TE TUPU NGĀTAHI
SUPPORTING GROWTH

# North West Redhills and Riverhead Assessment of Construction Noise and Vibration Effects

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Version 1

WAKA KOTAHI NZ TRANSPORT AGENCY

New Zealand Government

## Document Status

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# Abbreviations

| Acronym/Term | Description |
|---|---|
| **AEE** | Assessment of Effects on the Environment |
| **AT** | Auckland Transport |
| **AUP:OP** | Auckland Unitary Plan Operative in Part |
| **BCI** | Brigham Creek Interchange |
| **FUZ** | Future Urban Zone |
| **NAL** | North Auckland Line |
| **NoR** | Notice of Requirement (under the Resource Management Act 1991) |
| **RMA** | Resource Management Act 1991 |
| **SG** | Te Tupu Ngātahi Supporting Growth |
| **SH16** | State Highway 16 |
| **The Council** | Auckland Council |
| **Waka Kotahi** | Waka Kotahi NZ Transport Agency |
| **PPV** | Peak Particle Velocity, measured in mm/s |

# Glossary of Acronyms / Terms

| Acronym/Term | Description |
|---|---|
| **Auckland Council** | Means the unitary authority that replaced eight councils in the Auckland Region as of 1 November 2010. |
| **Redhills Riverhead Assessment Package** | Two Notices of Requirement (for Don Buck Road and Coatesville-Riverhead Road) and one alteration to an existing designation (Fred Taylor Drive) for the Redhills Riverhead Package of Projects for Auckland Transport. |

# 1 Executive Summary

Construction noise levels have been assessed using the method recommended in NZS 6803 in accordance with the Auckland Unitary Plan Operative in Part (AUP:OP). As construction of each Project is expected to last for more than 20 weeks, the “long-duration” noise limits are applicable.

Noisy activities will typically be carried out between 7am – 6pm on weekdays. Night-time and weekend works will be limited and only occur for critical activities.

Construction vibration levels have been assessed against the requirements of the AUP:OP, which refer to the criteria in DIN 4150-3:1999 for the avoidance of cosmetic building damage (DIN criteria). The AUP:OP also details amenity criteria, which act as a trigger for consultation if predicted to be exceeded.

Construction noise setback distances and vibration emission radii have been determined (based on assumptions of construction activities and equipment) for each of the NoR sections. The construction boundary is assumed to be the edge of the proposed alignment. Affected receivers have been identified using construction noise setback distances and vibration emission radii. The construction noise setback distances and vibration emission radii were used to determine where any potential construction noise and vibration exceedances of the relevant criteria could occur. It should also be noted that the emission radii are conservative and vibration levels measured on site tend to be much lower than those predicted at the NoR stage of a project.

Potential effects of construction noise and vibration have then been assessed and construction management and mitigation measures identified where appropriate. To avoid and/or minimise exceedances of the Project construction noise and vibration criteria, Best Practicable Option (BPO) mitigation and management measures should be utilised.

**NoR RE1 Don Buck Rd**

***Results of assessment and recommended measures***

Don Buck Road is an existing busy road with commercial buildings and residential dwellings along the road corridor. The noise environment is dominated by road traffic noise from vehicles on Don Buck Road and industrial noise from businesses located in the Light Industrial Zone.

Receivers are located at varying distances from the construction boundary along the alignment with the closest existing receiver being 2m from the alignment. With mitigation in place, as set out in Section 5.2, noise levels of up to 90 dB $L_{Aeq}$ could still occur intermittently at the closest receivers, if high noise generating activities occur on the construction boundary. At this level effects could include loss of concentration, annoyance, and a reduction in speech intelligibility.

Operation of construction equipment will be intermittent in nature. Construction will be linear so as the equipment moves away from the receiver noise levels will reduce. The worst-case situations, where mitigated noise levels could reach 90 dB $L_{Aeq}$ at the closest receivers, are not expected to be frequent, due to the setback distances to the majority of the proposed works and the use of equipment with lower source noise levels for large portions of the works. It is therefore predicted that mitigated noise levels can comply with the 70 dB $L_{Aeq}$ noise criterion for most of the construction works.

Vibration levels could exceed the Category B criteria at 30 existing dwellings and three commercial buildings prior to mitigation being implemented, if high vibration generating equipment, such as the

roller compactor, is used on the construction boundary at the closest position to the receivers. At these receivers there is potential for cosmetic damage to buildings (such as cracking) and annoyance from perception of vibration. Vibration can typically be tolerated inside buildings if it occurs intermittently during the day, is of limited duration and where there is effective prior engagement.

***Conclusion***

Construction noise and vibration can be mitigated and managed, utilising the measures set out in Section 5.2, to generally comply with the applicable limits as defined in the AUP:OP. Exceedances of the criteria could occur intermittently over a short duration if high noise or vibration generating equipment are used near occupied buildings. Where an exceedance is predicted at any receiver that exists at the time of construction, the effects will be mitigated and managed through the CNVMP and Schedules.

A CNVMP is the most effective way to avoid, remedy or mitigate construction noise and vibration effects on receivers.

**NoR RE2 Fred Taylor Drive**

***Results of assessment and recommended measures***

Fred Taylor Drive is located within a predominantly rural area with some dwellings and commercial receivers located close to the road corridor. The noise environment is dominated by road traffic noise from vehicles on Fred Taylor Drive and the surrounding road network.

Receivers are located at varying distances from the construction boundary along the alignment with the closest existing receiver at 2m. With mitigation in place as set out in Section 5.2, noise levels of up to 90 dB $L_{Aeq}$ could still occur intermittently at the closest receivers, if high noise generating activities occur on the construction boundary. At this level effects could include loss of concentration, annoyance, and a reduction in speech intelligibility.

Operation of construction equipment will be intermittent in nature. Construction will be linear so as the equipment moves away from the receiver noise levels will reduce. The worst-case situations, where mitigated noise levels could reach 90 dB $L_{Aeq}$ at the closest receivers, are not expected to be frequent, due to the setback distances to the majority of the proposed works and the use of equipment with lower source noise levels for large portions of the works. It is therefore predicted that mitigated noise levels can comply with the 70 dB $L_{Aeq}$ noise criterion for most of the construction works.

Vibration levels could exceed the Category B criteria at 15 existing dwellings and one commercial building prior to mitigation being implemented, if high vibration generating equipment, such as the roller compactor, is used on the construction boundary at the closest position to the receivers. At these receivers there is potential for cosmetic damage to buildings (such as cracking) and annoyance from perception of vibration. Vibration can typically be tolerated inside buildings if it occurs intermittently during the day, is of limited duration and where there is effective prior engagement.

***Conclusion***

Construction noise and vibration can be mitigated and managed, utilising the measures set out in Section 5.2, to generally comply with the applicable limits as defined in the AUP:OP. Exceedances of the criteria could occur intermittently over a short duration if high noise or vibration generating equipment are used near occupied buildings. Where an exceedance is predicted at any receiver that

exists at the time of construction, the effects will be mitigated and managed through the CNVMP and Schedules.

A CNVMP is the most effective way to avoid, remedy or mitigate construction noise and vibration effects on receivers.

**NoR R1 Coatesville-Riverhead Highway Upgrade**

***Results of assessment and recommended measures***

Coatesville-Riverhead Highway currently runs through urban and rural environments. In the rural area there are few receivers near the road. The noise environment is dominated by road traffic noise from vehicles using the Coatesville-Riverhead Highway and the surrounding road network. Development is highly likely to occur in the Future Urban Zone, located on the western side of the corridor. An increase in ambient noise levels is expected as the area urbanises.

Receivers are located at varying distances from the construction boundary along the alignment with the closest existing receiver being 2m away. With mitigation in place, as set out in Section 5.2, noise levels of up to 90 dB $L_{Aeq}$ could occur intermittently at the closest receivers, if high noise generating activities occur on the construction boundary. At this level effects could include loss of concentration, annoyance, and a reduction in speech intelligibility.

Operation of construction equipment will be intermittent in nature. Construction will be linear so as the equipment moves away from the receiver noise levels will reduce. The worst-case situations, where mitigated noise levels could reach 90 dB $L_{Aeq}$ at the closest receivers, are not expected to be frequent, due to the setback distances to the majority of the proposed works and the use of equipment with lower source noise levels for large portions of the works. It is therefore predicted that mitigated noise levels can comply with the 70 dB $L_{Aeq}$ noise criterion for most of the construction works.

Vibration levels could exceed the Category B criteria at 27 existing dwellings prior to mitigation being implemented, if high vibration generating equipment such as the roller compactor is used on the construction boundary at the closest position to the receivers. At these receivers there is potential for cosmetic damage to buildings (such as cracking) and annoyance from perception of vibration. Vibration can typically be tolerated inside buildings if it occurs intermittently during the day, is of limited duration and where there is effective prior engagement.

***Conclusion***

Construction noise and vibration can be mitigated and managed, utilising the measures set out for each transport corridor, to generally comply with the applicable limits as defined in the AUP. Exceedances of the criteria could occur intermittently over a short duration if high noise or vibration generating equipment are used near occupied buildings. Where an exceedance is predicted at any receiver that exists at the time of construction, the effects will be mitigated and managed through the CNVMP and Schedules.

A CNVMP is the most effective way to avoid, remedy or mitigate construction noise and vibration effects on receivers.

# 2 Introduction

This construction noise and vibration assessment has been prepared for the North West Redhills and Riverhead Local Arterials Notices of Requirement (**NoRs**) for Auckland Transport (**AT**) (the "**Redhills Riverhead Assessment Package**"). The NoRs are to designate land for future strategic and local arterial transport corridors as part of Te Tupu Ngātahi Supporting Growth Programme (**Te Tupu Ngātahi**) to enable the construction, operation and maintenance of transport infrastructure in the North West area of Auckland.

This report assesses the construction noise and vibration effects of the North West Redhills Riverhead Assessment Package, refer to the AEE for project areas.

## 2.1 Purpose and Scope of this Report

This assessment forms part of a suite of technical reports prepared to support the assessment of effects within the Redhills Riverhead Assessment Package. Its purpose is to inform the AEE that accompanies the Redhills Riverhead Assessment Package sought by AT.

This report considers the actual and potential effects associated with the construction of the Redhills Riverhead Assessment Package on the existing and likely future environment as it relates to the construction noise and vibration effects and recommends measures that may be implemented to avoid, remedy and/or mitigate these effects.

The key matters addressed in this report are as follows:

a) Identify and describe the noise and vibration context of the Redhills Riverhead Assessment Package area;
b) Identify and describe the actual and potential construction noise and vibration effects of each Project corridor within the Redhills Riverhead Assessment Package;
c) Recommend measures as appropriate to avoid, remedy or mitigate actual and potential construction noise and vibration effects (including any conditions/management plan required) for each Project corridor within the Redhills Riverhead Assessment Package; and
d) Present an overall conclusion of the level of actual and potential construction noise and vibration effects for each Project corridor within the Redhills Riverhead Assessment Package after recommended measures are implemented.

## 2.2 Report Structure

The report is structured as follows:

a) Overview of the methodology used to undertake the assessment and identification of the assessment criteria and any relevant standards or guidelines;
b) Description of each Project corridor and project features within the Redhills Riverhead Assessment Package as it relates to construction noise and vibration
c) Description of the existing and likely future noise environment;
d) Description of the actual and potential adverse construction noise and vibration effects of construction of the Projects;
e) Recommended measures to avoid, remedy or mitigate potential adverse construction noise and vibration effects; and
f) Overall conclusion of the level of potential adverse construction noise and vibration effects of the Projects after recommended measures are implemented.

This report should be read alongside the AEE, which contains further details on the history and context of the Projects. The AEE also contains a detailed description of works to be authorised for the Projects, likely staging and the typical construction methodologies that will be used to implement this work. These have been reviewed by the author of this report and have been considered as part of this assessment of the construction noise and vibration effects. As such, they are not repeated here, unless a description of an activity is necessary to understand the potential effects, then it has been included in this report for clarity.

## 2.3 Preparation for this Report

The construction methodology and construction drawings for each NoR was reviewed and reference to the AUP:OP, NZS 6803 and DIN 4150 was made (these documents are discussed further below).

# 3 Assessment Criteria

## 3.1 Construction Noise

Potential construction noise effects have been assessed in accordance with the applicable AUP:OP noise rules and standards. Standard E25.6.1(3) of the AUP:OP states that "The noise from any construction activity must be measured and assessed in accordance with the requirements of New Zealand Standard NZS6803:1999 Acoustics – Construction noise". Standards E.25.6.27(1) and E.25.6.27(2) contain noise limits for sensitive and all other receivers.

Furthermore, Standard E25.6.29 specifies that construction noise levels for work within the road for construction, maintenance and demolition activities must meet the relevant noise levels in the relevant table E25.6.27(1) or E25.6.27(2). Noise levels from E25.6.27(1) and E25.6.27(2) have been adopted for the purpose of this assessment and are reproduced in Table 3-1 and Table 3-2.

In accordance with Standard 25.6.27(4) of the AUP:OP, since the works will take longer than 20 weeks a 5dB reduction has been applied in all cases to noise limits in E25.6.27(1) and E25.6.27(2) of the AUP:OP. The long duration limits are detailed in Table 3-1 and Table 3-2 below.

**Table 3-1 Construction noise criteria for sensitive receivers (outside of Business – City Centre Zone and the Business – Metropolitan Centre Zone)**

| Day of the week | Time period | Maximum noise level night-time >20 weeks | |
|---|---|---|---|
| | | dB $L_{Aeq}$ | dB $L_{Aeq}$ |
| **Weekdays** | 6:30 – 7:30 | 55 | 70 |
| | 7:30 – 18:00 | 70 | 85 |
| | 18:00 – 20:00 | 65 | 80 |
| | 20:00 – 6:30 | 40 | 70 |
| **Saturdays** | 6:30 – 7:30 | 40 | 70 |
| | 7:30 – 18:00 | 70 | 85 |
| | 18:00 – 20:00 | 40 | 70 |
| | 20:00 – 6:30 | 40 | 70 |
| **Sunday and public holidays** | 6:30 – 7:30 | 40 | 70 |
| | 7:30 – 18:00 | 50 | 80 |
| | 18:00 – 20:00 | 40 | 70 |
| | 20:00 – 6:30 | 40 | 70 |

**Table 3-2 Construction noise criteria for all other receivers (outside of Business – City Centre Zone and the Business – Metropolitan Centre Zone)**

| Time period | Maximum noise night-time >20 weeks dB $L_{Aeq}$ |
|---|---|
| 7:30 – 18:00 | 70 |
| 18:00 – 7:30 | 75 |

Exemptions to these levels are provided in Rule E25.6.29 (2) and E25.6.29 (3) where noise levels specified do not apply for planned works in the road between the hours of 10pm and 7am where:

- The number of nights where the noise generated by the works exceeds the relevant noise levels at any one receiver exceeds the relevant noise levels for 3 nights or less; and
- The works cannot practicably be carried out during the day or because the road controlling authority requires this work to be night-time; or
- Because of the nature of the works the noise produced cannot practicably be made to comply with the relevant noise levels.

Under E25.6.29(3) noise levels specified (as replicated above in Table 3-1) do not apply for planned works in the road between the hours of 7am and 10pm where:

- The number of days where the noise generated by the works exceeds the relevant noise levels at any one receiver is 10 days or less; or
- Because of the nature of the works and the proximity of receivers the noise generated cannot be practicably made to comply with the relevant noise levels.

If situations fall under the exemption rules, then a copy of the works access permit issued by Auckland Transport will be provided to the Council five days prior to work commencing; or a construction noise and vibration management plan will be provided to the Council no less than five days prior to the works commencing in accordance with the applicable provisions of Standard E25.6.29(5).

## 3.2 Construction Vibration

The main objective of controlling construction vibration is to avoid vibration-related damage to buildings, structures, and services, in the vicinity of the works. Any adverse effects of construction vibration on human comfort would typically only be experienced for short durations, for most types of construction work.

It should be noted that the level of vibration perceived by humans, and the level of vibration that is likely to result in annoyance for some people, are magnitudes lower than the level of vibration capable of damaging structures. This means that vibration levels which readily comply with the building damage criteria will likely cause annoyance and adverse reaction from building occupants who mistakenly believe that their building is sustaining damage.

Potential exceedances of the amenity criteria will be considered when assessing the construction vibration effect on nearby receivers. It is recommended that the limits relating to human comfort detailed in Table 3-3 should be used as a trigger for communication and consultation and should be included in the construction management plan(s) that will be prepared as part of the Projects.

### 3.2.1 Auckland Unitary Plan

The AUP:OP contains rules relating to construction vibration that cover both building damage and amenity. Rule E25.6.30 states that construction activities must be controlled to ensure any resulting vibration does not exceed:

a. The limits set out in German Industry Standard DIN 4150-3 (1999): Structural Vibration Part 3 Effects of vibration on structures when measured in accordance with that Standard on any structure not on the same site; and
b. The limits set out in Table 3-3 in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building.

**Table 3-3 AUP:OP Table E25.6.30.1 Vibration limits in buildings**

| Receiver | Period | Peak Particle Velocity (PPV mm/s) |
|---|---|---|
| Occupied activity sensitive to noise or vibration | Night-time 10pm to 7am | 0.3 |
| | Daytime 7am to 10pm | 2.0 |
| Other occupied buildings | At all times | 2.0 |

Works generating vibration for three days or less between the hours of 7am to 6pm may exceed the limits in Table E25.6.30.1 Vibration limits in buildings above, but must comply with a limit of 5mm/s peak particle velocity in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500mm of ground level at the foundation of a single storey building, where:

(i) all occupied buildings within 50m of the extent of the works generating vibration are advised in writing no less than three days prior to the vibration-generating works commencing; and
(ii) the written advice must include details of the location of the works, the duration of the works, a phone number for complaints and the name of the site manager.

### 3.2.2 DIN 4150-3:1999 – Structural vibrations: Effects of vibrations on structures

DIN 4150 contains guidelines on the vibration limits for buildings which, when complied with "will not result in damage that will have an adverse effect on the structure's serviceability". These limits are reproduced in Table 3-4.

Different criteria are given for "short-term" (transient) vibration sources such as blasting and impact piling, and "long-term" sources such as vibrocompaction. Note that the definition of "short-term" and "long-term" in DIN 4150-3:1999 differ from those in NZS 6803:1999 and do not strictly relate to the duration of the works, but rather how a building responds to the construction vibration. Short term vibration does not excite a structure (which would result in a significant increase in vibration), therefore vibration limits are higher than for long-term vibration.

**Table 3-4 Vibration velocity guideline values for structures (DIN 4150)**

| **Type of structure** | **Short term vibration**** | | | | **Long Term Vibration** |
|---|---|---|---|---|---|
| | PPV at foundation, frequency of: | | | Vibration at horizontal plane of highest floor at all frequencies (mm/s) | PPV at horizontal plane of highest floor (mm/s) |
| | 1 Hz to 10 Hz | 10 Hz to 50 Hz | 50 Hz to 100 Hz* | | |
| Buildings used for commercial purposes, industrial buildings, and buildings of similar design | 20 | 20 to 40 | 40 to 50 | 40 | 10 |
| Dwellings and buildings of similar design and/or use | 5 | 5 to 15 | 15 to 20 | 15 | 5 |
| Structures that because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value | 3 | 3 to 8 | 8 to 10 | 8 | 2.5 |

* At frequencies above 100 Hz, the values given in this column may be used as minimum values

** The Standard defines short-term vibration as "vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance in the structure being evaluated". Long-term vibration is defined as all other vibration types not covered by the short-term vibration definition.

Clause 5.1 of DIN 4150-3 notes that a vibration level in excess of the DIN criterion does not necessarily result in building damage. The definition of 'damage' in DIN 4150-3 is: "any permanent effect of vibration that reduces serviceability of a structure or one of its components".

Examples of a ''reduction of serviceability' include.

- The impairment of stability of the building and its components; and
- A reduction in the bearing capacity of floors.

For dwelling type buildings and structures sensitive to vibration, the serviceability is considered to have been reduced if:

- Cracks form in plastered surfaces of walls;
- Existing cracks in the building are enlarged; and
- Partitions become detached from loadbearing walls or floors.

Clause 4.5 of DIN 4150-3 states that these effects are deemed 'minor damage'

### 3.2.3 Auckland Transport construction vibration criteria

The following criteria are the recommended Project construction vibration criteria for both building damage and amenity applicable for all NoRs.

The two category criteria, detailed in Table 3-5 are to facilitate a progressive management response to the increasing risks and effects during construction.

Category A sets the criteria for the amenity effects where vibrations may be perceived by occupants within a building, as adopted from the AUP:OP, and is an indicator of when communication and consultations should be initiated to manage effects. Category B are based on DIN 4150 building damage criteria for daytime.

**Table 3-5 Auckland Transport Construction vibration criteria**

| Vibration Level | Effect | Category A | Category B |
|---|---|---|---|
| Occupied Activities sensitive to noise | Night-time 2000h – 0630 | 0.3mm/s ppv | 2mm/s ppv |
| | Daytime 0630h – 2000h | 2mm/s ppv | 5mm/s ppv |
| Other occupied buildings | Daytime 0630h – 200h. | 2mm/s ppv | 5mm/s ppv |
| All other buildings | All other times | Tables 1 and 3 of DIN4150-3:1999 | |

Where compliance with the vibration standards set out in Table 3-5 is not practicable, and unless otherwise provided for in the CNVMP (refer Section 1.1.1), a schedule (refer Section 1.1.2) will be required.

# 4 Assessment Methodology

A consistent approach has been adopted for the whole Redhills Riverhead Package as set out in this section. It has been assumed that no concurrent project works will occur across the multiple areas where receivers may be subjected to impacts from more than one designation. Any receivers that may be impacted by more than one Project would be considered as part of the CNVMP closer to the time of construction. In most cases buildings within the current proposed designation footprint will be removed, as confirmed by the Project Team, and are not assessed. If the corridor footprint is redefined through the design process this should be considered in the CNVMP.

Construction noise setback distances and vibration emission radii have been determined (based on assumptions of construction activities and equipment) for each of the NoR sections.

The construction boundary is assumed to be the edge of the proposed alignment. Affected receivers have been identified using construction noise setback distances and vibration emission radii. The construction noise setback distances and vibration emission radii were used to determine where any potential construction noise and vibration exceedances of the relevant criteria could occur. Potential effects of construction noise and vibration have then been assessed and construction management and mitigation measures identified where appropriate. To avoid and/or minimise exceedances of the Project construction noise and vibration criteria, Best Practicable Option (BPO) mitigation and management measures should be utilised.

This report proposes a framework for construction noise and vibration management such that the most effective and practicable methods for mitigation will be planned and implemented, taking into account the extent of predicted effects. At the core of this framework is the Construction Noise and Vibration Management Plan (CNVMP) in Section 1.1.1 which will be developed prior to commencement of construction and updated as necessary throughout the duration of construction.

## 4.1 Construction methodology

An indicative construction methodology has been provided by the project team to inform the assessment of each of the NoRs.

The outline is based on a generic construction project and has not taken into consideration any project specific scope of works, constraints or staging requirements that may be applicable for each project. The indicative construction programme assumes a linear construction sequence.

The construction methodology for the projects is as follows:

### 4.1.1 Site establishment

- Site access construction;
- Tree removal and vegetation clearance;
- Remove footpath, streetlights, grass verge berm;
- Property/ building modification or demolition, including fencing, driveways and gates;
- Install environmental controls e.g. silt fencing, sediment retention ponds;
- Implement traffic management to establish the construction zones;
- Service protection works; and
- Construct access tracks/ haul roads (if any).

### 4.1.2 Advance works

- Relocation of utilities services; and
- Major earthworks to include the following:
  - Ground improvements, undercuts, embankment foundations;
  - Cut and fill works along the alignment to formation level, including preload if required; and
  - Remove preload upon settlement completion, and subgrade preparation.

### 4.1.3 Main works

- Minor earthworks (cut and fill);
- Remove verge and prepare subgrade formation;
- Construct new longitudinal drainage facilities;
- Construct new pavement, widening works in available areas;
- Move traffic to newly constructed pavement areas and continue with the remaining widening works;
- Pavement reconstruction or reconfiguration of existing road furniture;
- Complete tie in works, footpaths, cycleways, lighting and landscaping;
- Construct permanent stormwater wetlands;
- Construct new culverts including rip rap and headwalls;
- Install road safety barriers (if any); and
- Bridge construction works (if any) as follows:
  - Construct abutments;
  - Piling, pier, and headstock construction;
  - Install bridge beams and decking;
  - Install settlement slabs;
  - Retaining wall construction (if any);
  - Accommodation works; and
  - Install signage and lighting.

### 4.1.4 Finishing works and demobilisation

- Final road surfacing and road markings;
- Commission traffic signals (if any);
- Finishing works e.g. landscaping, street furniture, fencing and outstanding accommodation works;
- Move traffic to the final road configuration; and
- Practical completion and de-establishment.

### 4.1.5 Plant and Equipment

Table 4-1 provides an indicative list of plant and equipment which may be required for construction across each designation.

**Table 4-1 Indicative construction equipment**

| Construction | Construction Activity |
|---|---|
| **Typical across all works** | • Site facility<br>• Light Vehicles<br>• Hiab truck<br>• Trucks |
| **Earthworks** | • 20-30T Excavator<br>• Roller Compactor<br>• Water Cart<br>• Tippers<br>• Stabilizers |
| **Drainage** | • 20T Excavator<br>• Trench Shields<br>• Tandem Tipper<br>• Loader<br>• Plate compactor<br>• Trucks<br>• Water cart |
| **Pavement Construction** | • Grader<br>• Water Cart<br>• Smooth Drum Roller<br>• Vibratory Roller<br>• Tandem Tippers<br>• Kerbing Machine<br>• Concrete Truck<br>• Plate compactor<br>• Paver<br>• Excavators |

## 4.2 Construction Noise

Construction phases for each of the Projects are initially expected to occur for a minimum of 25 months, at the time of writing this report. Predictions have been assessed against the noise criteria for greater than 20 weeks “long-duration” under NZS6803:1999 as presented in Table 3-1. It is expected that the majority of the works will be carried out between 7am – 6pm Monday to Saturday. There will be extended hours during summer earthworks season (e.g. 6am to 8pm, Monday to Sunday), there is also the possibility of night works for critical activities (culvert construction and road surfacing).

Various construction activities and pieces of equipment will act as noise sources on site during construction works. An indicative construction equipment list has been provided by the project team to assess the noise and vibration effects. Given construction will occur in the future, the current methodology may not be inclusive of all equipment used nearer the time of construction. Equipment tables will need to be updated to reflect selection at the development of the management plan. A minimum set back distance from receivers to comply with day-time noise criterion of 70 dB $L_{Aeq}$ without mitigation has been calculated.

Table 4-2 details the sound power levels from the likely significant noise sources and the various receiver setback distances required to achieve compliance with the 70 dB $L_{Aeq}$ day-time noise criterion

without mitigation. The noise data has been taken from British Standard 5228-1:2009 “Code of practice for noise and vibration control on construction and open sites”, manufacturers data or the AECOM database of noise measurements[1]. Equipment selection at detailed design stage may include equipment with different sound power levels than those presented. The equipment list should be reassessed nearer the time at production of the CNVMP.

**Table 4-2 Construction Equipment Sound levels and indicative compliance distance**

| Equipment | Sound power level (dB $L_{Aeq}$) | Free field noise level at varying distances (dB $L_{Aeq}$) | | | | Minimum Setback distance to comply with day-time criteria without mitigation |
|---|---|---|---|---|---|---|
| | | 5 m | 10 m | 20 m | 50 m | |
| **30T excavator** | 105 | 86 | 80 | 73 | 66 | 30 |
| **20T excavator** | 99 | 80 | 74 | 67 | 60 | 13 |
| **Roller compactor** | 101 | 82 | 76 | 69 | 62 | 20 |
| **Tipper Truck** | 107 | 88 | 82 | 75 | 68 | 36 |
| **Loader** | 105 | 86 | 80 | 73 | 66 | 30 |
| **Vibratory Plate Compactor** | 110 | 91 | 85 | 78 | 71 | 45 |
| **Smooth Drum Roller** | 103 | 84 | 78 | 71 | 64 | 25 |
| **Paver** | 103 | 84 | 78 | 71 | 64 | 25 |
| **Grader** | 99 | 80 | 74 | 67 | 60 | 13 |

Table 4-3 details the sound power levels from key construction activities/types. The equipment sound power levels in Table 4-2 have been combined according to equipment that are likely to occur at the same time. From the combined level a minimum setback distance at which compliance can be achieved has been determined.

**Table 4-3 Activity Sound Power Levels and Compliance Distance**

| Construction Type | Activity Sound Power Level (dB $L_{Aeq}$) | Minimum set back distance from receivers to comply with day-time limit (70 dB $L_{Aeq}$) without mitigation, meters |
|---|---|---|
| Typical across all works | 110 | 48 m |
| Earthworks | 111 | 52 m |
| Drainage works | 113 | 56 m |
| Pavement Construction | 115 | 76 m |

[1] This is held on file. Details can be provided upon request.

## 4.3 Construction Vibration

Vibration generation and propagation is highly site specific. The generation of vibration is dependent on the local site geology, the equipment being used, the nature of the works, and even the operator.

To account for the inaccuracy in the prediction of vibration, the likely worst-case vibration has been calculated based on the equipment and hard ground geology.

Vibration from a source transmits in a spherical pattern and reduces with distance. There will be a particular distance from each source at which the vibration level equals the relevant vibration criteria. This distance is called the 'emission radius'. The vibration criteria and emission radii for high vibration generating equipment are detailed in Table 4-4.

**Table 4-4 Vibration sources and indicative emission radii**

| **Equipment** | **Daytime Occupied Buildings (2 mm/s)** | **DIN 4150 emission radii** | | |
|---|---|---|---|---|
| | | **Historic and Sensitive (2.5 mm/s)** | **Residential (5 mm/s)** | **Commercial (10 mm/s)** |
| **Roller Compactor** | 21m | 17m | 8m | 4m |
| **Excavator** | 12m | 10m | 6m | 2m |
| **Tipper Truck** | 2m | 2m | 1m | 0m |
| **Vibratory Plate Compactor** | 3m | 2m | 1m | 1m |

We recommend that vibration measurements are undertaken at specific locations as identified through the CNVMP and schedules at the commencement of construction activities to establish vibration propagation site laws for vibration generating equipment. This approach will confirm the emission radii used in this assessment and ensure the applicable criteria are complied with. It has been found on other major construction projects, that the measured vibration levels for a particular activity are much lower than those predicted during the assessment stage.

# 5 Redhills Riverhead Construction Effects

## 5.1 Overview of Construction Effects

Potential construction noise and vibration effects are summarised in this section

### 5.1.1 Construction noise

Table 5-1 gives examples of the potential effects on receivers at different noise levels based on NZS6803 with most exposed façades providing a 20 dB reduction. Depending on the construction of the house, facades may provide up to a 25 – 30 dB reduction, therefore assumptions and effects provided below are based on a conservative approach.

**Table 5-1 Potential construction noise effects on receivers**

| External Noise Level | Potential Daytime Effects Outdoors | Corresponding Internal Noise Level | Potential Daytime Effects Indoors |
|---|---|---|---|
| 65 dB $L_{Aeq}$ | Conversation becomes strained, particularly over longer distances | 45 dB $L_{Aeq}$ | Noise levels would be noticeable but unlikely to interfere with residential or office daily activities. |
| 65 to 70 dB $L_{Aeq}$ | People would not want to spend any length of time outside, except when unavoidable through workplace requirements | 45 to 50 dB $L_{Aeq}$ | Concentration would start to be affected. TV and telephone conversations would begin to be affected. |
| 70 to 75 dB $L_{Aeq}$ | Businesses that involve substantial outdoor use (for example garden centres such as Bunnings) would experience considerable disruption. | 50 to 55 dB $L_{Aeq}$ | Phone conversations would become difficult. Personal conversations would need slightly raised voices. Office work can generally continue, but 55 dB is considered by the experts to be a tipping point for offices. For residential activity, TV and radio sound levels would need to be raised. |
| 75 to 80 dB $L_{Aeq}$ | Some people may choose protection for long periods of exposure. Conversation would be very difficult, even with raised voices. | 55 to 60 dB $L_{Aeq}$ | Continuing office work would be extremely difficult and become unproductive. In a residential context, people would actively seek respite. |

| External Noise Level | Potential Daytime Effects Outdoors | Corresponding Internal Noise Level | Potential Daytime Effects Indoors |
|---|---|---|---|
| 80 to 90 dB $L_{Aeq}$ | Hearing protection would be required for prolonged exposure (8 hours at 85 dB) to prevent hearing loss. | 60 to 70 dB $L_{Aeq}$ | Untenable for both office and residential environments. Unlikely to be tolerated for any extent of time. |

With effective management of construction activities, which includes consultation and communication with affected parties and scheduling noisy works during the daytime rather than night-time period, noise levels can be controlled so that the effects on the nearest residential receivers are reduced. Barriers will not be effective at all locations, particularly where receivers are more than one storey. Where barriers are not going to be effective, the use of enclosures or local screening of equipment should be considered and implemented, where practicable. If noisy activities must take place during the night-time, and screening or other mitigation measures do not provide sufficient attenuation to meet the night-time noise criteria or are not practicable, it may be necessary to offer temporary relocation to affected residents. Temporary relocation should be considered on a case-by-case basis and as a last resort.

### 5.1.2 Construction Vibration

The vibration effects associated with construction of the Projects are considered in terms of human response and building damage. However, in our experience the main concern for building occupants during construction is damage to the building itself.

Humans can generally perceive vibrations at a much lower level than when building damage is likely to occur. The adverse effects of construction vibration on building occupants may be significant in some buildings adjacent to the areas of works. Adverse effects may range from annoyance to loss of amenity or inability to carry out work. Vibration effects will reduce with distance from the source, and the level of vibration transmission into a building will depend on a number of factors, such as the foundation type and building construction.

Potential effects and human perception of the vibration levels found within the AUP:OP/DIN criteria have been combined below and adopted for this assessment.

**Table 5-2 Potential vibration effects on human perception summary against AUP:OP/DIN criteria**

| External Noise Level | Potential Daytime Effects Outdoors |
|---|---|
| 0.14 mm/s | The threshold of perception for stationary people. Just perceptible in particularly sensitive environments. |
| 0.3 mm/s | Can be just perceptible during normal residential activities, particularly for more sensitive receivers. Levels above may wake most people from their sleep.<br><br>This is the AUP:OP limit for construction vibration generated at night-time for sensitive receivers. |
| 1 mm/s | Is typically tolerable with prior notification. Complaint or adverse reaction is likely in office or residential environments, particularly if there is no prior warning. What |

| External Noise Level | Potential Daytime Effects Outdoors |
|---|---|
| | people actually feel would be subject to the source but could include a steady vibration from sources such as vibratory compaction, or a small jolt such as from the movement of a large digger either of which could rattle crockery and glassware. Sleep disturbance would be almost certain for most people. |
| 2 mm/s | Vibration would clearly be felt. However, it can typically be tolerated in indoor environments such as offices, houses and retail if it occurs intermittently during the day and where there is effective prior engagement. Effects experienced would be somewhere between levels of 1 and 5 mm/s.<br><br>This is the AUP:OP limit for large construction projects generating vibration. |
| 5 mm/s | Unlikely to be tolerable in a workplace. Highly unsettling for both workplaces and dwellings. If exposure is prolonged, some people may want to leave the building Computer screens would shake and items could fall off shelves if they are not level.<br><br>This is the threshold below which no cosmetic damage will occur in the DIN standard. |
| 10 mm/s | Likely to be intolerable for anything other than a very brief exposure. |

The AUP:OP sets the criteria for amenity at 0.3mm/s for night time and 2 mm/s during the day. Based on the worst-case source of a roller compactor, any receiver within a 21m radius of the construction area may experience vibration of 2 mm/s inside their property. Whilst at this level building damage is highly unlikely to occur, human perception may result in slight concerns but can generally be tolerated if activity occurs intermittently and with prior notice.

At 0.3 mm/s the emission radii could be up to 140m from construction areas, and at this level people could feel slight vibrations especially during the night-time, which may cause sleep disturbance. High vibratory activities should therefore be avoided, where practicable, during the night-time and careful management of the type of equipment used at night should be included within the CNVMP (refer Section 1.1.1)

Construction vibration effects generally have a short timeframe, typically a few days at a time. The use of high vibratory equipment, such as a roller compactor, should be controlled through a CNVMP to limit potential vibration effects, and alternative equipment with lower vibratory effect should be used where practicable.

## 5.2 Recommended Measures to Avoid, Remedy or Mitigate Construction Effects

### 1.1.1 Construction Noise and Vibration Management Plan

Implementing noise management and mitigation measures via a CNVMP is the most effective way to control construction noise and vibration impacts. The objective of the CNVMP should provide a framework for the development and implementation of best practicable options to avoid, remedy or mitigate the adverse effects on receivers of noise and vibration resulting from construction.

E25.6.29(5) sets out the minimum level of information that must be provided in a CNVMP. Accordingly, as a minimum, we recommend that the CNVMP should include the following content:

- Description of the works and anticipated equipment/processes;
- Hours of operation, including times and days when construction activities would occur;
- The construction noise and vibration standards for the Projects;
- Identification of receivers where noise and vibration standards apply;
- Management and mitigation options, including alternative strategies adopting the BPO where full compliance with the relevant noise and/or vibration standards cannot be achieved;
- Methods and frequency for monitoring and reporting on construction noise and vibration, including:
  - Updating the predicted noise and vibration levels based on the final methodology and construction activities;
  - Confirming which buildings will be included in a pre and post building condition survey;
  - Identifying appropriate monitoring locations for receivers of construction noise and vibration;
  - Procedures to respond to complaints received on construction noise and vibration, including methods to monitor and identify noise and vibration sources;
  - Procedure for responding to monitored exceedances; and
  - Procedures for monitoring construction noise and vibration and reporting to the Auckland Council Consent Monitoring officer.
- Procedures for maintaining contact with stakeholders, notifying of proposed construction activities, the period of construction activities, and handling noise and vibration complaints;
- Contact details of the site supervisor or Project manager and the Requiring Authority's Project Liaison Person (phone, postal address, email address);
- Procedures for the regular training of the operators of construction equipment to minimise noise and vibration as well as expected construction site behaviours for all workers;
- Identification of areas where compliance with the noise and/or vibration standards will not be practicable and where a Site Specific Construction Noise and/or Vibration Management Schedule will be required;
- Procedures for how remedial works will be undertaken, should they be required as a result of the building condition surveys; and
- Procedures and timing of reviews of the CNVMP.

### 1.1.2 Schedules

In addition to a CNVMP, it may be necessary to produce Site Specific or Activity Specific Construction Noise and Vibration Management Schedules ("Schedules") where noise and/or vibration limits are predicted to be exceeded for a more sustained period or by a large margin. A schedule to the CNVMP provides a specific assessment of an activity and/or location and should include details such as:

- Activity location, start and finish dates;
- The nearest neighbours to the activity;
- A location plan;
- Predicted noise/vibration levels and BPO mitigation for the activity and/or location;
- Communication and consultation with the affected neighbours;
- Location, times and type of monitoring; and

- Any pre-condition survey of buildings predicted to receive vibration levels exceeding the Category B criteria, which document their current condition and any existing damage.

### 1.1.3 Noise mitigation measures

A hierarchy of mitigation measures will be adopted through the CNVMP and Schedules (where produced), as follows:

- Managing times of activities to avoid night works and other sensitive times;
- Liaising with neighbours so they can work around specific activities;
- Selecting equipment and methodologies to restrict noise;
- Using screening/enclosures/barriers; and
- Offering neighbours temporary relocation.

By following this hierarchy, the BPO for mitigation will be implemented, whilst avoiding undue disruption to the community. In particular, temporary relocation of neighbours can cause significant inconvenience and should only be offered where other options have been exhausted and noise levels still require mitigation.

Some activities are likely to be set back a considerable distance from the nearest receivers and require very little or no mitigation to achieve compliance with the relevant Project noise limits. Alternative methodologies, careful equipment selection and use of noise barriers or localised screening (e.g. for concrete cutting) would be suitable management and mitigation measures and should be implemented where they are practicable and effective.

### 1.1.4 Vibration mitigation

Similarly to noise, a hierarchy of vibration mitigation measures will be adopted through the CNVMP and Schedules (where produced) as follows:

- Managing times of activities to avoid night works and other sensitive times (communicated through community liaison);
- Liaising with neighbours so they can work around specific activities;
- Operating vibration generating equipment as far from sensitive sites as possible;
- Selecting equipment and methodologies to minimise vibration;
- Offering neighbours temporary relocation; and
- In specific situations, a cut-off trench may be used as a vibration barrier if located close to the source.

In general, there are less options available to mitigate vibration propagation and insulate receiver buildings, compared to noise. Mitigation will therefore focus on scheduling of activities, effective communication with neighbours, and selection of appropriate equipment and methods, where practicable.

Appropriate vibration mitigation measures for each activity will be listed in the CNVMP and Schedules (where produced).

### 1.1.5 Building Condition Survey

A detailed building precondition survey should be undertaken by a suitably qualified engineer prior to the start of construction at all buildings where the daytime Category B criteria may be exceeded. The survey shall include, but not be limited to, the following:

- Determination of building classification: commercial, industrial, residential or a historic or sensitive structure;
- Determination of building specific vibration damage risk thresholds; and
- Recording (including photographs) the major features of the buildings including location, type, construction (including foundation type), age and present condition, including existing levels of any aesthetic damage or structural damage.

A post-construction condition survey of the same buildings shall be conducted when construction is completed, and any damage shown to have been caused by the Project construction rectified by the Project Team.

### 1.1.6 Night Works

Night works have the potential to cause the greatest disturbance to residents and should be avoided where possible. However, it is possible that night works will be required during the construction period for critical activities. Before night works are programmed, it is important to determine if there are alternative options that would avoid working at night and, if so, whether those options are technically and practicably feasible.

Where there are no practicable alternative options to night works, it may be necessary to implement enhanced noise and vibration management measures, but this will depend on the location of the worksite and the proposed activities.

When work must be carried out at night, it may be necessary to:

- Increase the frequency of communications with stakeholders;
- Carry out regular noise and vibration monitoring to confirm noise and vibration levels; or
- Offer temporary relocation to neighbours if unreasonable noise and/or vibration levels cannot be avoided.

# 6 NoR RE1: Don Buck Road FTN Upgrade

## 6.1 Project Corridor Features

A section of Don Buck Road is proposed to be upgraded from a corridor width of 27-35m to a 30m wide four-lane local arterial with priority lanes for buses, separated cycle lanes and footpaths on both sides of the corridor. Intersections located along the corridor are proposed to be signalised. The project ties in with the proposed upgrades to the Royal Road intersection as part of the North West Housing Infrastructure Fund (NW HIF) package of work. The proposed upgrade is expected to remain within the existing corridor to the extent possible with localised widening occurring near intersections.

Key features of the proposed new corridor include the following:

- Widening of Don Buck Road to a 30m wide four-lane local arterial with priority lanes for buses and separated cycle lanes and footpaths on both sides of the corridor.
- Upgrades to the intersections with Fred Taylor Drive, Westgate Drive, Rush Creek Drive and Beauchamp Road.
- Tie-ins with existing roads, stormwater dry ponds, wetlands and culverts.
- Batter slopes to enable widening of the corridor, and associated cut and fill activities (earthworks).
- Vegetation removal along the existing road corridor

An overview of the proposed design is provided in Figure 6-1.


**Figure 6-1 Overview of the Don Buck Road FTN Upgrade**

## 6.2 Existing and Likely Future Environment

### 6.2.1 Planning context

The land adjacent to Don Buck Road is comprised of various business, residential and open space zoning. The following outlines the key elements of the planning context for the Don Buck Road FTN Upgrade:

- The eastern side of Don Buck Road above Westgate Drive is zoned under the AUP:OP as Business – Light Industry. To the south of Westgate Drive, the eastern side of Don Buck Road contains an Open Space – Community Zone (occupied by Massey Leisure Centre), with the remaining land zoned as Residential – Mixed Housing Zone.
- The western side of Don Buck Road is within the I610 Redhills Precinct and is predominantly zoned Residential – Mixed Housing Urban, with a portion of land in the northern section of the corridor zoned Residential – Terraced Housing and Apartment Buildings Zone (**THAB**). Land further to the west of Don Buck Road forms part of the Redhills Precinct.

Table 6-1 below provides a summary of the existing and likely future environment as it relates to the Don Buck Road FTN Upgrade.

**Table 6-1: Don Buck Road FTN Upgrade Existing and Likely Future Environment**

| Environment today | Zoning | Likelihood of Change for the environment[2] | Likely Future Environment[3] |
|---|---|---|---|
| **Business** | Business (Industrial) | Low | Business |
| **Residential** | Residential – Mixed Housing Urban Zone<br>Residential – Terraced Housing and Apartment Zone | Low | Residential |
| **Open Space** | Open Space – Community Zone | Low | Open Space |

### 6.2.2 Noise Environment

Don Buck Road is an existing busy road with commercial buildings and residential dwellings along the road corridor. The noise environment is dominated by road traffic noise from vehicles on Don Buck Road and industrial noise from businesses located in the Light Industrial Zone.

[2] Based on AUP:OP zoning/policy direction
[3] Based on AUP:OP zoning/policy direction

## 6.3 Assessment of Construction Noise and Vibration Effects

### 6.3.1 Construction Noise Effects

Receivers are located at varying distances from the construction boundary along the alignment with the closest existing receiver being 2m from the alignment. High noise generating activities may not occur right on the construction boundary but if they do, 152 existing receivers could experience unmitigated noise levels that exceed the daytime noise criterion. Details of all properties where the criteria could be exceeded are provided in Appendix A.

With mitigation in place, as set out in Section 5.2, noise levels of up to 90 dB $L_{Aeq}$ could still occur intermittently at the closest receivers, if high noise generating activities occur on the construction boundary. At this level effects could include loss of concentration, annoyance, and a reduction in speech intelligibility. We note that the existing receivers may not be present at the time of construction.

Future receivers constructed within 76m of the works could experience unmitigated noise levels that exceed the 70 dB $L_{Aeq}$ noise criterion during high noise generating activities such as the pavement works.

Operation of construction equipment will be intermittent in nature. Construction will be linear so as the equipment moves away from the receiver noise levels will reduce. The worst-case situations, where mitigated noise levels could reach 90 dB $L_{Aeq}$ at the closest receivers, are not expected to be frequent, due to the setback distances to the majority of the proposed works and the use of equipment with lower source noise levels for large portions of the works. It is therefore predicted that mitigated noise levels can comply with the 70 dB $L_{Aeq}$ noise criterion for most of the construction works.

If a critical activity has to be carried out during the night-time in close proximity to residential receivers, consultation and mitigation measures will be essential. The use of noisy equipment should be avoided, where practicable, to prevent sleep disturbance. Any night-time works are likely to be limited in duration and will be managed through the CNVMP (as per Section 1.1.1) and a Schedule (as per Section 1.1.2).

Provided that the works are mitigated and managed through the CNVMP and Schedules at the time of construction, we consider that noise effects from construction works as currently planned will be reasonable.

### 6.3.2 Construction Vibration Effects

Existing receivers near Don Buck Road are a mix of residential and commercial type structures. 30 existing dwellings may experience vibration levels above 5mm/s PPV and three existing commercial buildings may experience levels above 10mm/s PPV, exceeding the daytime Category B criterion, if the roller compactor is used on the construction boundary in the closest position to them. The addresses of receivers where the Category B criteria may be exceeded are listed in Appendix B. Once the compactor is 8m away from the dwellings and 4m from commercial buildings the Category B criterion will be met. All the other vibration generating equipment identified in Table 4-4 can comply with the Category B criterion at all existing receivers. The Category B criteria would be met at future residential structures that are 8m or more from the proposed works and commercial structures that are 4m or more from the proposed works.

At buildings in close proximity to the proposed works, there is the potential for cosmetic damage to buildings (such as cracking) and annoyance from perception of vibration. Buildings where the daytime Category B criteria may be exceeded will be identified at the time of construction, and pre-condition surveys will be carried out at these buildings.

The Category A vibration amenity criteria could be exceeded in existing or future buildings if they are occupied during the works and within 21 m of the roller compactor or within the emission radii identified for the other vibration generating equipment in Table 4-4. The effect on receivers would be subject to their respective proximity to the works but could include steady vibration from the roller compactor or a small jolt from a digger which could rattle crockery and glassware. The Category A criteria should be used as a trigger to initiate consultations with affected parties to manage effects.

Vibration can typically be tolerated inside buildings if it occurs intermittently during the day, is of limited duration and where there is effective prior engagement. As discussed in Section 3.2.1, the AUP:OP allows exceedances of the vibration amenity criteria in occupied buildings for three days or less, between the hours of 7am to 6pm, where there has been appropriate communication and consultation with affected parties.

High vibration generating activities should not occur during the night-time in close proximity to residential receivers to avoid sleep disturbance, unless it is a critical activity and there is no alternative.

It should also be noted that the emission radii are conservative and vibration levels measured on site tend to be much lower than those predicted at the NoR stage of a project.

## 6.4 Conclusions

The predicted construction noise and vibration levels are based on indicative information provided by the Project team, as set out in Section 4, and any conclusions in this assessment should be confirmed during the detailed design stage, taking account of the receivers as they exist at the time of construction.

Construction noise and vibration can be mitigated and managed, utilising the measures set out in Section 5.2, to generally comply with the applicable limits as defined in the AUP:OP. Exceedances of the criteria could occur intermittently over a short duration if high noise or vibration generating equipment are used near occupied buildings. Where an exceedance is predicted at any receiver that exists at the time of construction, the effects will be mitigated and managed through the CNVMP and Schedules.

A CNVMP is the most effective way to avoid, remedy or mitigate construction noise and vibration effects on receivers.

# 7 NoR RE2: Fred Taylor Drive FTN Upgrade

## 7.1 Project Corridor Features

The Fred Taylor Drive Upgrade involves the upgrade of the corridor between Hailes Road and Dunlop Road to accommodate a 30m wide four-lane FTN arterial with separated walking and cycling facilities.

Key features of the proposed upgrade include the following:

- The upgrade of the existing corridor to a 30m wide four-lane FTN arterial with separated walking and cycling. This widening is expected to remain in the existing designation 1433 to the extent possible.
- Localised widening outside the existing designation 1433 occurring at intersections.
- The upgrade of the intersections with Kakano Road and Northside Drive to signalised intersections.
- Additional land for tie-ins with side streets and stormwater wetlands
- Batter slopes to enable widening of the corridor, and associated cut and fill activities.
- Vegetation removal along the existing road corridor.
- Other construction related activities required outside the permanent corridor including the re-grade of driveways, construction traffic manoeuvring and construction laydown areas

An overview of the proposed design is provided in Figure 7-1


**Figure 7-1 Overview of Fred Taylor Drive FTN Upgrade**

## 7.2 Existing and Likely Future Environment

### 7.2.1 Planning context

The existing Fred Taylor Drive corridor runs through a mix of residential and industrial land uses.

The northern section of Fred Taylor Drive is within the Redhills North FUZ, with an area of land zoned under the AUP:OP as Open Space – Sport and Active Recreation Zone (Fred Taylor Park) adjacent the road corridor. The southern section of Fred Taylor Drive is zoned under the AUP:OP as THAB zone on the western side, and forms part of the I610 Redhills Precinct. The eastern side is zoned Business – Light Industry Zone and Business – Mixed Use Zone and forms part of the I615 Westgate Precinct.

Table 7-1 below provides a summary of the existing and likely future environment as it relates to the Fred Taylor Drive FTN Upgrade.

**Table 7-1: Fred Taylor Drive FTN Upgrade Existing and Likely Future Environment**

| Environment today | Zoning | Likelihood of Change for the environment[4] | Likely Future Environment[5] |
|---|---|---|---|
| **Business** | Business (Light Industrial) | Low | Business |
| | Business (Mixed Use) | Low | |
| **Residential** | Residential – Terraced Housing and Apartment Zone | Low | Residential |
| **Open Space** | Open Space – Sport and Active Recreation | Low | Open Space |
| **Undeveloped greenfield areas** | Future Urban | **High** | Urban |

### 7.2.2 Noise Environment

Fred Taylor Drive is located within a predominantly rural area with some dwellings and commercial receivers located close to the road corridor. The noise environment is dominated by road traffic noise from vehicles on Fred Taylor Drive and the surrounding road network.

[4] Based on AUP:OP zoning/policy direction
[5] Based on AUP:OP zoning/policy direction

## 7.3 Assessment of Construction Noise and Vibration Effects

### 7.3.1 Construction Noise Effects

Receivers are located at varying distances from the construction boundary along the alignment with the closest existing receiver at 2m. High noise generating activities may not occur right on the construction boundary, but if they do, 59 existing properties could experience unmitigated noise levels that exceed the daytime noise criterion. Details of all properties where the criteria could be exceeded are provided in Appendix A.

With mitigation in place as set out in Section 5.2, noise levels of up to 90 dB $L_{Aeq}$ could still occur intermittently at the closest receivers, if high noise generating activities occur on the construction boundary. At this level effects could include loss of concentration, annoyance, and a reduction in speech intelligibility. We note that the existing receivers on FUZ zoned land may not be present at the time of construction.

Future receivers constructed within 76m of the works could experience unmitigated noise levels that exceed the 70 dB $L_{Aeq}$ noise criterion during high noise generating activities such as the pavement works.

Operation of construction equipment will be intermittent in nature. Construction will be linear so as the equipment moves away from the receiver noise levels will reduce. The worst-case situations, where mitigated noise levels could reach 90 dB $L_{Aeq}$ at the closest receivers, are not expected to be frequent, due to the setback distances to the majority of the proposed works and the use of equipment with lower source noise levels for large portions of the works. It is therefore predicted that mitigated noise levels can comply with the 70 dB $L_{Aeq}$ noise criterion for most of the construction works.

If a critical activity has to be carried out during the night-time in close proximity to residential receivers, consultation and mitigation measures will be essential. The use of noisy equipment should be avoided where practicable to prevent sleep disturbance. Any night-time works are likely to be limited in duration and will be managed through the CNVMP and a Schedule.

Provided that the works are mitigated and managed through the CNVMP and Schedules at the time of construction, we consider that noise effects from construction works as currently planned will be reasonable.

### 7.3.2 Construction Vibration Effects

Existing receivers near Fred Taylor Drive are a mix of residential and commercial type structures. 15 existing dwellings may experience vibration levels above 5mm/s PPV and one existing commercial receiver may experience vibration levels above 10mm/s PPV, exceeding the Category B criterion, if the roller compactor is used on the construction boundary in the closest position to them. Once the compactor is 8m away from the dwellings and 4m from commercial buildings the Category B criterion will be met. All the other vibration generating equipment identified in Table 4-4 can comply with the Category B criterion at all existing receivers. The Category B criteria would be met at future residential structures that are 8m or more from the proposed works and commercial structures that are 4m or more from the proposed works.

At buildings in close proximity to the proposed works, there is the potential for cosmetic damage to buildings (such as cracking) and annoyance from perception of vibration. Buildings where the daytime

Category B criteria may be exceeded will be identified at the time of construction, and pre-condition surveys will be carried out at these buildings.

The Category A vibration amenity criteria could be exceeded in existing or future buildings if they are occupied during the works and within 21 m of the roller compactor or within the emission radii identified for the other vibration generating equipment in Table 4-4. The effect on receivers would be subject to their respective proximity to the works but could include steady vibration from the roller compactor or a small jolt from a digger which could rattle crockery and glassware. The Category A criteria should be used as a trigger to initiate consultations with affected parties to manage effects.

Vibration can typically be tolerated inside buildings if it occurs intermittently during the day, is of limited duration and where there is effective prior engagement. As discussed in Section 3.2.1, the AUP:OP allows exceedances of the vibration amenity criteria in occupied buildings for three days or less, between the hours of 7am to 6pm, where there has been appropriate communication and consultation with affected parties.

High vibration generating activities should not occur during the night-time in close proximity to residential receivers to avoid sleep disturbance, unless it is a critical activity and there is no alternative.

It should also be noted that the emission radii are conservative and vibration levels measured on site tend to be much lower than those predicted in the early stages of a project.

## 7.4 Conclusions

The predicted construction noise and vibration levels are based on indicative information to support this NoR, as set out in Section 4, and any conclusions in this assessment should be confirmed during the detailed design stage, taking account of the receivers as they exist at the time of construction.

Construction noise and vibration can be mitigated and managed, utilising the measures set out in Section 5.2, to generally comply with the applicable limits as defined in the AUP:OP. Exceedances of the criteria could occur intermittently over a short duration if high noise or vibration generating equipment are used near occupied buildings. Where an exceedance is predicted at any receiver that exists at the time of construction, the effects will be mitigated and managed through the CNVMP and Schedules.

A CNVMP is the most effective way to avoid, remedy or mitigate construction noise and vibration effects on receivers.

# 8 NoR R1: Coatesville-Riverhead Highway Upgrade

## 8.1 Project Corridor Features

The Coatesville-Riverhead Highway is an existing arterial road extending from SH16 in the south to its intersection with Dairy Flat Highway in the north east, with the extents of the proposed upgrade from SH16 in the south to its intersection with Riverhead Road in the north. The southern section of the alignment from SH16 to Short Road runs through rural land uses which are expected to remain. The northern section (close to and within the Riverhead township) runs through low-medium density residential land uses on the east and future urban zoned land on the west.

Key features of the proposed new corridor include the following:

- Upgrading the southern section of the corridor to a 33m two-lane low speed rural arterial with active mode space on the western side and upgrading the northern section of the alignment to a 24m two-lane urban arterial with walking and cycling facilities on both sides of the corridor
- The upgrade of the Coatesville-Riverhead Highway / Old Railway Road intersection from un-signalised to a roundabout.
- The upgrade of the existing Coatesville-Riverhead Highway / Riverhead Road roundabout intersection.
- Tie-ins with existing roads, stormwater wetland and culverts.
- Batter slopes to enable widening of the corridor, and associated cut and fill activities (earthworks).
- Vegetation removal along the existing road corridor
- Other construction related activities required outside the permanent corridor including the re-grade of driveways, construction traffic manoeuvring and construction laydown areas

An overview of the proposed design is provided in

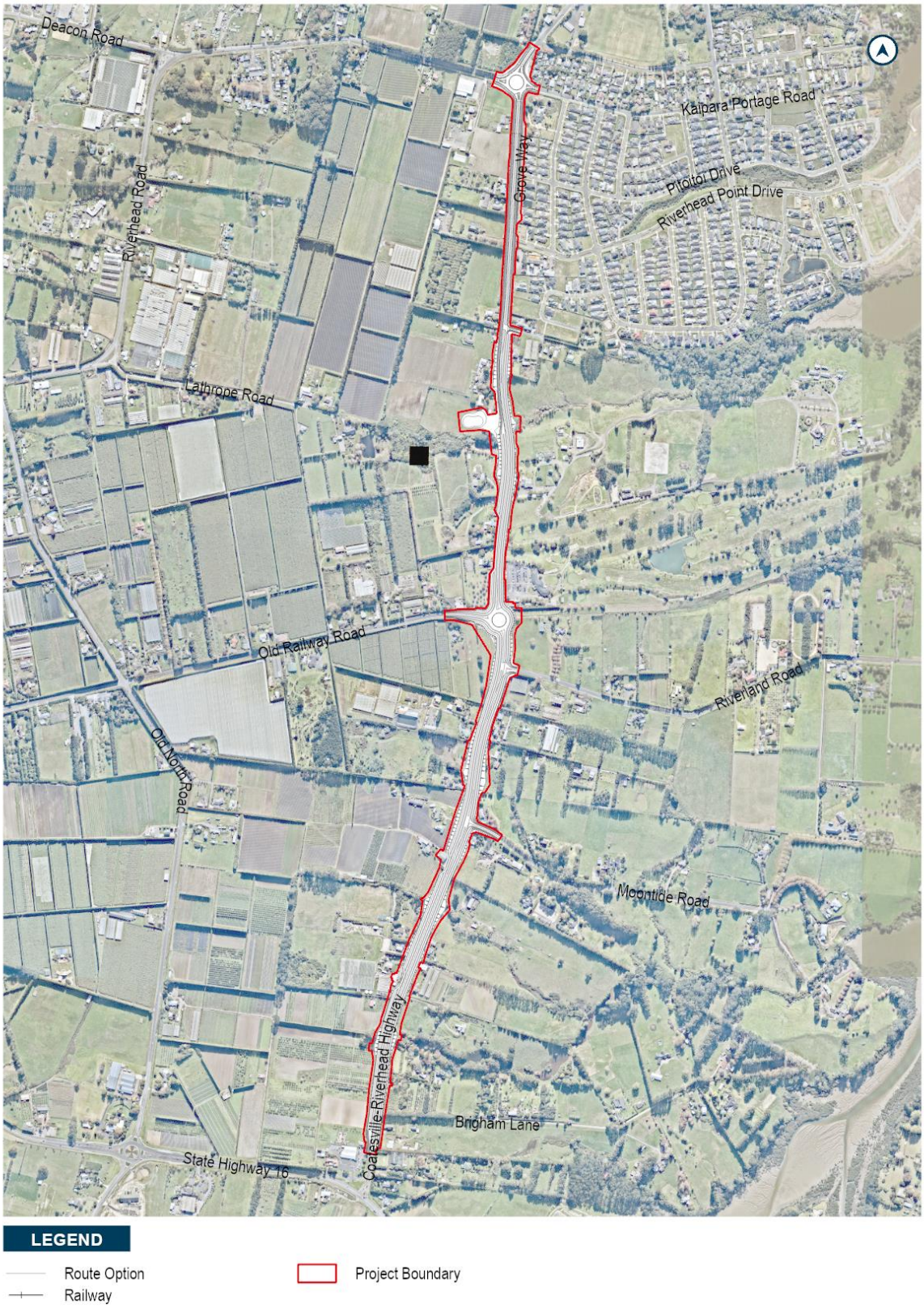


Figure 8-1.

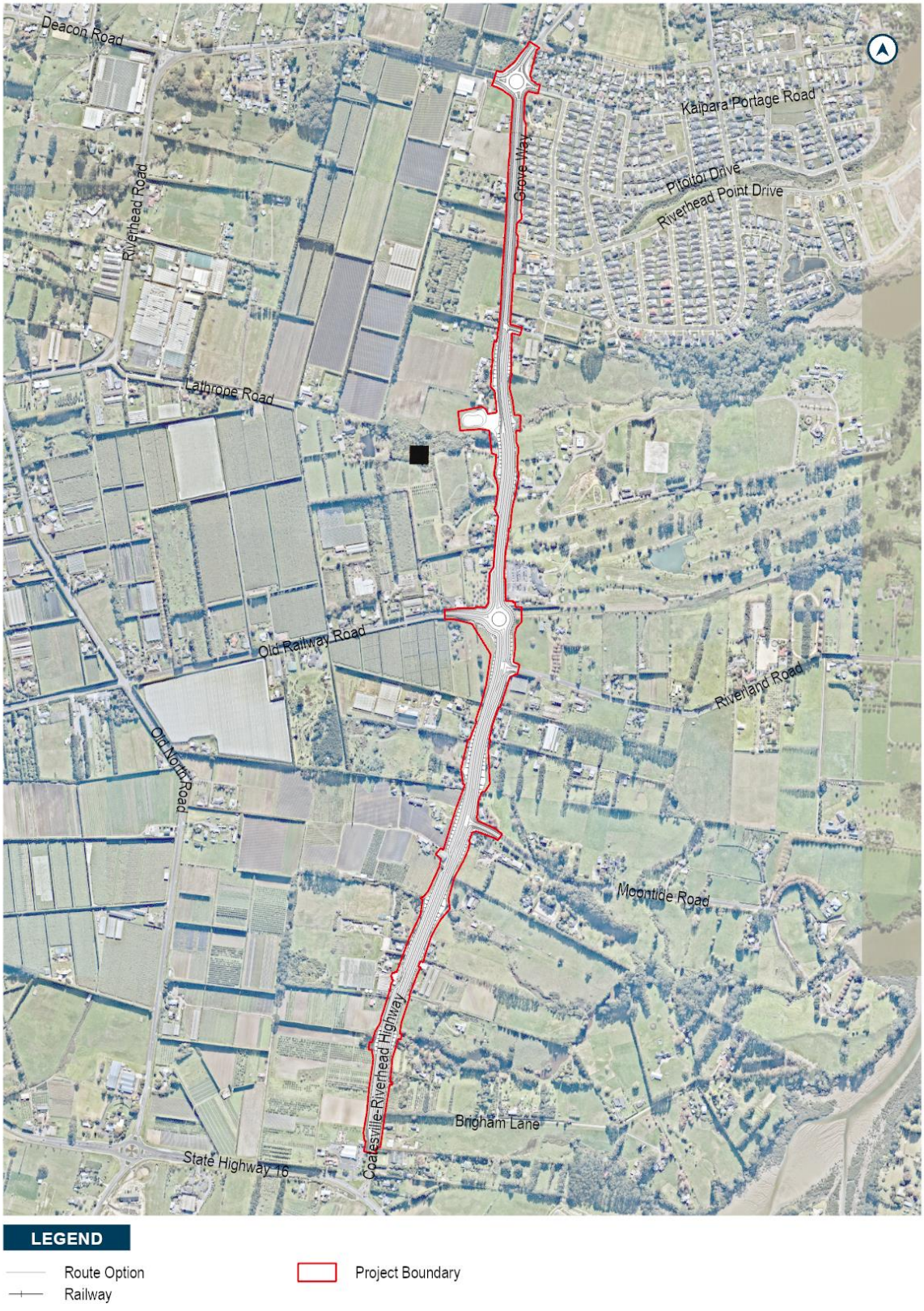


**Figure 8-1 Overview of the Coatesville-Riverhead Highway Upgrade**

## 8.2 Existing and Likely Future Environment

### 8.2.1 Planning context

The southern section of Coatesville-Riverhead Highway from SH16 to Short Road runs through rural land uses predominantly zoned under the AUP:OP as Rural – Mixed Rural Zone on both sides of the existing corridor. The northern section (close to and within the Riverhead township) runs through land zoned as Residential – Single House Zone and to the east and future urban zoned land on the west.

Table 8-1 below provides a summary of the North-West existing and likely future environment as it relates to the Coatesville-Riverhead Highway Upgrade.

**Table 8-1: Coatesville-Riverhead Highway Existing and Likely Future Environment**

| Environment today | Zoning | Likelihood of Change for the environment[6] | Likely Future Environment[7] |
|---|---|---|---|
| **Rural** | Rural | Low | Rural |
| **Residential** | Residential | Low | Residential |
| **Future Urban Zone / Undeveloped greenfield areas** | Future Urban | High | Urban |

### 8.2.2 Noise Environment

Coatesville-Riverhead Highway currently runs through urban and rural environments. In the rural area there are few dwellings near the road. The noise environment is dominated by road traffic noise from vehicles using the Coatesville-Riverhead Highway and the surrounding road network.

In the urban section residential properties are located on the eastern side of the corridor. Development is highly likely to occur in the Future Urban Zone, located on the western side of the corridor. An increase in ambient noise levels is expected as the area urbanises.

## 8.3 Assessment of Construction Noise and Vibration Effects

### 8.3.1 Construction Noise Effects

Receivers are located at varying distances from the construction boundary along the alignment with the closest existing receiver being 2m away. High noise generating activities may not occur right on the construction boundary but if they do, 99 existing properties could experience unmitigated noise levels that exceed the daytime noise criterion. Details of all properties where the criteria could be exceeded are provided in Appendix A.

With mitigation in place, as set out in Section 5.2, noise levels of up to 90 dB $L_{Aeq}$ could occur intermittently at the closest receivers, if high noise generating activities occur on the construction

[6] Based on AUP:OP zoning/policy direction
[7] Based on AUP:OP zoning/policy direction

boundary. At this level effects could include loss of concentration, annoyance, and a reduction in speech intelligibility. We note that the existing receivers on FUZ zoned land may not be present at the time of construction.

Future receivers constructed within 76m of the works could experience unmitigated noise levels that exceed the 70 dB $L_{Aeq}$ noise criterion during high noise generating activities such as the pavement works.

Operation of construction equipment will be intermittent in nature. Construction will be linear so as the equipment moves away from the receiver noise levels will reduce. The worst-case situations, where mitigated noise levels could reach 90 dB $L_{Aeq}$ at the closest receivers, are not expected to be frequent, due to the setback distances to the majority of the proposed works and the use of equipment with lower source noise levels for large portions of the works. It is therefore predicted that mitigated noise levels can comply with the 70 dB $L_{Aeq}$ noise criterion for most of the construction works.

If a critical activity has to be carried out during the night-time in close proximity to residential receivers, consultation and mitigation measures will be essential. The use of noisy equipment should be avoided where practicable to prevent sleep disturbance. Any night-time works are likely to be limited in duration and will be managed through the CNVMP and a Schedule.

Provided that the works are mitigated and managed through the CNVMP and Schedules at the time of construction, we consider that noise effects from construction works as currently planned will be reasonable.

### 8.3.2 Construction Vibration Effects

Existing receivers near Coatesville-Riverhead Highway are a mix of residential and commercial type structures. 27 existing dwellings may experience vibration levels above 5mm/s PPV, exceeding the Category B criterion for residential structures, if the roller compactor is used on the construction boundary in the closest position to them. Once the compactor is 8m away from the dwellings the Category B criterion will be met. All the other vibration generating equipment identified in Table 4-4 can comply with the Category B criterion at all existing residential receivers. The Category B criteria are predicted to be complied with at all existing commercial receivers, as they are sufficiently set back from the construction boundary. The Category B criteria would be met at future residential structures that are 8m or more from the proposed works and commercial structures that are 4m or more from the proposed works.

At buildings in close proximity to the proposed works, there is the potential for cosmetic damage to buildings (such as cracking) and annoyance from perception of vibration. Buildings where the daytime Category B criteria may be exceeded will be identified at the time of construction, and pre-condition surveys will be carried out at these buildings.

The Category A vibration amenity criteria could be exceeded in existing or future buildings if they are occupied during the works and within 21 m of the roller compactor or within the emission radii identified for the other vibration generating equipment in Table 4-4. The effect on receivers would be subject to their respective proximity to the works but could include steady vibration from the roller compactor or a small jolt from a digger which could rattle crockery and glassware. The Category A criteria should be used as a trigger to initiate consultations with affected parties to manage effects.

Vibration can typically be tolerated inside buildings if it occurs intermittently during the day, is of limited duration and where there is effective prior engagement. As discussed in Section 3.2.1, the AUP:OP allows exceedances of the vibration amenity criteria in occupied buildings for three days or less, between the hours of 7am to 6pm, where there has been appropriate communication and consultation with affected parties.

High vibration generating activities should not occur during the night-time in close proximity to residential receivers to avoid sleep disturbance, unless it is a critical activity and there is no alternative.

It should also be noted that the emission radii are conservative and vibration levels measured on site tend to be much lower than those predicted in the early stages of a project.

## 8.4 Conclusions

The predicted construction noise and vibration levels are based on indicative information to support this NoR, as set out in Section 4, and any conclusions in this assessment should be confirmed during the detailed design stage, taking account of the receivers as they exist at the time of construction.

Construction noise and vibration can be mitigated and managed, utilising the measures set out in Section 5.2, to generally comply with the applicable limits as defined in the AUP:OP. Exceedances of the criteria could occur intermittently over a short duration if high noise or vibration generating equipment are used near occupied buildings. Where an exceedance is predicted at any receiver that exists at the time of construction, the effects will be mitigated and managed through the CNVMP and Schedules.

A CNVMP is the most effective way to avoid, remedy or mitigate construction noise and vibration effects on receivers.

# 9 Conclusion

An assessment of the construction noise and vibration effects has been undertaken for the Projects considering a reasonable worst case scenario. The predicted noise levels and effects are based on indicative information as provided by the Project team and any assessment conclusions should be confirmed during the detailed design stage, taking account of the final equipment selections, methodology and receivers as they exist at the time of construction.

Construction noise and vibration can be mitigated and managed, utilising the measures set out in Section 5.2, to comply with the applicable limits for the majority of the works. Exceedances of the criteria could occur intermittently across all NoRs, if high noise or vibration generating equipment is used near occupied buildings. The most impacted receivers are located within 10m of the construction boundary.

Night works will be limited to critical activities that cannot be carried out at any other time.

A CNVMP will be prepared prior to construction commencing in accordance with Section 1.1.1 of this report. The CNVMP will provide a framework for the development and implementation of best practicable options to avoid, remedy or mitigate the adverse effects of construction noise and vibration on receivers that exist at the time of construction. Communication and consultation will occur with the affected receivers and a site specific schedule will be prepared if required.

Elevated noise levels should be avoided and mitigated where possible to reduce the likelihood of adverse effects such as loss of concentration, annoyance and sleep disturbance (for night works).

Whilst vibration levels at the Category A criterion of 2mm/s PPV can generally be tolerated if activity occurs intermittently and with prior notice, communication and consultation will be the key management measure to avoid annoyance and concern. Where vibration levels are predicted to exceed the Category B criteria, and where the construction methodology cannot be changed to reduce vibration levels, building conditions surveys are recommended.

# Appendix A – Affected Receivers – Noise (Unmitigated)

**NoR R1**

| Address | | |
|---|---|---|
| 486 Don Buck Road | 545 Don Buck Road | 484 Don Buck Road |
| 2 Rush Creek Drive | 8 Westgate Drive | 4 Asti Lane |
| 538 Don Buck Road | 16 3 Kāpia Road | 554 Don Buck Road |
| 494 Don Buck Road | 465 Don Buck Road | 3 Rush Creek Drive |
| 1 Rush Creek Drive | 5 Rush Creek Drive | 7/485 Don Buck Road |
| 2/575 Don Buck Road | 26 Beauchamp Drive | 7-9 Westgate Drive |
| 490 Don Buck Road | 2 Stonegate Close | 7 Lazurite Drive |
| 532-534 Don Buck Road | 24 Cinnabar Place | 13 Lazurite Drive |
| 5/485 Don Buck Road | 7 Cinnabar Place | 11 Lazurite Drive |
| 12/485 Don Buck Road | 6 Rush Creek Drive | 15 Lazurite Drive |
| 9/485 Don Buck Road | 19 Lazurite Drive | 4 Rush Creek Drive |
| 560 Don Buck Road | 16 2 Kāpia Road | 27 Beauchamp Drive |
| 2/485 Don Buck Road | 9 Cinnabar Place | 545 Don Buck Road |
| 13/485 Don Buck Road | 545 Don Buck Road | 42 Regents Park Place |
| 583-585 Don Buck Road | 545 Don Buck Road | 17 Lazurite Drive |
| 31 Beauchamp Drive | 9 Arlose Place | 1-3 Fernhill Drive |
| 492A Don Buck Road | 11 Cinnabar Place | 496 Don Buck Road |
| 552A Don Buck Road | 545 Don Buck Road | 544 Don Buck Road |
| 477 Don Buck Road | 4 Stonegate Close | 5 Lazurite Drive |
| 15 Cinnabar Place | 1/28 Beauchamp Drive | 6 Westgate Drive |
| 475 Don Buck Road | 559-567 Don Buck Rd | 482 Don Buck Road |
| 6/485 Don Buck Road | 40-42 Fred Taylor Dr | 28 Beauchamp Drive |
| 542 Don Buck Road | 23 Beauchamp Drive | 25 Beauchamp Drive |
| 500 Don Buck Road | 7 Arlose Place | 554A Don Buck Road |
| 502 Don Buck Road | 4 Astil Lane | 13 Cinnabar Place |
| 540 Don Buck Road | 5 Cinnabar Place | 16 4 Kāpia Road |
| 546 Don Buck Road | 17-19 Fred Taylor Dr | 16  11 Kāpia Road |
| 547 Don Buck Road | 480 Don Buck Road | 559-567 Don Buck Rd |
| 559-567 Don Buck Road | 24 Beauchamp Drive | 6 Stonegate Close |
| 8/485 Don Buck Road | 463 Don Buck Road | 35 Regents Park Place |
| 508 Don Buck Road | 1 Stonegate Close | 1 Arlose Place |
| 504 Don Buck Road | 9 Lazurite Drive | 14 Kāpia Road |
| 510 Don Buck Road | 41 Regents Park Place | 37 Regents Park Place |
| 488 Don Buck Road | 31 Regents Park Place | 8 Rush Creek Drive |
| 545 Don Buck Road | 39 Regents Park Place | 3 Stonegate Close |
| 19 Cinnabar Place | 28 Maki Street | 16 6 Kāpia Road |
| 17 Cinnabar Place | 16 1 Kāpia Road | 1 Lazurite Drive |
| 21 Fred Taylor Drive | 33 Regents Park Place | 3 Arlose Place |
| 556 Don Buck Road | 16  12 Kāpia Road | 29 Regents Park Place |
| 510 Don Buck Road | 579 Don Buck Rd | 3B Reverie Place |
| 21 Cinnabar Place | 7 Rush Creek Drive | 3 Cinnabar Place |
| 23 Cinnabar Place | 22 Cinnabar Place | 22 Beauchamp Drive |
| 506 Don Buck Road | 17-19 Fred Taylor Dr | 461 Don Buck Road |
| 545 Don Buck Road | 10 Cinnabar Place | 16 10 Kāpia Road |
| 3/485 Don Buck Road | 21 Lazurite Drive | 1-5 Pinot Lane |
| 496 Don Buck Road | 545 Don Buck Rd | 12 Kāpia Road |
| 4/485 Don Buck Road | 16 7 Kāpia Road | 12 Cinnabar Place |
| 558 Don Buck Road | 43 Regents Park Place | 11 Arlose Place |
| 29 Beauchamp Drive | 16 Kāpia Road | 478 Don Buck Road |
| 579E Don Buck Road | 575 Don Buck Rd | 16 5 Kāpia Road |
| 5 Arlose Place | 8 Stonegate Close | |

**NoR R2**

| Address | | |
|---|---|---|
| 94 Fred Taylor Drive | 111 Fred Taylor Drive | 116 Fred Taylor Drive |
| 100 Fred Taylor Drive | 79 Rotu Drive | 109 Fred Taylor Drive |
| 1A Matakohe Road | 10 Heri Lane | 88 Fred Taylor Drive |
| 144 Fred Taylor Drive | 12 Heri Lane | 114 Fred Taylor Drive |
| 83 2 Fred Taylor Drive | 14 Heri Lane | 112 Fred Taylor Drive |
| 3 Northside Drive | 2 Heri Lane | 102 Fred Taylor Drive |
| 1B Matakohe Road | 105 Fred Taylor Drive | 110 Fred Taylor Drive |
| 166 Fred Taylor Drive | 8 Heri Lane | 3A Matakohe Road |
| 1C Matakohe Road | 5 Northside Drive | 3B Matakohe Road |
| 1D Matakohe Road | 5 Matakohe Road | 78 Fred Taylor Drive |
| 118 Fred Taylor Drive | 6 Heri Lane | 9 Heri Lane |
| 83 Fred Taylor Drive | 4 Heri Lane | 5 Heri Lane |
| 73 Fred Taylor Drive | 1 Kakano Road | 11 Heri Lane |
| 61 Fred Taylor Drive | 7 Matakohe Road | 11 Heri Lane |
| 164 Fred Taylor Drive | 81-83 Rotu Dr | 13 Matakohe Road |
| 98 Fred Taylor Drive | 9 Matakohe Road | 7 Heri Lane |
| 122 1 Fred Taylor Drive | 127 Fred Taylor Drive | 3 Heri Lane |
| 130 Fred Taylor Drive | 11 Matakohe Road | 1 Heri Lane |
| 122 2 Fred Taylor Drive | 13 Heri Lane | 124 Fred Taylor Drive |
| 77 Fred Taylor Drive | 121 Fred Taylor Drive | |

**NoR R1**

| Address | | |
|---|---|---|
| 1293 Coatesville-Riverhead Highway | 1308 B3 Coatesville-Riverhead Highway | 1 Pitoitoi Drive |
| 1197 Coatesville-Riverhead Highway | 1169 Coatesville-Riverhead Highway | 1156 B2 Coatesville-Riverhead Highway |
| 1156 Coatesville-Riverhead Highway | 3 Riverhead Point Drive | 1186 Coatesville-Riverhead Highway |
| 1351 1 Coatesville-Riverhead Highway | 4 Princes Street | 1169 Coatesville-Riverhead Highway |
| 1323 Coatesville-Riverhead Highway | 1230 Coatesville-Riverhead Highway | 3 Kaipara Portage Road |
| 1351 Coatesville-Riverhead Highway | 3 Pitoitoi Drive | 1328 Coatesville-Riverhead Highway |
| 1397 Coatesville-Riverhead Highway | 14 Leebank Crescent | 8 Jelas Drive |
| 1296 Coatesville-Riverhead Highway | 16 Leebank Crescent | 1352 Coatesville-Riverhead Highway |
| 1363 Coatesville-Riverhead Highway | 20 Jelas Drive | 1170 Coatesville-Riverhead Highway |
| 17 Grove Way | 14 Jelas Drive | 5 Kaipara Portage Road |
| 1175 Coatesville-Riverhead Highway | 1158 B2 Coatesville-Riverhead Highway | 3A Riverhead Point Drive |
| 1 Riverhead Point Drive | 12 Jelas Drive | 179 Old Railway Road |
| 15 Grove Way | 28 Jelas Drive | 7 Short Road |
| 9 Grove Way | 18 Leebank Crescent | 1368 Coatesville-Riverhead Highway |
| 1187 Coatesville-Riverhead Highway | 16 Jelas Drive | 1411 Coatesville-Riverhead Highway |
| 11 Grove Way | 22 Jelas Drive | 182 Old Railway Road |
| 21 Grove Way | 340 Riverhead Road | 1308 B2 Coatesville-Riverhead Highway |
| 1158 Coatesville-Riverhead Highway | 26 Jelas Drive | 1092 Coatesville-Riverhead Highway |
| 19 Grove Way | 7 Kaipara Portage Road | 1261 Coatesville-Riverhead Highway |
| 5 Grove Way | 1229 2 Coatesville-Riverhead Highway | 1196 Coatesville-Riverhead Highway |
| 7 Grove Way | 1335 Coatesville-Riverhead Highway | 315 State Highway 16 |
| 2 Pitoitoi Drive | 1194 Coatesville-Riverhead Highway | 340 Riverhead Road |
| 1095 Coatesville-Riverhead Highway | 24 Jelas Drive | 1229 3 Coatesville-Riverhead Highway |
| 1093 Coatesville-Riverhead Highway | 1156 B3 Coatesville-Riverhead Highway | 1409 Coatesville-Riverhead Highway |
| 1404 Coatesville-Riverhead Highway | 5 Riverhead Point Drive | 1196 Coatesville-Riverhead Highway |
| 2 Princes Street | 1288 Coatesville-Riverhead Highway | 9 Kaipara Portage Road |
| 1229 Coatesville-Riverhead Highway | 30 Jelas Drive | 11 Leebank Crescent |
| 1210 Coatesville-Riverhead Highway | 1404 Coatesville-Riverhead Highway | 28 Leebank Crescent |
| 1356 Coatesville-Riverhead Highway | 1335 2 Coatesville-Riverhead Highway | 1385 Coatesville-Riverhead Highway |
| 1295 Coatesville-Riverhead Highway | 1385 B2Coatesville-Riverhead Highway | 8 2 Riverland Road |
| 1140 Coatesville-Riverhead Highway | 6 Princes Street | 12 Short Road |
| 1171 Coatesville-Riverhead Highway | 1090 Coatesville-Riverhead Highway | 8 Princes Street |

| | | |
|---|---|---|
| 1320 Coatesville-Riverhead Highway | 181 Old Railway Road | 1293 2 Coatesville-Riverhead Highway |

# Appendix B – Affected Receivers – Vibration (unmitigated)

**NoR R1**

| Address | Building Type/Structure |
|---|---|
| 486 Don Buck Road | Residential |
| 2 Rush Creek Drive | Residential |
| 538 Don Buck Road | Residential |
| 494 Don Buck Road | Residential |
| 1 Rush Creek Drive | Residential |
| 490 Don Buck Road | Residential |
| 5/485 Don Buck Road | Residential |
| 12/485 Don Buck Road | Residential |
| 9/485 Don Buck Road | Residential |
| 560 Don Buck Road | Residential |
| 2/485 Don Buck Road | Residential |
| 13/485 Don Buck Road | Residential |
| 31 Beauchamp Drive | Residential |
| 492A Don Buck Road | Residential |
| 552A Don Buck Road | Residential |
| 477 Don Buck Road | Residential |
| 15 Cinnabar Place | Residential |
| 475 Don Buck Road | Residential |
| 6/485 Don Buck Road | Residential |
| 542 Don Buck Road | Residential |
| 500 Don Buck Road | Residential |
| 502 Don Buck Road | Residential |
| 540 Don Buck Road | Residential |
| 546 Don Buck Road | Residential |
| 8/485 Don Buck Road | Residential |
| 508 Don Buck Road | Residential |
| 504 Don Buck Road | Residential |
| 488 Don Buck Road | Residential |
| 19 Cinnabar Place | Residential |
| 17 Cinnabar Place | Residential |
| 2/575 Don Buck Road | Commercial |
| 532-534 Don Buck Road | Commercial |
| 583-585 Don Buck Road | Commercial |

## NoR R2

| Address | Building Type/Structure |
|---|---|
| 94 Fred Taylor Drive | Residential |
| 100 Fred Taylor Drive | Residential |
| 1A Matakohe Road | Residential |
| 144 Fred Taylor Drive | Residential |
| 83 2 Fred Taylor Drive | Residential |
| 1B Matakohe Road | Residential |
| 166 Fred Taylor Drive | Residential |
| 1C Matakohe Road | Residential |
| 1D Matakohe Road | Residential |
| 118 Fred Taylor Drive | Residential |
| 83 Fred Taylor Drive | Residential |
| 73 Fred Taylor Drive | Residential |
| 61 Fred Taylor Drive | Residential |
| 164 Fred Taylor Drive | Residential |
| 98 Fred Taylor Drive | Residential |
| 3 Northside Drive | Commercial |

**NoR R1**

| Address | Building Type/Structure |
|---|---|
| 1293 Coatesville-Riverhead Highway | Residential |
| 1197 Coatesville-Riverhead Highway | Residential |
| 1156 Coatesville-Riverhead Highway | Residential |
| 1351 1 Coatesville-Riverhead Highway | Residential |
| 1323 Coatesville-Riverhead Highway | Residential |
| 1351 Coatesville-Riverhead Highway | Residential |
| 1397 Coatesville-Riverhead Highway | Residential |
| 1296 Coatesville-Riverhead Highway | Residential |
| 1363 Coatesville-Riverhead Highway | Residential |
| 17 Grove Way | Residential |
| 1175 Coatesville-Riverhead Highway | Residential |
| 1 Riverhead Point Drive | Residential |
| 15 Grove Way | Residential |
| 9 Grove Way | Residential |
| 1187 Coatesville-Riverhead Highway | Residential |
| 11 Grove Way | Residential |
| 21 Grove Way | Residential |
| 1158 Coatesville-Riverhead Highway | Residential |
| 19 Grove Way | Residential |
| 5 Grove Way | Residential |
| 7 Grove Way | Residential |
| 2 Pitoitoi Drive | Residential |
| 1095 Coatesville-Riverhead Highway | Residential |
| 1093 Coatesville-Riverhead Highway | Residential |
| 2 Princes Street | Residential |
| 1229 Coatesville-Riverhead Highway | Residential |
| 1210 Coatesville-Riverhead Highway | Residential |

Overall, construction noise and vibration can be controlled for all NoRs (NoRs RE1, RE2 and R1) to reasonable levels with the implementation of appropriate mitigation and management measures.