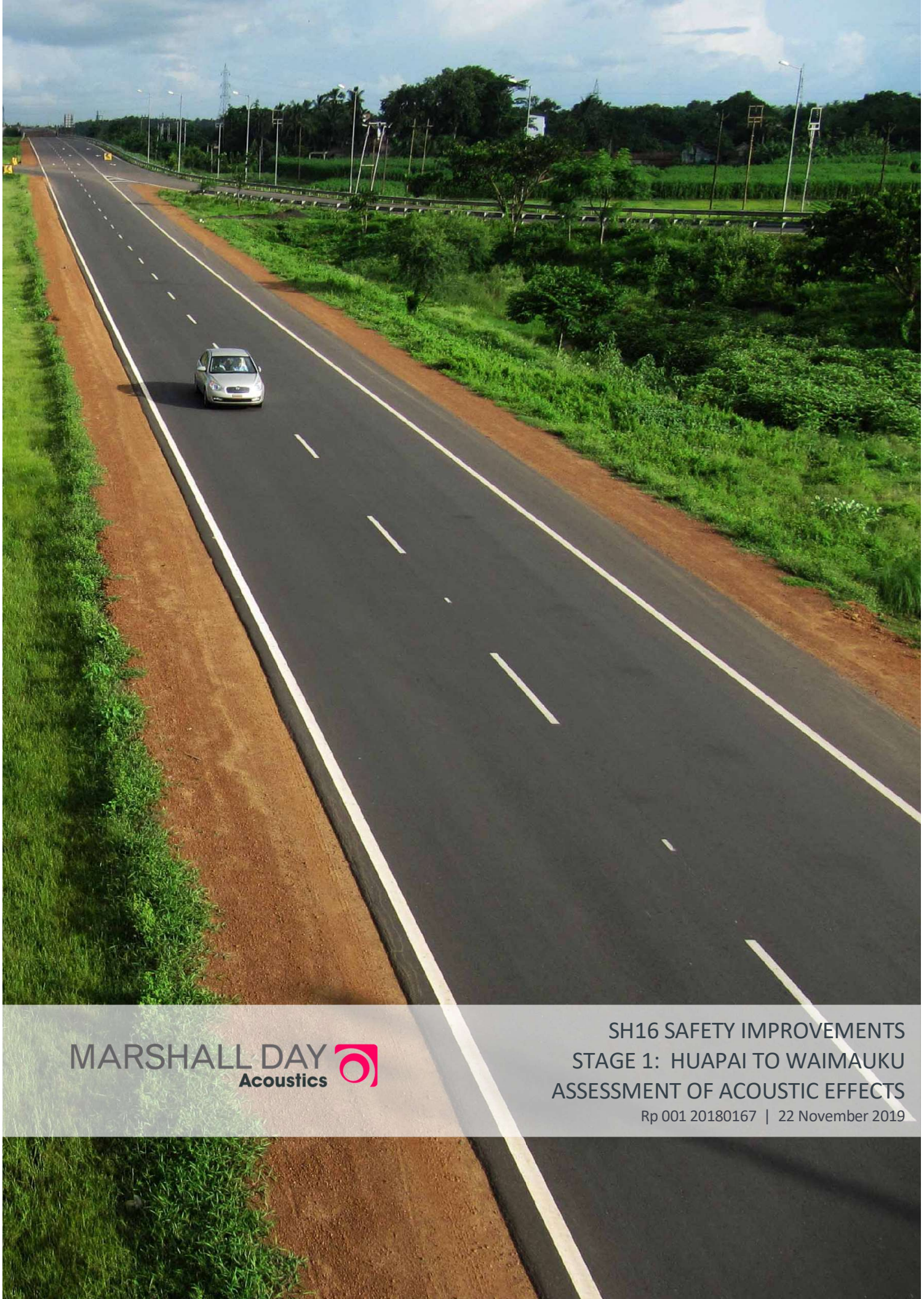
APPENDIX L – ASSESSMENT OF ACOUSTIC EFFECTS



MARSHALL DAY Acoustics

SH16 SAFETY IMPROVEMENTS
STAGE 1: HUAPAI TO WAIMAUKU
ASSESSMENT OF ACOUSTIC EFFECTS

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1.0 INTRODUCTION

The Safe Roads Alliance has been formed to implement safety improvements to existing State highways throughout New Zealand. State Highway 16 will be upgraded from Brigham Creek Road to Waimauku, excluding Kumeu. The project will be undertaken in stages. This report discusses the section from Huapai to Waimauku and is referred to as Stage 1.

The report discusses noise and vibration effects from the proposed construction works.

Most of the works will be undertaken within the existing designation. However, there are some small areas where there are earthworks required that will be outside the existing designation, and for these areas an alteration to the designation is sought.

This report is intended to form part of an application that will be submitted to Auckland Council for their consideration under the relevant statutory process.

A glossary of terminology is attached in Appendix A.

2.0 PROPOSAL

For Stage 1 improvement works include the following:

- A combination of wire median barriers and wide centre lines along the length of the corridor, and construction of wire side barriers
- Providing lane widths of 3.5m, shoulder widths of 1.5m and wire median barrier centreline widths of between 1.5m and 2.5m (1.5m wide centreline and 2.5m wide median with guardrail)
- Constructing turning bays
- Accessway changes
- Re-marking of the existing road

The full extent of works, as reviewed by MDA, can be seen in drawing number SR1003 – 01 – CE – 1201-1214.

3.0 EXISTING ENVIRONMENT

The Project area contains predominantly rural and lifestyle blocks. A schedule of all relevant nearby noise sensitive receivers adjacent to the alignment is presented below in Table 1.

Table 1: Sensitive receiver locations and approximate distances from works

Address	Distance from alignment (m)	Approximate chainage no.
405 State Highway 16	18	196650
407 State Highway 16	8	196700
529 State Highway 16	55	196900
51 Gilbransen Road	100	197000
573 State Highway 16	47	197350
583 State Highway 15	120	197400
587 State Highway 16	30	197500
29 Meryl Avenue	104	197530
31 Meryl Avenue	150	197600
619 State Highway 16	12	197800

Address	Distance from alignment (m)	Approximate chainage no.
623 State Highway 16	36	197850
631 State Highway 16	20	197970
641 State Highway 16	113	198020
643 State Highway 16	24	198060
647 State Highway 16	24	198100
653 State Highway 16	28	198100
665 State Highway16	23	198200
677 State Highway 16	23	198400
693 State Highway 16	120	198500
695 State Highway 16	58	198600
727 State Highway 16	31	198850
726 State Highway 16	114	198870
372 Matua Road	200	199000
761 State Highway 16	88	199200
763 State Highway 16	117	199290
771 State Highway 16	140	199300
779 State Highway 16	16	199400
805 State Highway 16	22	199650
815 State Highway 16	81	199750
5 Joyce Adams Place	47	199770
825 State Highway 16	150	199800
831 State Highway 16	52	199900
1 Joyce Adams Place	32	200000
3 Joyce Adams Place	40	200050
851 State Highway 16	25	200120
1 Factory Road	25	200200

4.0 PERFORMANCE STANDARDS

4.1 Traffic Noise – NZS 6806:2010

Under the Auckland Unitary Plan Operative in Part (AUP), Rule E25.6.33 requires the following:

(1) All new roads and all altered roads that are within the scope of New Zealand Standard NZS 6806:2010 Acoustics – Road traffic noise – New and altered roads must comply with the requirements of New Zealand Standard NZS 6806:2010 Acoustics – Road traffic noise – New and altered roads.

NZS 6806:2010 has been developed by a group of independent acoustic experts, roading industry representatives and the Ministry of Health. The Standard allows for strategic infrastructure to develop while mitigating the adverse traffic noise effects on the environment.

The Standard provides separately for 'new' and 'altered' roads, with different thresholds of applicability and criteria. It applies only to buildings that a classified as PPFs under the standard. PPFs include buildings used for residential activities, Marae, spaces used for overnight patient care, and schools.

MDA has determined that this standard would not be applicable for this project due to the minor changes to the road alignment, which will not change the noise effects from the road. This is discussed in Section 5.1.

4.2 Construction

Most of the works are undertaken within the existing designation. The existing designation does not contain any conditions relating to construction noise or vibration.

Where works are undertaken outside the existing designation, the Auckland Unitary Plan (Operative in Part) (AUP) construction rules have been used as the basis of this assessment.

4.2.1 Noise

The AUP Rule E25.6.27 provides construction noise limits. Rule E25.6.1.3 states that the noise from construction must be measured and assessed in accordance with New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"*. This rule applies in all zones except the Business – City Centre Zone and the Business – Metropolitan Centre Zone. For works within the road, the AUP Rule E25.6.29 *"Construction noise levels for work within the road"* applies.

While the entire project will extend for longer than 20 weeks, each receiver is likely to be affected by 20 weeks or less. Therefore, the typical duration noise standards measured at 1m from an occupied building, would generally apply. These are given in Table 2 below.

Table 2: Construction noise standards

Time of Week	Time Period (hrs)	Noise Limits	
		dB L_{Aeq}	dB L_{AFmax}
Building with noise sensitive activities			
Weekdays	0630 – 0730	60	75
	0730 – 1800	75	90
	1800 – 2000	70	85
	2000 – 0630	45	75
Saturdays	0730 – 1800	75	90
	1800 – 0730	45	75
Sundays and public holidays	0730 – 1800	55	85
	1800 – 0730	45	75
Building with all other activities			
All days	0730 – 1800	75	-
	1800 – 0730	80	-

Given that the works within and outside the designation cannot be distinguished, and that the designation does not contain any noise performance standards, it is recommended that, in order to assess the effects from, and determine appropriate management of, construction noise for surrounding sites, the AUP Rule E25.6.29 is applied.

As works in a transportation corridor are often time constrained, and in order to avoid adverse effects on the use of such corridor, and require weekend and night time works, Rule E25.6.29 provides exceptions for such works as set out below.

Between 7am and 10pm, E25.6.29(3) states that these Standards do not apply, where:

a) Exceedances are less than 10 days at any one receiver, or

b) Works cannot practicably comply, or

c) A works access permit is obtained from Auckland Transport or New Zealand Transport Agency, or

d) "*For planned works where the works will take more than 8 hours to complete and a construction noise and vibration management plan [*CNVMP*] is provided to Council no less than five days prior to the works commencing in accordance with the applicable provisions of Standard E25.6.29 (5)*".

Similarly, for night-time exceedances between 10pm and 7am, E25.6.29(2) states that these Standards do not apply at any one receiver for up to 3 nights, where:

a) Works cannot practicably be undertaken during the day, or

b) Works cannot practicably comply, or

c) A works access permit is obtained from Auckland Transport or New Zealand Transport Agency, or

d) "*For minor planned works a construction noise and vibration management plan is provided to Council no less than five days prior to the works commencing in accordance with the applicable provisions of Standard E25.6.29 (5)".*

In this case:

- The works cannot always practicably comply, particularly during night-time or Sunday and Public Holiday works. For these works, the noise limit would be 45 and 55 dB L_{Aeq} respectively, which is unlikely to be complied with.
- A works permit would be obtained from the NZTA, and
- A draft CNVMP will be prepared to satisfy the requirements of E25.6.29 (5) by way of the following features:
  - It includes a description of the works, duration, anticipated equipment and construction methodology
  - It enables the identification of the best practicable options (BPO) to mitigate and minimise noise from activities that are likely to exceed the relevant limits from E25.6.29 (1)
  - It requires prior communication to advise the occupiers of properties within 100m of the works

4.2.2 Vibration

Construction vibration levels would generally be low for all works, with the exception of vibratory rollers where road widening is undertaken.

Rule E25.6.30.1 sets out construction vibration limits in two clauses. Clause (a) protects buildings from cosmetic damage due to construction vibration and specifies that construction should not exceed the limits set out in German Standard DIN 4150-3 (1999): Structural Vibration – Part 3 Effects of Vibration on Structures. These limits are shown below:

Table 3: Construction vibration limits

Type of Structure	Short-term vibration*				Long-term vibration
	PPV at the foundation at a frequency of			PPV at horizontal plane of highest floor (mm/s)	PPV at horizontal plane of highest floor (mm/s)
	1-10Hz (mm/s)	10-50Hz (mm/s)	50-100Hz (mm/s)		
Commercial / industrial	20	20 – 40	40 – 50	40	10
Residential / school	5	5 – 15	15 – 20	15	5
Historic / sensitive structure	3	3 – 8	8 – 10	8	2.5

* The Standard defines short-term as "*vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated*".

Clause (b) provides vibration amenity limits when measured within an occupied building sensitive to noise. During daytime between 0700 – 2200 hrs, the limit is 2mm/s Peak Particle Velocity (PPV). However, the rule allows for up to three days of more intensive works provided it is less than 5mm/s PPV and that prior notification is given to receivers within 50m of the works.

Note that Clause (b) of the rule should be used as a trigger for consultation and should not be used as construction vibration limits, which are set out in Clause (a).

5.0 ASSESSMENT

5.1 Traffic Noise

There are proposed to be some new turning bays constructed in the following locations.

- Outside 407 SH16 (in the vicinity of Trigg Road)
- Outside 601 SH16
- Outside 641 SH16
- Outside 23 Foster Road
- Outside 1 Factory Road

Anticipated traffic volumes on the turning bays vary, and are given in

Table 4: Traffic volumes on turning bays

Turning bay	Weekday traffic movements	Weekend traffic movements
Factory Road	410	n/a
Foster Road	420	620
Trigg Road	130	205

Traffic volumes for the turning bays at 601 and 641 SH16 are not known, however, it is assumed that the inclusion of these bays will reduce the traffic volumes at the other turning bays, according to input provided by the client.

The turning bay at Trigg Road is within 8 metres of a dwelling (407 SH16). With up to 205 traffic movements per day, many of them likely to be of heavy vehicles, the noise level change has been

calculated at this dwelling. The noise level change with the turning bay in place, is between 0.3 dB $L_{Aeq\ (24h)}$ and 0.5 dB $L_{Aeq\ (24h)}$ (depending on the percentage of heavy vehicles).

The turning by at Foster Road is approximately 60 metres from dwellings at 695 and 717 SH16. For 620 movements per day, the change in noise level due to this turning bay is less than 0.3 dB irrespective of the percentage of heavy vehicles using it.

The turning bay at Factory Road is within 26 metres of the 1 Factory Road. This site is a substation. The closest dwelling is 4 Buttercup Place, across SH16 from the turning bay. Noise levels would not change due to the use of the turning bay.

Therefore, any adverse noise effect from use of the turning bays would be at such a small degree as to be considered insignificant and therefore reasonable. The main noise source contribution would still be from SH16.

There would also be some widening of the road at some locations. From reviewing the drawings, the only section that appears to be widened is near Foster Road, as shown below in Figure 1.

Figure 1: Section of SH16 to be widened

The effect of this limited widening is considered insignificant (less than 1 decibel) and therefore the provisions of the road noise standard are not relevant. For these reasons, no further assessment of traffic noise effects is undertaken.

5.2 Construction

5.2.1 Noise

Indicative sound power levels for equipment likely to be used in the construction phase are listed in Table 3. The table also shows predicted noise levels at distance, and the compliance setback distance at which the night-time noise limit would be complied with (without mitigation/shielding). We note that the terrain throughout the Project extent is relatively flat so there would be marginal to no shielding provided by the local terrain. The predicted levels below assume uninterrupted line-of-sight and are therefore a worst-case level.

Table 5: Indicative construction noise levels without mitigation or shielding

Equipment	Sound Power Level (dB L_{Aeq})	Noise Level at 1m from the facade (dB L_{Aeq})			Compliance Setback (m)*	
		20 m	50 m	100 m	75 dB L_{Aeq}	45 dB L_{Aeq}
Bitumen emulsion	94	63	54	46	5	110
Bored or screw piling (small)	103	72	63	55	14	251
Concrete drill	108	77	68	60	25	398
Concrete truck & pump (Discharging)	103	72	63	55	14	251
Generator (150kVA)	93	62	53	45	4	100
Paving Machine	103	72	63	55	14	251
Truck (driving)	108	77	68	60	25	398
Truck (idling)	91	60	51	43	4	83
Vibratory roller	103	72	63	55	14	251

Based on the above, for most daytime works, noise levels would comply with the standards in Table 2 at most locations. For dwellings located closer than 25m from works, management and mitigation would need to be implemented.

Notwithstanding this, the Resource Management Act requires in all cases that the best practicable option is implemented irrespective of whether compliance is achieved, based on the high relative noise levels generated on-site construction activity.

In order to achieve compliance with the night-time noise standards, a large setback distance is required if line-of-sight is maintained.

For many of the dwellings this means that construction noise levels would exceed the night-time noise standards by a considerable margin, and management and mitigation would need to be implemented. It is noted that construction will travel along the alignment progressively, thus each dwelling will only be affected for a limited time when works are in the vicinity. This may extend from two nights to potentially up to 10 nights, depending on the works required and the line-of-sight from the receiving dwelling to the works.

5.2.2 Vibration

Use of vibratory roller is the main source of vibration. The safe setback distance, where outside of which, it is predicted that there is no exceedance of the vibration limit, is given below in Table 6.

Table 6: Vibratory roller safe setback distance

Equipment	Vibration Amenity (2mm/s)	Cosmetic Building Damage		
		Heritage (2.5mm/s)	Residential (5mm/s)	Commercial (10 mm/s)
Vibratory Roller	38	30	14	6

Two dwellings are within 14m of a potential vibratory rolled area. These receivers are 407 and 619 SH16. Therefore, it is predicted that there would be a risk of exceeding the cosmetic damage criteria at these receivers. MDA recommends that, if practicable, a static roller is used instead. If this is impracticable, MDA recommends that pre-construction building condition surveys are carried out in addition to vibration monitoring during works. This will enable determination of liability due to

damage that may be caused due to and during the vibratory rolling. It is also important that communication with affected parties is carried out. This is discussed further in section 5.3.1 below.

No commercial buildings appear within 6m of the alignment edge.

With respect to amenity, there will be a number of affected parties. MDA recommends that all receivers within 40m of the alignment is notified prior to any vibration works occurring so that vibration effects are minimised.

5.3 Mitigation and Management

The anticipated need for night-time works means that compliance with the relevant criteria is not practicable. Therefore, the activities must be managed through a CNVMP, as per AUP Rule E25.6.29 (5).

Mitigation measures, which will be outlined in the CNVMP are discussed below. The CNVMP will contain information regarding noise performance standards, predicted levels, affected receivers, on-site management, mitigation options, communication procedures, and complaints procedures.

The CNVMP should be implemented on site for the duration of the construction works. It is considered a living document and should be kept up to date regarding actual timing/equipment use and methodologies, should these change throughout the construction process

5.3.1 Engagement

The most important management tool for construction noise and vibration is consultation and communication.

Any persons affected by noise levels higher than the construction noise and vibration standards should be informed of the proposed works, including timing. Notice should be provided to those households prior to works being carried out, by means of letter drops or similar. In addition, a contact phone number should be available to residents should they have concerns about the works or require further information.

It is understood that a communication plan has already been developed for this Project. This Plan should reflect the communication requirements for noise issues contained in the CNVMP.

5.3.2 Barriers

Placing temporary noise barriers, such as sheets of plywood or construction noise curtains, between dwellings and the construction activities can reduce noise levels by up to 10 decibels. While some works can benefit from localised screening (e.g. using a concrete drill for the installation of the wire barriers), other activities are linear and cannot be practicably mitigated by barriers.

For road works moving along in a linear fashion, barriers are not always a practicable mitigation option. However, where night-time works are required in the vicinity of dwellings, shielding equipment should be considered to reduce overall noise levels. The could include the construction of the Coopers Creek bridge in the vicinity of 573 SH16.

Where works would be in close proximity to dwellings (e.g. the construction of the turning bay at Trigg Road within 8 metres of 407 SH16), barriers could also be used to reduce noise levels. In this location, the barrier could be kept in place to reduce traffic noise levels also.

5.3.3 Avoidance of Unnecessary Noise and Vibration

At many construction sites, some practices unnecessarily increase noise or vibration levels. Examples include the sounding of horns when a truck is fully laden, the utilisation of tonal reversing alarms or the forced cleaning of excavator buckets by thumping them on the ground.

Noise and vibration levels can be reduced by means of site management and protocols, fitting of mufflers to trucks, the replacement of tonal reversing alarms with broadband reversing alarms and

considerate use of machinery, which should be considered as part of the development of the CNVMP.

5.3.4 Night-time works

There is the potential that night-time works will be required to avoid traffic disruptions during daytime. Where this is the case, timing, location, equipment and methodology should be carefully assessed in order to avoid or reduce adverse noise and/or vibration effects on neighbouring buildings that are sensitive to noise.

Management should, amongst others, involve the following aspects:

- Noisiest works such as surface milling, concrete drilling or cutting, if required to be undertaken at night, should be scheduled for early in the night (before midnight) to manage effects
- No tonal reversing alarms should be used, but rather alternative measures such as broad band reversing alarms
- Works should be undertaken away from dwellings if practicable
- Response times to complaints should be reduced to 1 hour

5.3.5 Response to Potential Non-compliance

At present, only potential effects have been assessed, based on potential worst-case scenarios. However, when a contractor has been appointed and equipment, timing and staging is better understood, these facts will be included in the CNVMP.

However, the overall CNVMP will be prepared prior to commencement of the project, when not every detail will be known. During the cause of project progression, issues such as actual or potential non-compliance due to specific activities or timing required will become known. In some cases these instances of non-compliance would be allowed in accordance with the rules in the AUP (refer section 4.2.1). However, this rule still requires them to be addressed in the CNVMP. Therefore, in order to address any such instances, the entire CNVMP would need to be updated. Alternatively, and more commonly, schedules are added to the CNVMP that respond to specific issues of identified non-compliance.

Such schedules would include consultation undertaken with the affected residents and proposed management and mitigation measures, and will then enable an appropriate response

Therefore, we recommend that an overarching CNVMP is prepared, and schedules added as required to address specific issues identified non-compliance.

6.0 CONCLUSION

Marshall Day Acoustics has assessed construction noise and vibration with regard to the road improvement along SH16 between Brigham Creek Road to Waimauku, excluding Kumeu. This report focusses on the section from Huapai to Waimauku.

Construction noise and vibration criteria are predicted to be exceeded at times for some receivers within a certain setback distance from the alignment. To minimise effects, mitigation measures have been recommended to be implemented. The works should be managed through a Construction Noise and Vibration Management Plan.

Although there will be some minor alterations to the horizontal alignment, noise level predictions show that effects will be minimal and therefore, that an assessment under NZS 6806 is not required. This is because the proposed changes would not have a material effect on traffic noise as there would be no increase on traffic volume due to the project.

APPENDIX A GLOSSARY OF TERMINOLOGY

Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
$L_{A10\ (t)}$	The A-weighted noise level equalled or exceeded for 10% of the measurement period. This is commonly referred to as the average maximum noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
$L_{A95\ (t)}$	The A-weighted noise level equalled or exceeded for 95% of the measurement period. This is commonly referred to as the background noise level.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
Noise	A sound that is unwanted by, or distracting to, the receiver.