/ James Whitlock (Marshall Day Acoustics)		9 August 2011
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on behalf of	Marshall Day Acoustics		

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1 Introduction

This Construction Noise and Vibration Management Plan (CNVMP) forms part of a suite of environmental management plans within the Construction Environmental Management Plan (CEMP). It applies to the construction phase of the Project, specifically:

- State highway: 1
- Project: MacKays to Peka Peka Expressway (the Project)
- Construction location: Just south of Poplar Avenue in the south to Peka Peka Road in the north
- Construction start date: (TBC when known)
- Construction finish date: (TBC when known)
- Designation number: (TBC when known)

This CNVMP identifies the noise and vibration performance standards that must, where practicable, be complied with. It also sets out best practicable options for noise and vibration management for the Project. This CNVMP is intended as a framework for the development and implementation of particular noise and vibration management and control methodologies to minimise adverse effects on health and safety of residents and to reduce the adverse impact on the environment.

This CNVMP will be updated, with the necessary approval, throughout the course of the Project to reflect material changes associated with any changes to the construction methodologies or techniques or the natural environment. The document shall be reviewed annually to ensure that any changes are reflected.

A Glossary of technical terms is contained in Appendix F. A.

The Project is divided into four sectors, as identified in the Project sector diagram (refer to Part D, Chapter 7, Volume 2 of the AEE).

This CNVMP will be implemented in accordance with information, management tools and standards as specified on the NZTA website for the management of transport noise located at http://acoustics.nzta.govt.nz/tools.

2 Roles and responsibilities

The CEMP Report (Volume 4 of the AEE) details roles and responsibilities associated with managing environmental effects from construction on the Project. The Alliance Project Manager has the overall responsibility for meeting the requirements of this CNVMP and the Alliance Environmental Manager will implement the plan. This includes all required noise and vibration monitoring, and leads the review of results with appropriate communication to Local Authorities and the NZTA.

The following is a schedule of contact details for key personnel connected to the Construction Phase of the Project:

Table 2-1 Schedule of contact details

Role	Name	Organisation	Phone	Email
Alliance Project Manager		MacKays to Peka Peka Alliance		
Alliance Environmental Manager		MacKays to Peka Peka Alliance		
NZTA Project Manager		NZTA		
Project Noise and Vibration Consultants	Siiri Wilkening James Whitlock	Marshall Day Acoustics	09 379 7822	siiri.wilkening@marshallday.co.nz james.whitlock@marshallday.co.nz
Council – Noise/ Environmental Health				
Public complaint contact number				

All site personnel will be briefed on this CNVMP and sign appropriate induction forms and any relevant schedules. All personnel working on the Project, including contractor employees and subcontractors, are responsible for following the requirements of this CNVMP.

3 Key construction noise and vibration effects

The Project construction involves significant numbers of equipment operating in close proximity to noise and/or vibration sensitive receivers. Limited night-time construction is required in certain areas.

The primary effects of construction noise relate to annoyance and disturbance of people.

The primary effect of construction vibration relates to structural damage of dwellings, private structures such as garages or swimming pools and infrastructure assets such as roads, pipes etc. Secondary vibration effects relate to annoyance and disturbance of people, and the possible damage of property inside dwellings (e.g. ornaments, crockery etc. if they are not well secured or not sitting on level surfaces).

Responding to, and mitigating, the primary effect often alleviates the secondary (annoyance) effects, and communication and prior warning of any high-vibration activities can mitigate the effects on residents and internal property.

A list of the predominant noise and vibration generating activities in each Sector are outlined in Table 3-1 below:

Table 3-1: Key construction noise and vibration activities

Sector	Noise generating activities	Vibration generating activities
1	Fill delivery for preload construction Excavation and fill Road base course and sealing works Bridge construction, including piling & vibroreplacement Local road realignment and resurfacing	Vibratory rollers for road base course and surfacing works Off-road fill transport Excavators cutting and filling close to receivers' boundaries Vibro-hammer or cast-in-place piling for bridge construction

Sector	Noise generating activities	Vibration generating activities
2	Fill delivery for preload construction Excavation and fill Off-road earthworks transport Road base course and sealing works Bridge construction, including piling & vibroreplacement Construction of traffic noise barriers Local road realignment and resurfacing	Vibratory rollers for road base course and surfacing works Off-road fill transport Excavators cutting and filling close to receivers' boundaries Vibro-hammer or cast-in-place piling for bridge construction
3	Fill delivery for preload construction Excavation and fill Off-road earthworks transport Road base course and sealing works Bridge construction, including piling & vibroreplacement Local road realignment and resurfacing	Vibratory rollers for road base course and surfacing works Off-road fill transport Excavators cutting and filling close to receivers' boundaries Vibro-hammer or cast-in-place piling for bridge construction
4	Fill delivery for preload construction Excavation and fill Off-road earthworks transport Road base course and sealing works Bridge construction, including piling & vibroreplacement Local road realignment and resurfacing	Vibratory rollers for road base course and surfacing works Off-road fill transport Excavators cutting and filling close to receivers' boundaries Vibro-hammer or cast-in-place piling for bridge construction

Other construction machinery and activities, not specified in the above table, may produce noise and ground vibration also, but generally to a lesser degree.

Consideration must also be given to the potential for damage to existing roads and structures from high-vibration activities, particularly at tie-ins. These effects shall be managed in a manner similar to any other sensitive receiver, in terms of consultation, monitoring and reparation should any damage result.

4 Timeframe

The overall construction timeframe for the entire Project is expected to be four years. This will comprise of the following activities:

- Preload and surcharge of peat areas (Sectors 1, 3 and 4): 3 years
- Kāpiti Road to Te Moana Road (Sectors 2 and 3): 3 years
- Southern Tie-in south of Poplar Ave (Sectors 1 and 2): 3 years
- Northern Tie-in at Peka Peka Beach Road (Sector 4): 3 years

These durations relate to the entire activity and would not occur for the entire time at all closest receivers. Management and mitigation of shall be applied as appropriate (i.e. as machinery progresses along the alignment) in accordance with Sections 10 and 11.

Each receiver will be subject to varying noise levels throughout the construction period which may range from inaudible to very loud.

5 Hours of operation

Hours of operation are generally limited to 6.30 am to 8 pm, Monday-Friday, and 7.30 am to 6 pm, Saturdays, for all Sectors.

Night-time operation (i.e. 8 pm to 6.30 am) will be expected in each Sector for the placement of bridge beams across the local roads.

6 Noise performance standards

The noise levels in Tables 6-1 and 6-2 below are applicable at 1 metre from the building façade of any receiver.

Table 6-1: Project construction noise criteria: residential receivers

Time of week	Time period	Duration of work	
		Long-term duration (dB)	
		$L_{Aeq(T)}$	L_{AFmax}
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

Table 6-2: Project construction noise criteria: commercial and industrial receivers

Time period	Construction noise criteria (long-term construction) dB
	$L_{Aeq(T)}$*
0730 – 1800	70
1800 – 0730	75

* T means an assessment duration of no less than 10 minutes and not exceeding 60 minutes

7 Vibration performance standards

The construction vibration criteria for this Project are based on the draft NZTA vibration guide for managing vibration during construction associated with state highway projects. The guide addresses both building damage and human response to vibration by applying appropriate international vibration standards in a dual category approach, as follows:

7.1 Vibration Category A

Category A adopts criteria from British Standard BS 5228-2:2009 and is designed to practically address the human response effects in dwellings during the daytime and night-time periods, and offices during the daytime. For other building types, and offices during the night-time (i.e. unoccupied), the policy reverts to the building damage criteria from German Standard DIN 4150-3:1999.

If measured or predicted vibration levels exceed the Category A criteria then a suitably qualified expert shall be engaged to assess and manage construction vibration and to comply with the Category A criteria. If the Category A criteria cannot be practicably achieved, the Category B criteria shall be applied.

7.2 Vibration Category B

Category B is designed to protect buildings against damage and adopts criteria from DIN 4150-3:1999 and BS 5228-2:2009, but retains a higher degree of protection for dwellings at night-time, as contained in the human response criteria of BS 5228-2:2009.

If measured or predicted vibration levels exceed Category B criteria, then construction activity shall only proceed if there is continuous monitoring of vibration levels and effects on buildings at risk of exceeding the Category B criteria, by suitably qualified experts.

The Project criteria for construction vibration are given in Table 7-2 below:

Table 7-2 Project construction vibration criteria

Receiver	Details	Category A	Category B
Occupied dwellings	Night-time 2000h - 0630h	0.3 mm/s PPV	1 mm/s PPV
	Daytime 0630h - 2000h	1 mm/s PPV	5 mm/s PPV
Other occupied buildings*	Daytime 0630h - 2000h	2 mm/s PPV	5 mm/s PPV
All other buildings	Vibration – continuous**	5 mm/s PPV	50% of Line 2 values in Table B.2 of BS 5228-2:2009

* 'Other occupied buildings' is intended to include daytime workplaces such as offices, community centres etc., not industrial buildings. Schools, hospitals, rest homes etc. would fall under the occupied dwellings category.

** This line addresses ‘continuous’ or ‘long-term’ vibration (as opposed to ‘transient’ or ‘short-term’ vibration – refer Appendix A.1 for definitions) as there are no construction machinery proposed which produces transient vibration.

8 Staff training

Training for all staff will be undertaken as part of the site induction programme as described in the CEMP report within Volume 4 of the AEE. This requires all new staff to participate in an induction training session when they commence work, and regular (annual as a minimum) refresher courses.

Environmental Induction will include a briefing on this CNVMP, with attention given to the following aspects in particular:

- Roles and responsibilities for management of Project noise and vibration issues
- Designation requirements/conditions
- Project noise and vibration criteria
- Information about noise and vibration sources on-site, and locations of critical receiver positions
- Noise and vibration management procedures
- Complaints management procedures

If required, training of site personnel in matters relating to construction noise and vibration will be provided by a suitably qualified acoustics expert.

9 Monitoring

9.1 Requirements

Construction noise levels shall be monitored and assessed in accordance with the requirements of NZS 6803:1999 *“Acoustics - Construction Noise”*.

Construction vibration levels shall be monitored and assessed in accordance the requirements of German Standard DIN 4150-3:1999 *“Structural vibration – Part 3: Effects of vibration on structures”*.

Monitoring shall be undertaken:

- as and when required during critical phases of construction, i.e. when possible exceedance of the Project criteria is anticipated, e.g. night works;
- in response to reasonable complaints about noise, vibration or re-radiated noise (due to vibration) being received;
- at locations representative of sensitive receivers in the vicinity;

- by a suitably qualified and experienced acoustic/vibration specialist.

General monitoring locations may include, but are not limited to:

- Sector 1: Residential areas located in Leinster Avenue, Main Road (SH1) and Raumati Road;
- Sector 2: Residential areas located in Raumati Road, Rata Road, Milne Drive, Kāpiti Road, Mazengarb Road, residential areas east of the Expressway between Kāpiti Road and Mazengarb Road, Cheltenham Drive and Oxford Court;
- Sector 3: Residential areas located near the Otaihanga Road bridge and Kauri, Puriri and Te Moana Roads;
- Sector 4: Adjacent to Ngarara Road bridge, residences at End Farm Road and residential areas in the vicinity of Peka Peka Road.

9.2 Contingency measures

In the event that measurement shows non-compliance with the Project criteria, the following procedures shall be implemented:

- For noise, the processes of the flow chart attached in Appendix F.B shall be followed. This includes further measurement to be undertaken where necessary to determine the extent of non-compliance and preparation of a report outlining the non-compliance and, if required, potential mitigation and management measures.
- For vibration, the processes of the flow chart attached in Appendix F.B shall be followed. This includes a building condition survey and a report prepared by a suitably qualified person, including photographs, detailing the state of repair of the existing structure, and an opinion as to whether any damage may be due to construction activity. Subsequent additional monitoring and other management as required. Upon implementation of any additional mitigation measures, further measurements shall be undertaken to confirm the effectiveness of those mitigation measures.
- The Alliance Environmental Manager shall liaise with affected receivers throughout this process.

9.3 Reporting

Any noise, vibration or building condition surveys shall be summarised in a report to be submitted by the Alliance Environmental Manager to the Alliance Project Manager within one week of the assessment. Monitoring records shall be kept at the site office and made available upon request.

Any monitoring results shall also be uploaded to the NZTA Transport Noise website:

http://acoustics.nzta.govt.nz/monitoring-prediction-assessment/construction-noise-surveys

10 General management procedures and mitigation measures

The following sections outline noise and vibration management and mitigation measures that shall be implemented throughout construction of the Project.

Sector specific mitigation measures are provided in Section 11 of this CNVMP and shall be implemented in addition to the general measures outlined below.

Any appropriate management and mitigation measure shall be implemented and installed in the appropriate location prior to the construction works occurring that have been identified to cause an exceedance of the criteria set out in Sections 6 and 7 above.

10.1 Consultation

Consultation with affected parties shall be carried out prior to commencement of construction activities as follows:

- Receivers within 300 metres of the construction area (night-works only): Written notification and a Project description shall be provided to raise awareness of the Project, its expected activities and duration in the vicinity. It should be suggested to residents that they keep their windows shut when sleeping.
- Receivers within 100 metres of the construction area: Written notification and a Project description shall be provided to raise awareness of the Project, its expected activities and duration in the vicinity.
- Receivers within 50 metres of the construction area: Individual written notification shall be provided and opportunity made available for discussions on a case-by-case basis, if requested by the occupants/owners.
- Receivers within 20 metres of the construction area: Individual discussions shall be held and, if required, suitable alternatives and/or mitigation options explored that are acceptable to both parties. Ongoing consultation shall be carried out throughout the duration of construction.

When discussing concerns over vibration, it is important to convey that vibration can be felt at levels far below those that pose a risk of building damage.

Further details on identifying at-risk receivers in each Sector are contained in Schedules [xx] in Appendix F.C. **[Schedules xx of at-risk receivers shall be completed by the contractor prior to commencement of the Project]**

10.2 Training of personnel

All personnel on site shall be made aware of the importance of operating in the least disruptive manner. All personnel working on the Project, including Contractor employees and subcontractors, shall be familiar with, and be responsible for, implementing this CNVMP.

10.3 Selection of low noise and vibration plant

Low noise and vibration plant shall be selected and used wherever practicable. Where plant is identified as being particularly noisy and/or vibration inducing, action shall be taken to reduce emissions. This may involve the fitting of mitigation devices, such as silencers, enclosures or isolation pads. Plant shall be maintained to ensure that noise and vibration emissions remain as low as practicable.

10.4 Building condition surveys

Prior to the commencement of Project construction operations, a detailed pre-construction building condition survey of identified at-risk buildings, services and structures shall be conducted by a suitably qualified engineer. In addition, each building shall be classified according to the Project vibration criteria (refer Table 7-2) to identify the relevant vibration limit for that receiver.

Potentially at-risk buildings, as identified in the Assessment of Vibration Effects (Technical Report 18, Volume 3) are tabulated in Sections 11.2.1 to 11.2.4.

The survey shall include, but not be limited to, the following:

- Existing condition of buildings, services or structures, including existing levels of any aesthetic damage or structural damage;
- Record (including photographs) of the major features of the buildings, services and structures including location, type, construction, age and present condition, including defects;
- Foundation type of the building, service or structure;
- Preparation of a report recording the findings of the survey. A copy of each report shall be forwarded to the Contractor Environmental Manager and kept at the site office;
- Resurvey of buildings, services and structure, which are the subject of complaints, or if the vibration criteria have been exceeded and there is potential for damage to have occurred;
- Within six months of completion of the Project, a detailed post-construction condition survey of the same buildings, services and structures shall be conducted and a report prepared.

10.5 Reversing alarms

All equipment operating on any of the Project construction sites during night-time shall be fitted with alternatives to tonal reversing alarms. Such alternatives may include, but not be limited to, visual signals or broadband auditory devices.

10.6 Night-time operation

In close proximity to residences, high-noise and/or vibration activities shall be scheduled for the daytime where practicable, and avoided during the night-time.

In close proximity to schools and commercial buildings, high-noise and/or vibration activities shall be scheduled during the evening and night-time period where this is practicable.

For contractors yards located adjacent to noise sensitive receivers, noisy vehicles shall enter and leave the site only during daytime hours, where practicable. Where this is not practicable, truck routes shall be chosen so as to minimise disruption to sensitive receiver positions.

10.7 Mechanical ventilation of dwellings

Where external windows of a residence must be closed in order to achieve compliance with the internal night-time Project noise criteria, the installation of mechanical ventilation shall be considered for that residence. This shall be implemented as a last resort only after all other general noise management and mitigation have been deemed impracticable.

10.8 Hierarchy of mitigation options

In the event that potential non-compliance with the construction Project criteria is predicted, a site specific management plan will be prepared in accordance with the process set out in Section 13.

Appropriate mitigation options will be considered and implemented following the hierarchy set out below. Each question shall be considered in sequence before moving onto the next one.

1. Have equipment and methodologies been chosen that reduce the overall noise from the activity? Can quieter alternative equipment or methodologies be practicably implemented?
2. Is it imperative that night-time works be undertaken, or can works be re-scheduled to daytime?
3. Can temporary construction noise or vibration barriers be erected or installed within the designation, which provide effective shielding of the equipment/activity?
4. Can the works be sequenced to avoid sensitive times for neighbouring residents/businesses, e.g. can works be scheduled for school holidays?
5. Have potentially affected persons been contacted and implications discussed/feedback taken into consideration in the planning of this activity?

6. When appropriate, have residents been offered temporary relocation to suitable alterative accommodation, and have they accepted the offer?
7. Is the activity of long duration and likely to impact on the same group of residents for an extended time? Is there a justified case for affected houses to be upgraded to provide a suitable internal noise environment during this activity, e.g. by installing alternative ventilation/improved glazing? (Advice from a suitably qualified acoustic engineer required)

10.9 Noise barriers and enclosures

In areas where the Project noise criteria may be exceeded, noise barriers shall be used where they provide effective mitigation (i.e. break acoustic line-of-sight and are close to either the source (preferable) or the receiver).

Where practicable, permanent (traffic) noise barriers required for operational noise mitigation following completion of the Project shall be erected early during construction. This is relevant specifically where traffic noise barriers are required. Permanent noise barriers can be constructed in their final form and utilising the proposed final materials. Alternatively, permanent framing of barriers can be used in conjunction with temporary barrier materials such as plywood which, after completion of construction, can then be replaced with permanent materials. This may be practicable where permanent materials may be damaged by construction activities.

Temporary noise barriers shall be utilised for those areas where no permanent noise barriers are required or where these cannot be practicably implemented early during construction. Temporary barriers are typically constructed from plywood and shall contain no gaps and be of sufficient height to interrupt line-of-sight between the receiver and the source. Alternative barrier constructions may include, but not limited to, fibre cement, shipping containers or mass-loaded vinyl.

Where a noise barrier is not sufficient to achieve compliance with the Project noise criteria, an enclosure may be used where practicable, i.e. stationary plant such as conveyors or crushers. The enclosure shall be designed by a suitably qualified and experienced acoustic specialist.

All barriers and/or enclosures shall be installed in relevant positions prior to those construction works occurring that have been identified to require mitigation.

10.10 Vibration barriers and isolators

Vibration barriers can provide limited attenuation for ground-borne vibration. Accordingly, the practicability of implementing vibration barriers shall be assessed on a case-by-case basis by a suitably qualified and experienced specialist.

Vibration barrier options include, but are not limited to; open trenches, backfilled trenches, concrete-filled trenches, sheet pile walls, concrete pile walls and grout curtains.

The required depth of the barrier is based on the frequency characteristics of the vibration source.

Vibration isolators (such as suitably specified rubber pads) can provide limited attenuation for items of fixed plant, including stationary excavators (refer Section 10.3).

10.11 Vibration from excavator use

The soft ground conditions (particularly peat) in the vicinity of the Expressway mean that the weight-shift associated with vigorous excavator operation can generate significant vibrations. Excavators must be operated smoothly, avoiding the following movements:

- Banging of the ground with the bucket or any other attachment. Any compaction should be carried out by a compactor;
- Sudden changes of direction or quick rotations of the chassis, particularly when on an incline;
- Buckets shall be plastic lined to prevent material getting stuck and needing to be shaken out.
- Load-spreading platforms would also mitigate vibration effects of weight-shifting

10.12 Vibration effects on infrastructure assets

Any infrastructure assets such as roads, underground pipework etc. near areas of high-vibration activity shall be identified prior to commencing construction and **included as a Schedule in Appendix F.C.**

It is noted that German Standard DIN 4150-3:1999 (which the Project Criteria are based on, in part) contains vibration criteria for buried pipework in Table 2 of the Standard. The most stringent criterion in the table is 50 mm/s PPV (for masonry and plastic pipes) which indicates that, compared with dwellings, pipework is not particularly vulnerable to vibration damage.

Notwithstanding this, risk assessments of relevant infrastructure assets should be undertaken, and managed through SSCVMPs (refer Section 13.2) as appropriate.

10.13 Temporary resident relocation

Where all practicable noise and vibration management and mitigation measures have been implemented, but compliance with the Project criteria is still not achievable, relocation of affected receivers may need to be considered.

Relocation shall be considered in exceptional cases only, and expert advice from a suitably qualified and experienced acoustics specialist shall be sought.

11 Sector-specific management and mitigation measures

11.1 Noise

Sections 11.1.1 to 11.1.4 below describe site specific noise mitigation measures that are required in each of the Project Sectors, in addition to the general measures noted in Section 10 above, in circumstances where the Project noise criteria are predicted to be exceeded.

In addition, a set of construction risk diagrams (aerial maps with 'cloud markings' to indicate areas which are at risk of exceeding the Project noise criteria) has been developed, refer Appendix F.E.

- Construction likely to exceed the Project noise criteria

11.1.1 Sector 1: Raumati South

Activity	Noisiest equipment	Exceeds daytime criterion 70 dB L_{Aeq}	Exceeds night-time criterion 45 dB L_{Aeq}	Potential mitigation option	Potential exceedance with mitigation	
					Daytime	Night-time
Poplar Ave realignment – earthworks and sealing	Graders Excavators Trucks	Yes	n/a	▪ Temporary construction noise barriers ▪ Choice of low noise equipment ▪ Operation at north end of site during least sensitive times ▪ Good communication and case-by-case mitigation	No	n/a
Earthworks on Poplar Ave to Raumati Road	Graders Excavators Trucks	Yes	n/a	▪ Installation of traffic noise barriers shall be programmed for construction early in the construction period, if practicable. ▪ Temporary construction noise barriers ▪ Operation in proximity to dwellings during least sensitive times ▪ Good communication and case-by-case mitigation	Yes	n/a

11.1.2 Sector 2: Raumati/Paraparaumu

Activity	Noisiest equipment	Exceeds daytime criterion 70 dB L_{Aeq}	Exceeds night-time criterion 45 dB L_{Aeq}	Potential mitigation option	Potential exceedance with mitigation	
					Daytime	Night-time
Raumati Bridge Construction	Vibro-compaction Vibro hammer Bridge beam placement (concrete breakers, trucks)	Yes	Yes	▪ Piling to occur at least sensitive times ▪ Resident relocation during night works ▪ Temporary noise barriers ▪ Good communication and case-by-case mitigation ▪ Schedule noisy activities for the daytime period	Yes (Vibro hammer / vibro piling only)	Yes
Earthworks between Raumati Rd and Wharemakau Stream	Graders Excavators Trucks Scrapers	Yes	n/a	▪ Installation of traffic noise barriers shall be programmed for construction early in the construction period, if practicable. ▪ Temporary construction noise barriers ▪ Operation in proximity to dwellings during least sensitive times ▪ Good communication and case-by-case mitigation	Yes	n/a
Earthworks between Wharemakau Stream and Kāpiti Road	Graders Excavators Trucks Scrapers	Yes	n/a	▪ As above	Yes	n/a

Earthworks and sealing Kāpiti Road Widening	Graders Excavators Trucks	Yes	Yes	▪ Conduct noisy activities during daytime periods where practicable ▪ Temporary construction noise barriers ▪ Resident relocation during night works ▪ Good communication and case-by-case mitigation	Yes	Yes
Kāpiti Road bridge construction	Vibro-compaction Vibro hammer	Yes	Yes	▪ Piling to occur at least sensitive times ▪ Resident relocation during night works ▪ Temporary noise barriers ▪ Good communication and case-by-case mitigation ▪ Schedule noisy activities for the daytime period	Yes (Vibro hammer and vibro-compaction only)	Yes
Earthworks between Kāpiti Road and Mazengarb Road	Graders Excavators Trucks Scrapers	Yes	n/a	▪ Installation of traffic noise barriers shall be programmed for construction early in the construction period, if practicable. ▪ Temporary construction noise barriers ▪ Operation in proximity to dwellings during least sensitive times ▪ Good communication and case-by-case mitigation	Yes	n/a

Vertical realignment of Kāpiti Road	Piling Graders Trucks Excavators	Yes	Yes	▪ Conduct piling operations during daytime ▪ Limit night-time operations where practicable ▪ Choose quiet piling methods where practicable (i.e avoid Vibro hammer piling) ▪ Temporary construction noise barriers	No	No
Piling and beam launching for Mazengarb Road	Vibro-compaction Piling Concrete breakers Large plant	Yes	Yes	▪ Piling to occur at least sensitive times ▪ Resident relocation during night works ▪ Temporary noise barriers ▪ Good communication and case-by-case mitigation ▪ Schedule noisy activities for the daytime period	Yes (Vibro hammer /vibro-compaction only)	Yes
Earthworks on Mazengarb road	Graders Excavators Trucks Scrapers	Yes	n/a	▪ Installation of traffic noise barriers shall be programmed for construction early in the construction period, if practicable. ▪ Temporary construction noise barriers ▪ Operation in proximity to dwellings during least sensitive times ▪ Good communication and case-by-case mitigation	Yes	n/a

Excavation of stormwater wetland ponds	Excavators Off road trucks	Yes	n/a	▪ Good communication and case-by-case mitigation	No	n/a
Construction Yard (Raumati Road)	Equipment Mobilisation	No	Yes	▪ Noise control to generators ▪ Avoid mobilising equipment en-masse during sensitive periods ▪ Solid site hoarding	No	No
Construction Yard (Kāpiti Road)	Equipment Mobilisation	No	Yes	▪ As above	No	No
Construction Yard (Mazengarb Road)	Equipment Mobilisation	No	Yes	▪ As above	No	No

11.1.3 Sector 3: Otaihanga/Waikanae

Activity	Noisiest equipment	Exceeds daytime criterion 70 dB L_{Aeq}	Exceeds night-time criterion 45 dB L_{Aeq}	Potential mitigation option	Potential exceedance with mitigation	
					Daytime	Night-time
Bridge beam placement on Otaihanga Road	Cranes Hand tools	No	Yes	▪ Limit night-time construction where practicable ▪ Good communication and case-by-case mitigation	No	Yes
Earthworks for new road link to Otaihanga Road	Excavators Trucks Graders	Yes	n/a	▪ Good communication and case-by-case mitigation	No	n/a
Earthworks between Otaihanga Road and Waikanae River	Excavators Trucks Graders Scrapers	Yes	n/a	▪ Good communication and case-by-case mitigation	No	n/a

Bridge construction for Waikanae River Bridge	Vibrocompaction Vibro Hammer	Yes	n/a	▪ Good communication and case-by-case mitigation	No	n/a
Earthworks between Waikanae River and Te Moana Road	Excavators Trucks Graders Scrapers	Yes	n/a	▪ Good communication and case-by-case mitigation ▪ Scheduling of work during off-peak season to avoid effects on El Rancho	No	n/a
Road sealing Te Moana Road Intersection	Excavators Trucks Graders	Yes	n/a	▪ Temporary noise barriers ▪ Good communication and case-by-case mitigation	No	n/a
Bridge Construction at Te Moana Road	Vibrocompaction Vibro hammer Bridge beam placement	Yes	Yes	▪ Piling to occur at least sensitive times ▪ Resident relocation during night works ▪ Temporary noise barriers ▪ Good communication and case-by-case mitigation ▪ Schedule noisy activities for the daytime period	Yes (Vibro hammer / vibro-compaction only)	Yes
Construction yard (Otaihanga Rd)	Concrete casting Truck deliveries Site mobilisation	No	Potentially	▪ Locate plant and access roads away from nearby receivers ▪ Operate during the daytime where practicable	No	No

Construction yard (Te Moana Road)	Concrete casting Truck deliveries Site mobilisation	No	Yes	▪ Noise control to generators ▪ Avoid mobilising equipment en-masse during sensitive periods ▪ Solid site hoarding	No	No

11.1.4 Sector 4: Waikanae North

Activity	Noisiest equipment	Exceeds daytime criterion 70 dB L_{Aeq}	Exceeds night-time criterion 45 dB L_{Aeq}	Potential mitigation option	Potential exceedance with mitigation	
					Daytime	Night-time
Earthworks for Smithfield Road Realignment	Excavators Trucks Graders	Yes	n/a	▪ Good communication and case-by-case mitigation	No	n/a
Earthworks between Ngarara Road and Peka Peka	Excavators Trucks Graders Scrapers	Yes	n/a	▪ Good communication and case-by-case mitigation	No	n/a
Earthworks and sealing for Peka Peka Interchange	Excavators Trucks Graders	Yes	Yes	▪ Resident relocation during night works ▪ Temporary noise barriers ▪ Good communication and case-by-case mitigation ▪ Schedule noisy activities for the daytime period where practicable	No	Yes
Bridge beam placement for Peka Peka Road	Cranes Hand tools Trucks	No	Yes	▪ Schedule noisy activities for the daytime period where practicable	No	Yes

11.2 Vibration

The primary management measure for vibration is to identify and develop awareness of vibration risk, i.e. which construction sources impose a risk of exceeding the Project criteria, and which structures are susceptible to damage. In addition to dwellings, this may include garages and swimming pools.

The tables in the following Sections 11.2.1 to 11.2.4 specify, for each Project sector, key vibration sources, their 'risk contours' inside which the Project vibration criteria may be exceeded, and the addresses of at-risk buildings. In addition, a set of construction risk diagrams (aerial maps with 'cloud markings' to indicate these areas) has been developed, refer Appendix F.E.

The risk contours are based on theoretical models, and should be updated as site-specific measurement data becomes available.

Risk is categorised as High or Medium and each risk level requires specific actions to be undertaken when working in those areas, as follows:

High Risk: Receivers located within the risk contour of any vibration source
- Individual discussion with building owners and ongoing consultation
- Building condition survey prior to construction
- Site-specific vibration measurements to assess damage risk

Med Risk: Receivers that are not inside, but are close to the risk contour (approx. risk contour + 20%)
- Notification of building owners and opportunity for discussion if requested
- Site-specific vibration measurements to assess damage risk if requested

11.2.1 Sector 1: Raumati South

Source	Risk contour (m)	Risk level	At risk receivers
Piling: Vibro-hammer or cast-in-place methods only	19m	Med	90 Raumati Road
Vibratory rollers	16m	High	106, 107, 108, 112 Leinster Avenue 240 Main Road (front house) 10, 12 Conifer Court 110 Raumati Road
		Med	105 [+garage] Leinster Avenue 2 eastern-most dwellings of 260 Main Road subdivision (Shalom village) 218B Matai Road 90 Raumati Road
Excavators (digging and tracking) Wheeled loaders Motor scrapers Off-road trucks	8m	High	106, 107, 112 Leinster Avenue 240 Main Road (front house) 12 Conifer Court
		Med	105 [garage] 108 Leinster Avenue 10 Conifer Court 218B Matai Road 90, 110 Raumati Road

11.2.2 Sector 2: Raumati/Paraparaumu

Source	Risk contour (m)	Risk level	At risk receivers
Vibratory rollers	16m	High	29, 39, 41 Quadrant Heights 21, 23, 24, 26 Observation Place 51, 55, 59 Milne Drive 84, 86, 88, 90, 92, 94 Kāpiti Road 13, 15, 15A, 17, 18 Greenwood Place 7, 8, 8A, 9, 9A Elder Grove 14B, 16B, 22, 24, 28B Cypress Grove 15, 33, 35, 37B Spackman Crescent 63A, 63B, 65–93 (odd numbers only), 97B, 99B, 105, 107 Makarini Street 6B, 8, 8B, 10, 14, 16, 18A, 18B, 24 Palmer Court 4, 6, 8, 10, 12 Oxford Court 9 [+pool], 11, 15, 24 St James Court 20, 22, 37B, 41 [pool], 45 Chilton Drive 345, 353 Mazengarb Road
		Med	45, 47 Quadrant Heights 17 Datum Way 15, 27 Observation Place 5 Elder Grove garage 18 [garage], 20B [+garage], 26, 28A Cypress Grove 17, 21, 25 [+garage], 27 [+garage], 29, 31, 37A Spackman Crescent 95, 97A Makarini Street 2/24, 3/24, 26-34 & 42-50 (even numbers only) Cheltenham Drive 12 Palmer Court

			37A Chilton Drive
Excavators (digging and tracking) Wheeled loaders Motor scrapers Off-road trucks	8m	High	29 Quadrant Heights 21, 23, 24, 26 Observation Place 51, 55, 59 Milne Drive 84, 86, 88, 90, 92, 94 Kāpiti Road 13, 15, 15A, 17, 18 Greenwood Place 7, 8A, 9, 9A Elder Grove 14B, 16B, 28B Cypress Grove 35, 37B Spackman Crescent 63A, 63B, 77, 97B, 99B, 105, 107 Makarini Street 6B, 8B, 18A, 18B Palmer Court 4, 6, 8, 10, 12 Oxford Court 9 [+pool], 11, 15 St James Court 20, 22 Chilton Drive 60A Ratanui Road
		Med	39, 41 Quadrant Heights 8 Elder Grove 18 [garage], 20B [garage], 22, 24 Cypress Grove 15, 25 [garage], 27 [garage], 33 Spackman Crescent 65–75 & 79-93 (odd numbers only), 97B, 99B, 105, 107 Makarini Street 8, 10, 14, 16 Palmer Court 24 St James Court 37B, 41 [pool], 45 Chilton Drive

11.2.3 Sector 3: Otaihanga/Waikanae

Source	Risk contour (m)	Risk level	At risk receivers
Vibratory rollers	16m	High	18 [+pool], 20, 23 Kauri Road
		Med	25A Kauri Road (El Rancho building)
Excavators (digging and tracking) Wheeled loaders Motor scrapers Off-road trucks	8m	High	18 [pool], 23 Kauri Road 145, 190B Te Moana Road
		Med	49, 61 Killalea Place 18 Kauri Road 31, 53 Puriri Road 145A, 164 (two houses) Te Moana Road

11.2.4 Sector 4: Waikanae North

Source	Risk contour (m)	Risk level	At risk receivers
Vibratory rollers	16m	High	31 Peka Peka Road
		Med	20 Peka Peka Road
Excavators (digging and tracking) Wheeled loaders Motor scrapers Off-road trucks	8m	High	20, 31 Peka Peka Road
		Med	27 Te Kowhai Road

12 Procedures for handling noise and vibration complaints

Complaints procedures are detailed in the CEMP. As part of the liaison process, affected parties shall be informed to direct noise and/or vibration complaints to the Alliance Environmental Manager. Flowcharts outlining the process for noise and vibration complaints are contained in Appendix F.B of this CNVMP.

The following complaint procedures shall be followed:

- The Contractor shall maintain a 24 hour hotline and this number shall be displayed in all consultation material and other publications.
- Upon receiving a complaint, the complainant's name, contact details and the nature of their complaint will be noted and immediately forwarded to a designated Contractor staff member.
- The Contractor staff member shall contact the complainant within one hour during the day and 15 minutes at night (10:00 pm to 7:00 am), or as soon as practicable thereafter, to address their concerns.
- If practicable and appropriate, construction workers shall be instructed to modify the activity of concern and the complainant shall be informed.
- If the complaint relates to building damage from construction vibration, the activity of concern shall cease and a building condition survey shall be undertaken.
- Any noise or vibration complaint shall be logged to the complaints register on the NZTA website.

For on-going complaints, the Alliance Environmental Manager shall request additional measurements by a suitably qualified and experienced acoustic specialist targeting the specific noise or vibration source. The investigation of an ongoing noise or vibration complaint may include the following:

- Identification of noise or vibration inducing activities at the time of complaint, and measurement and assessment of noise or vibration levels from these activities.
- Determination of the best practicable mitigation options in conjunction with the Construction Manager.
- Implementation of the management or mitigation measure in a timely manner.
- Measurement of noise or vibration levels following implementation of mitigation action(s).
- Communication with complainant.
- Reporting of findings and actions to the Alliance Project Manager.

In addition, a complaints file will be maintained at the Project office, and be available for inspection during normal office hours by affected parties and the relevant local authority.

13 Site specific construction management plans

13.1 Site specific construction noise management plans (SSCNMP)

For any construction activities that have the potential to breach the noise criteria, as set out in Section 6, a noise assessment will be undertaken.

Where noise levels are predicted to exceed the noise criteria in Section 6 by less than 5 dBA, all practicable measures will be implemented as per the CNVMP with the aim of achieving compliance with the construction noise criteria. Monitoring of these activities will be undertaken to determine compliance. Where the modelled noise levels are predicted to be 5 dBA or more above the noise criteria in Section 6, a SSCNMP will be submitted to KCDC prior to works commencing.

If the measured levels are higher than the noise criteria plus 5 dBA, the works causing the exceedance shall cease and a Site Specific Construction Noise Management Plan (SSCNMP) will be provided to Kāpiti Coast District Council (KCDC).

13.2 Site specific construction vibration noise management plans (SSCVMP)

For vibration issues, a Site Specific Construction Vibration Management Plan (SSCVMP) shall be developed and submitted to KCDC for any activities measured or predicted to exceed the Category B Project criteria, refer Section 7.

13.3 General requirements

Notwithstanding the requirement to submit a SSCNMP or SSCVMP, mitigation measures will continue to be implemented as per the CNVMP and reviewed/monitored to confirm compliance and effectiveness of the plan. This includes the overall aim to achieve compliance with the relevant Project criteria.

For noise, the likelihood of exceedance shall be determined by utilising appropriate prediction tools, e.g. the calculation tools of NZTA, specifically the NZTA NZS 6803 Tool:

acoustics.nzta.govt.nz/monitoring-prediction-assessment/construction-maintenance-noise

For vibration, the likelihood of exceedance shall be determined by pre-construction measurements of relevant vibration inducing equipment to establish safe distances.

The SSCNMP shall contain, to an appropriate detail:

- The activity and location proposed;
- Timing/duration;
- Equipment utilised;
- Predicted noise levels;

- Identified dwellings at which compliance cannot be achieved with conventional mitigation measures;
- Alternative management and mitigation measures proposed.

SSCMPs will be submitted to the KCDC Council Noise Officer and Council Compliance Officer for review at least 5 working days prior to the proposed works commencing.

14 Construction noise and vibration management schedule

Management schedules for construction noise and vibration shall be prepared for each Sector.

The vibration schedules (Schedules in Appendix F.C) shall detail high-vibration equipment, their safe distances and all sensitive receivers within the high and medium risk categories.

The noise schedules (Schedules in Appendix F.D) shall detail high-noise equipment and all sensitive receivers as follows:

- for daytime work: within the 20 metre and 50 metre categories, and
- for night-time work: within the 20 metre, 50 metre and 100 metre categories. (refer Section 10.1)

The schedules shall be completed prior to commencement of construction works in each Sector.

15 CNVMP review

This CNVMP, including environmental controls and procedures, shall be reviewed to ensure that it remains applicable to the activities being carried out.

The CNVMP will be reviewed by the contractor after confirmation of the resource consent and designation conditions and will be revised in accordance with these conditions. The CNVMP will be updated, with the necessary approval, throughout the course of the Project to reflect material changes associated with changes to construction techniques or the natural environment. Consultation with the Kāpiti Coast District Council will be required for any relevant revisions of a material nature for the CNVMP.

A management review of the CNVMP will be undertaken at least annually by the Project management team and the NZTA environmental representative. The management review will be organised by the Alliance Project Manager, and the Project team (this Plan/Report refers to the Project team as carrying out works on behalf of and as contracted by the NZTA. The NZTA is the requiring authority and the consent holder), will be informed of any changes to this plan through the regular Project communications processes.

The review will take into consideration:

- Significant changes that affect the noise and/or vibration generation
- Key changes to roles and responsibilities within the Project
- Changes in industry best practice standards
- Changes in methodology or management in response to noise and/or vibration monitoring showing non-compliance
- Changes in legal or other requirements (social and environmental legal requirements, consent conditions, NZTA objectives and relevant policies, plans, standards, specifications and guidelines)
- Public complaints

Reasons for making changes to the CNVMP will be documented. A copy of the original CNVMP document and subsequent versions will be kept for the Project records, and marked as obsolete. Each new/updated version of the CNVMP documentation will be issued with a version number and date to eliminate obsolete CNVMP documentation being used.

Appendix F.A
Glossary

Appendix F.A - Glossary

Noise

Ambient Noise	Ambient Noise is the all-encompassing noise associated with any given environment and is usually a composite of sounds from many sources near and far.
A-weighting	A frequency filter which is applied to a measurement of sound so as to more closely approximate the frequency bias of the human ear.
dB	Decibel – the basic measurement unit of sound. It is a logarithmic ratio of measured sound pressure level with respect to a reference level of 20 micropascals.
$L_{Aeq(T)}$	The A-weighted, time averaged sound level (on a logarithmic/energy basis) over the measurement period T (e.g. between 10 and 60 minutes).
L_{AFmax}	The maximum A-weighted sound level recorded during the measurement period. Measured with fast time weighting i.e. a 125 millisecond time constant
L_{A10}	The A-weighted sound level which is equalled or exceeded for 10% of the measurement period.
L_{A90}	The A-weighted sound level which is equalled or exceed for 90% of the measurement period. L_{A90} is an indicator of the mean minimum noise level and is used in New Zealand as the descriptor for background noise
L_{A95}	The A-weighted sound level which is equalled or exceed for 95% of the measurement period.
L_{Zpeak}	The peak instantaneous pressure level recorded during the measurement period, with a flat (i.e. no) frequency weighting.
Noise	A sound that is unwanted by, or distracting to, the receiver.
NZS 6801:2008	New Zealand Standard NZS 6801:2008 *"Acoustics - Measurement of Sound"*
NZS 6802:2008	New Zealand Standard NZS 6802:2008 *"Acoustics - Environmental Noise".*
NZS 6803:1999	New Zealand Standard NZS 6803:1999 "*Acoustics – Construction Noise*".

Vibration

BS 5228-2:2009	British Standard BS 5228-2:2009 "Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration". This is the standard adopted for this Project to assess human response to construction.
DIN 4150-3:1999	German Standard DIN 4150-3:1999 "Structural Vibration – Part 3: Effects of vibration on structures". This standard is generally adopted in NZ to assess building damage.
PPV	Peak Particle Velocity, measured in mm/s. This is the standard metric for assessing construction vibration levels.
Risk contour	The closest distance to a vibration source at which a measurement would be expected to comply with the risk assessment criteria

Appendix F.B
Flowcharts

Refer to Management Plan Appendices, Appendix F, Volume 5

Appendix F.C

Vibration management schedules

Appendix F.C – Vibration management schedules

Activity

This is a schedule to the construction noise and vibration management plan for [click and type project name] dated [click and type date]. This schedule provides specific assessment of the following activity:

- Activity location: [click and type location]
- Activity start date: [click and type date]
- Activity finish date: [click and type date]

[click and add a description of the activity/location including timeframes]

Neighbours

The nearest neighbours to this activity are:

Reference	Address	Building type/comments	Distance to works	Mitigation required
A				
B				

Appendix F.D

Noise management schedules

Appendix F.D – Noise management schedules

Activity

This is a schedule to the construction noise and vibration management plan for [click and type project name] dated [click and type date]. This schedule provides specific assessment of the following activity:

- Activity location: [click and type location]
- Activity start date: [click and type date]
- Activity finish date: [click and type date]

[click and add a description of the activity/location including timeframes]

Neighbours

The nearest neighbours to this activity are:

Reference	Address	Building type/comments	Distance to works	Mitigation required
A				
B				

Predictions and mitigation

Basic step of activity	Equipment	Time / duration	Predicted noise (no mitigation)			Mitigation required
			Neighbour	$L_{Aeq(10\text{-}60min)}$	L_{AFmax}	

Appendix F.E
Construction Risk Diagrams: Aerial maps with cloud markings to indicate areas which are at risk of exceeding the relevant criteria are located in:

Noise: Appendix 16.C Technical Report Appendices Report 16, Volume 5

Vibration: Appendix 18.D Technical Report Appendices, Report 18, Volume 5