MARSHALL DAY Acoustics

ROTOKAURI ARTERIAL DEVELOPMENT
ASSESSMENT OF NOISE EFFECTS

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Project: **ROTOKAURI ARTERIAL ROAD DEVELOPMENT**
Assessment of Noise Effects

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TABLE OF CONTENTS

1.0 INTRODUCTION

Marshall Day Acoustics (MDA) has been engaged by Beca Limited (Beca) to assess noise emissions from the proposed new arterial road development planned within the Rotokauri Structure Plan Area.

This report details the measurements undertaken of the existing noise environment, the prediction methodology, and provides the assessment of the potential environmental effects of road traffic noise from the project. The report also addresses the noise and vibration impacts from construction activities.

Appendix A contains a glossary of terminology.

2.0 PROJECT DESCRIPTION

This Rotokauri Arterial Network Notice of Requirement (2022) has been prepared to support a Notice of Requirement (NoR) being prepared by Beca Limited on behalf of Hamilton City Council (HCC) as a requiring authority pursuant to section 168A of the Resource Management Act 1991 (RMA). HCC requires land to be designated in Hamilton City for the construction and operation of the 'Rotokauri Arterial Network' (the designation).

The NoR is seeking the designation of a key transportation network and strategic infrastructure corridor servicing the Rotokauri Growth Cell. The designation will enable:

- Land associated with key corridors to be secured by HCC
- Future construction of the infrastructure networks
- Facilitate planned future urban growth within the Rotokauri area.

Rotokauri is situated to the northwest of Hamilton as shown in Figure 1 below. Rotokauri is identified as one of four areas of future growth for Hamilton City. Future growth has been earmarked for the Rotokauri area since 1989 and included as a 'structure plan area', with the Rotokauri Structure Plan (RSP) notation included in the Hamilton District Plan since 2005.

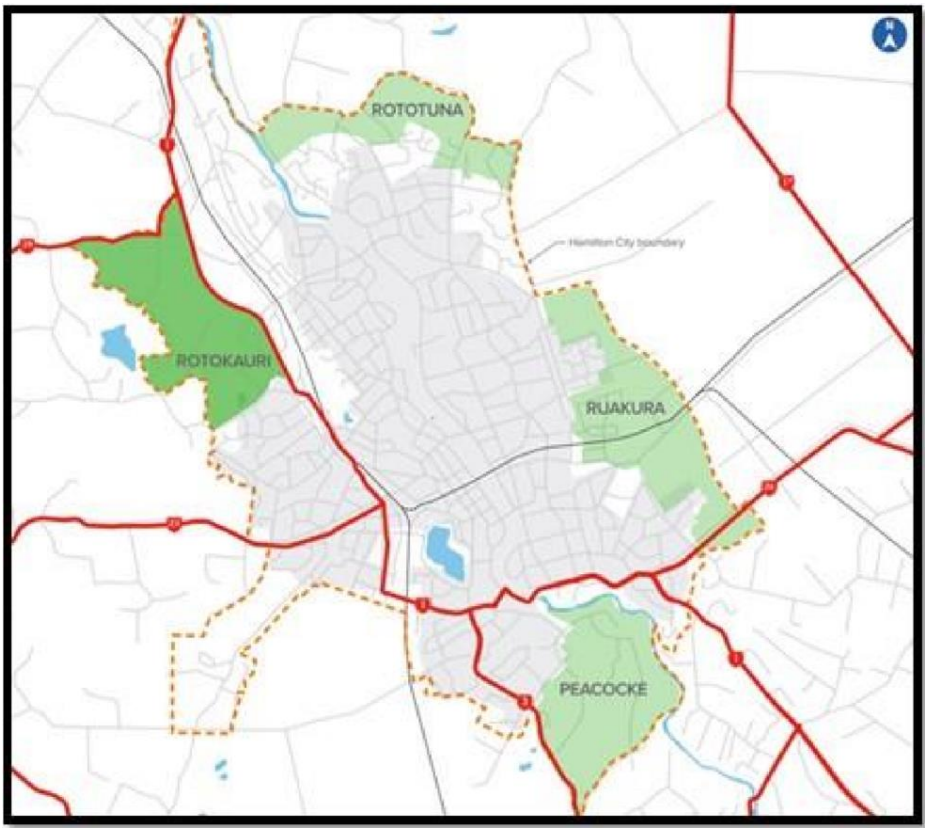


Figure 1: Rotokauri Development Location Plan (Source Hamilton City Council Urban Growth Strategy)

The designation of the strategic transportation and infrastructure corridor is to occur in a way that:

- Responds to the RSP context
- Meets the vision for development in Rotokauri as encapsulated within the RSP
- Responds to an increasingly urgent need to secure an infrastructure corridor

The designation of the strategic transportation and infrastructure corridor will in the short term protect the corridor network from 'build-out' by private developments along the preferred routes. With the long-term purpose of facilitating an integrated transport network.

Development of Rotokauri in the southern section is underway with residential subdivision and development occurring in areas that can be serviced from existing networks. To date the developments have considered the RSP details and is generally consistent with the anticipated level of development with the routes for key connections being provided. Master planning and development pressures will continue to create spatial pressures and therefore necessitates route protection as soon as possible. Private Plan Change 7 (Operative as of 15 Jully 2022) also proposes 2,000 dwellings and a neighbourhood commercial centre in the north of the RSP area.

The Rotokauri arterial network designation as depicted in Figure 2 (overleaf) covers a combined 5.8km length of corridors, including the design of a new 5.2km corridor relating to greenfield area which will support future growth and development in Rotokauri.

- Proposed major arterial – approx. 0.7km on existing roads (purple)
- Proposed minor arterials – approx. 3.8km (red)
- Proposed collector roads – approx. 0.7km (yellow)

This includes a north-south corridor that commences in the north at the State Highway 39 (SH39) and Koura Drive roundabout and proceeds in a south-eastern direction to the intersection with Te Wetini Drive.

There are also two east-west corridors (Te Kowhai East Road and Chalmers Road) that align with existing grade separated underpasses under State Highway 1 and link the Rotokauri growth cell to key transport destinations, and the wider Hamilton city transportation network. Arthur Porter Drive is a strategic local road (collector) connection with an enhanced connection between two existing portions of the corridor to better connect the transportation network in this location.

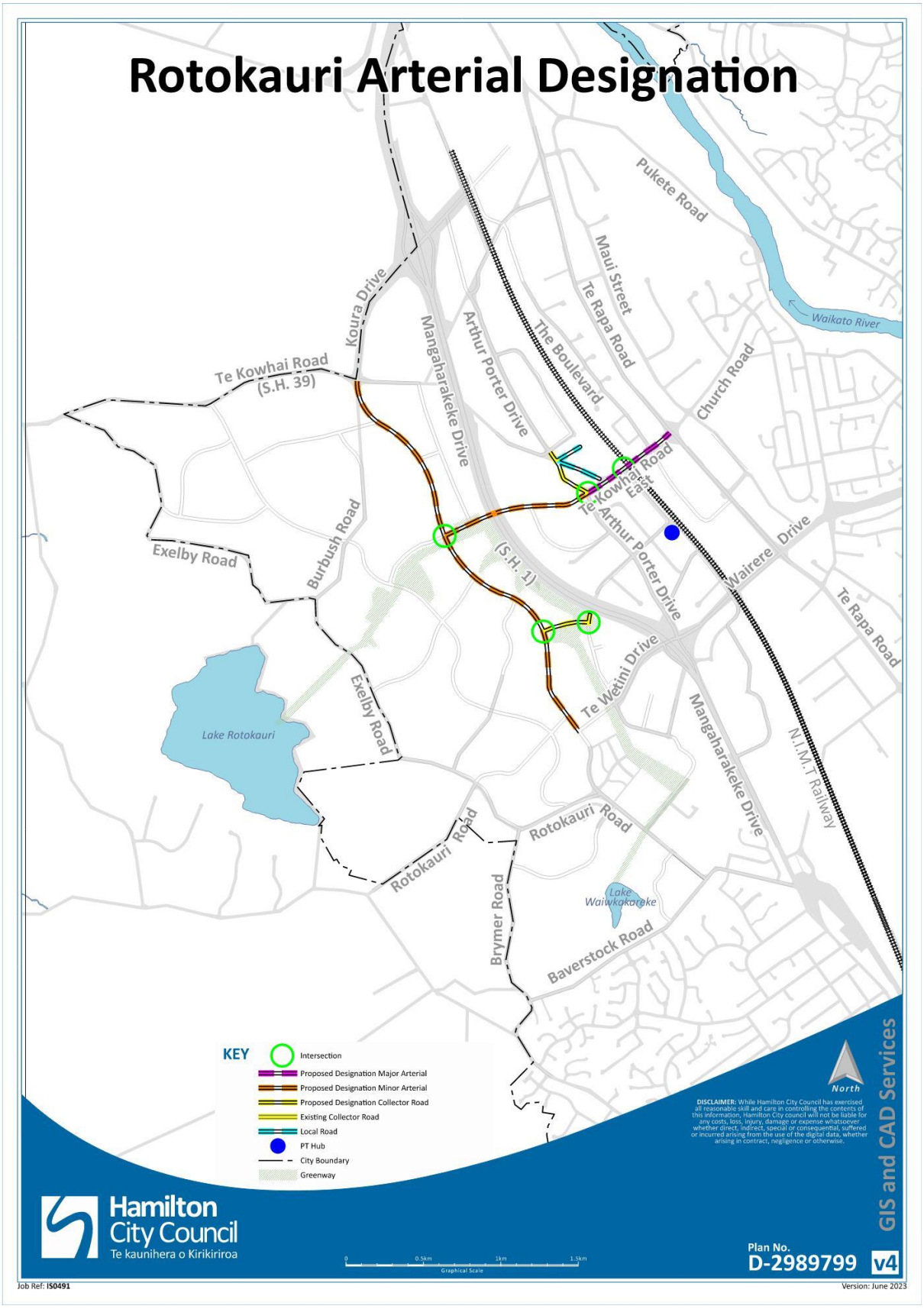


Figure 2: Proposed Rotokauri Arterial Network Source: Hamilton City

The proposed design of the transport network has a strong urban design focus contributing to achieving HCC's strategic objectives for land use planning, urban growth infrastructure provision and economic development. These include those core aspects associated with the primary use of multimodal transportation and secondary functions of a strategic network designation including associated infrastructure provisions and how they affect the spatial requirements of the land to be designated. Broadly, these include multimodal transportation facilities, bus stops, parking, spatial provisions for utilities network including three waters infrastructure, connections to recreational spaces and small amenity areas where there is a transition in land-use or context.

They also include associated stormwater facilities including rain gardens and treatment swales directly associated with the road that would be needed to provide an appropriate level of treatment and allow the construction of the network to give effect to the designation. Some elements of the broader Rotokauri scheme overlap with the proposed designation for the Stormwater areas with specific wetland treatment areas to be included within the designated corridor.

There is an existing HCC designation already in effect as it relates to the Rotokauri Greenway Corridor which is an identified precursor to any development of the land within the RSP or of the strategic arterial networks which are the subject of the NoR. The Rotokauri Arterial Network will build on the Greenway Project with stormwater facilities intended to work in conjunction with the Greenway and provide modal connections which enhance the identified recreation functions associated with the Greenway. Further descriptions and details of the Rotokauri Greenway and the interfacing aspects relevant to the proposal are outlined in the NoR document.

In summary, in terms of our operational noise assessment, we consider the following discrete sections:

- **Section 1 – Minor Arterial (Part A, Part B and Part C)**
  (Te Wetini Drive to Koura Drive (SH39) roundabout)

  This section is sparsely populated with a total of two PPFs[1] within the assessment area.
  Section 1 is classified as a New Road, according to NZS 6806:2010 Section 1.6.

- **Section 2 – Te Kowhai Road East Extension**
  (Minor Arterial to Te Rapa Road Intersection)

  This is a proposed major arterial road connecting the minor arterial to Arthur Porter Drive Intersection and widening the road from the intersection to Te Rapa Road intersection. This section is populated with numerous commercial/industrial developments a total of two possible PPFs have been identified within the assessment area
  Section 2 is a combination of a New Road and Altered Road as per NZS 6806:2010.

- **Section 3 – Chalmers Road Extension**
  (Collector to Chalmers Road)

  Only the new built road section of this proposed development is classified as a New Road per NZS 6806:2010. All other segments do not qualify for assessment.

[1] PPFs is the term used in NZS 6806 for noise sensitive receivers and is defined in Section 3.2.1 .

3.0 NOISE PERFORMANCE STANDARDS

3.1 Hamilton City Council Operative District Plan – Operative Noise Rules

Typically, district plans set out the methodology and limits to assess environmental noise, however, the Hamilton City Council's (HCC) Operative District Plan (ODP) states that New or Altered Roads (estimated to carry traffic flows of at least 2,000 annual average daily traffic movements (AADT) at design year), should be assessed according to the New Zealand Standard (NZS) 6806:2010 *"Acoustics - Road-traffic noise - New and altered roads"* (NZS 6806). The relevant rule (Rule 25.8.3.4) of the ODP is given below.

25.8.3.4 Design and Construction of New and Altered Roads

a) Application of this standard.

i. This standard shall apply only to new and altered roads predicted to carry at least 2000 annual average daily traffic (AADT) at the design year.

b) This standard shall not apply:

i. In circumstances where NZS 6806: 2010 does not apply, as listed in paragraph 1.3.1 of NZS 6806: 2010.

ii. To local transport corridors identified within Volume 2, Appendix 15-4, Figures 15-4b to 15-4f.

iii. To altered roads where the vertical or horizontal alignment changes relate solely to providing pedestrian footpaths, cycleways, dedicated passenger transport or high-occupancy vehicle lanes, vehicle stopping or parking whereby that part of the carriageway dedicated to usual vehicle movement does not move closer to any protected premises and facilities.

c) Road-traffic noise shall be measured and assessed in accordance with NZS 6806:2010 'Acoustics – Road traffic noise – New and altered roads'.

d) Subject to 25.8.3.4(a) and (b) above, new or altered roads are designed and constructed to mitigate road-traffic noise in compliance with NZS 6806: 2010 'Acoustics – Road traffic noise – New and altered roads'.

Note

1. This rule mainly affects road controlling authorities such as Council and the New Zealand Transport Authority, but sometimes may affect a private developer building or altering a road in a subdivision designed to carry the requisite traffic volumes. The practical effect of the standard is that traffic noise received at 'protected premises and facilities' will be reduced by design features such as quieter road surfaces.

The Rotokauri Arterial Development and road upgrading project consists of New Road sections and Altered Road sections in terms of NZS 6806. Therefore, the ODP rule applies and NZS 6806 should be used for assessment. This New Zealand Standard is described in more detail in the next section.

3.2 NZS 6806:2010 "Acoustics – Road-traffic noise – New and altered roads"

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

3.2.1 Assessment positions and criteria

NZS 6806 identifies 'Protected Premises and Facilities' (PPFs[2]), such as dwellings and educational facilities, which are considered noise sensitive receivers, that should be protected from road-traffic noise.

Commercial and business uses are not PPFs as they are not considered noise sensitive and are often noise producers in their own right - therefore, they are excluded from our assessment.

Only the existing PPFs, and those that have obtained building consent, must be considered. Future use of any land adjacent to the Project can take account of the proposed changes, thus avoiding reverse sensitivity effects.

3.2.2 Assessment area

NZS 6806 stipulates that the assessment area is dependent on the Statistics New Zealand definition of an area as either 'urban' or 'rural' (this definition is not dependent on the current or future use of the area). In 'urban' areas, only identified PPFs within 100 metres of the alignment qualify for assessment. For 'rural' regions, the assessment buffer distance is 200m from the alignment.

According to Statistics New Zealand's boundary map, the Project falls within the Hamilton City district and is identifiable as 'urban'. Therefore, the assessment area extends 100m from the alignment.

Appendix B shows all identified PPFs within the 100m buffer area of the alignment.

3.2.3 Identified PPFs

The identified PPFs are:

- 27 Burbush Road
  This PPF is an existing residential dwelling adjacent Project Section 1 part C (considered a New Road)
- 79 Te Kowhai East Road
  This PPF is Project Section 2. The area of Section 2 adjacent 79 Te Kowhai Road East is considered to be an Altered Road – given it is a realignment of Te Kowhai Road East. The property is in an Industrial Zone and is the location of a commercial operation - Saint Nicks Christmas Tree Farm. However, the building on the property appears to be residential in nature. In the absence of confirmation that the building is not used as residential dwelling we have conservatively considered them as a PPF for this assessment.
- 97 Te Kowhai Road
  This PPF is Project Section 2. The area of Section 2 adjacent 97 Te Kowhai Road East is considered to be an Altered Road – given it is a realignment of Te Kowhai Road East. The property is in an Industrial Zone and is the location of a commercial operation – Jack House Transit. However, the building on the property appears to be residential in nature. In the absence of confirmation that the building is not used as residential dwelling we have conservatively considered them as a PPF for this assessment.
- 244 Te Kowhai Road (SH39)
  This PPF is an existing residential dwelling adjacent Project Section 1 part C. Given the existing SH39 (and a roundabout intersection between SH39, Burbush Road and Te Kowhai Rd) lies between Project Section 1 part C and the existing dwelling, we have considered this PPF as adjacent an Altered Road for our assessment.

[2] NZS 6806 Clause 1.4 defines the term PPF

3.2.4 Applicability of NZS 6806

The first stage is to ascertain whether the provisions of NZS 6806 apply.

NZS 6806 Clause 1.2.3 (c) stipulates all New Road sections automatically require a traffic noise assessment where the noise at any one or more PPFs is predicted to increase by 3 dB when compared to the *existing*[3] noise environment.

NZS 6806 Clauses 1.5.2 (a) and (b) stipulate for all Altered Road sections (Te Kowhai East Road Extension) that the Standard applies only when the *do-minimum* noise environment is compared to the *do–nothing* noise environment, and certain criteria are met. These are:

- the do-minimum noise environment is greater than or equal to 64 $L_{Aeq\ (24h)}$ and noise levels are predicted to increase by 3 dB, or
- the do-minimum noise environment is greater than or equal to 68 $L_{Aeq\ (24h)}$ and noise levels are predicted to increase by 1 dB.

In terms of the Standard:

- the do-nothing scenario represents the circumstances at the design year where the project has not been implemented; however, traffic volumes and subsequent noise levels have changed - generally increased over time.
- the do-minimum scenario represents the circumstances at the design year where a project has been implemented without any specific noise mitigation.

We outline in Section 5.3 that none of the identified PPFs were above the test thresholds and therefore a full assessment according to NZS 6806 is not required. Nevertheless, we provide an outline of NZS 6806 performance criteria in the following section for reference.

3.2.5 Noise criteria

If it were deemed necessary to undertake a full assessment, the relevant noise criteria to apply are established. The noise criteria of the Standard are dependent on if the project consists of a New Road or Altered Road and are to be achieved at the external façade (or internally) of a dwelling. We consider these criteria provide for an acceptable level of amenity for both outdoor and indoor uses.

There are three criteria categories (A, B and C) for both new and Altered Roads. Both are applicable and set out in Table 1 overleaf.

[3] The "existing noise environment" for Altered Roads, represents the current road layout and traffic volume, and for new Roads the ambient noise environment as determined by survey and modelling. Both are determined based on the 'existing year'. For this project we have considered two periods for the 'existing year': 2020 and 2030. 2020. 2020 is the date for which the most recent traffic data is available at the time of writing. 2030 represents the expected 'existing environment' around the time at which the Project is expected to commence.

Table 1: Project traffic noise assessment criteria

Category		New Roads	Altered Roads
		dB $L_{Aeq(24h)}$	dB $L_{Aeq(24h)}$
A	(primary free-field external noise criterion)	57	64
B	(secondary free-field external noise criterion)	64	67
C	(internal noise criterion)	40*	40*

** This criterion applies only for those habitable rooms where the internal noise level would be 45 dB $L_{Aeq(24h)}$ or higher following the implementation of the Project and all structural mitigation such as road noise barriers or specific low noise road surface.*

The PPFs are assigned the relevant criteria based on the status (New or Altered Road) of the road section assessed.

The criterion to be achieved at each PPF depends on the application of the best practicable option (BPO) test, with the 'A' criterion being met or bettered if this is consistent with the BPO, the 'B' criterion being met or improved if criterion 'A' is not achievable with the BPO. Criterion 'C' is achieved with the adoption of the BPO if criterion 'B' is not feasible with the BPO. In all cases, where the 'A' criterion is not achieved, there should be the development of noise mitigation measures.

3.2.6 Prediction scenarios

NZS 6806 assesses several different scenarios (for both the applicability test and full assessment) which are then compared. These are:

- The "existing environment" which, for Altered Roads, represents the current road layout and traffic volume, for the existing year (i.e., the year 2020 and year 2030)
- A future "Do-nothing" scenario, which represents a scenario at the design year (2050) where the Project has not been implemented, however, traffic volumes and subsequent sound levels have changed – generally increased – over time
- A future "Do-minimum" scenario, which represents the circumstances at the design year (2050) where the Project has been implemented (without any specific noise mitigation). This means that the selection of road surface material has not been undertaken based on its sound generating characteristics, and the only barriers included are safety barriers, which are required for reasons other than noise mitigation.
  Note that the Do-minimum scenario is intended to assess the effect of the Project only, therefore, this scenario does not include noise contributions from existing roads that are outside of the Project scope
- Where required, mitigation options would be determined to develop the best practicable mitigation for the circumstance.

The Standard requires the road controlling authority to define the design year, normally being a year between 10 and 20 years after the opening. Because of the future urban development timeframes, the design year for this assessment is 2050.

3.3 Hamilton City Council Operative District Plan – Construction Noise & Vibration Rules

3.3.1 Construction Noise (NZS 6803: 1999 "Acoustics - Construction Noise")

NZS 6803, referenced under Rule 25.8.3.2 of the HCC ODP, provides different construction noise limits (Residential and Commercial/Industrial) depending on the total duration of a project. The applicable limits are summarised overleaf in Table 2. The Rule also states that noise from construction must be measured and assessed following this Standard.

For construction works with a duration longer than 20 weeks (such as the Rotokauri Arterial Development Project), the noise limits when applied at 1m from an occupied building are:

Table 2: Construction noise limits, long-term (>20 weeks duration)

Time of Week	Time (hrs)	Noise Limits	
		dB L_{Aeq}	dB L_{AFmax}
Building with noise-sensitive activities			
Weekdays	0630 – 0730	55	75
	0730 – 1800	70	85
	1800 – 2000	65	80
	2000 – 0630	45	75
Saturdays	0730 – 1800	70	85
	1800 – 0730	45	75
Sundays and public holidays	0730 – 1800	55	85
	1800 – 0730	45	75
Building with all other activities			
-	0730 – 1800	70	-
	1800 – 0730	75	-

3.3.2 Construction Vibration (DIN 4150-3:1999)

Rule 25.8.3.3 in the HCC ODP states that construction vibration received by any building must comply with the German Standard DIN 4150-3:1999 "Structural vibration – Effects of vibration on structures". The compliance levels are shown below:

Table 3: Construction vibration limits

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

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

3.4 Resource Management Act

The RMA stipulates a duty to adopt the best option to ensure that noise (including vibration) from any development does not exceed a reasonable level. Specifically, Sections 16 and 17 reference noise effects as follows.

Section 16 states that "every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level".

Section 17 states that "every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by or on behalf of the person, whether or not the activity is in accordance with –

(a) Any of sections 10, 10A, 10B and 20A; or

(b) A national environmental standard, a rule, a resource consent, or a designation."

We have used the guiding principles of Sections 16 and 17 of the RMA in assessing effects and recommending mitigation measures which are adopted in NZS 6806.

4.0 EXISTING NOISE ENVIRONMENT

The existing noise environment is controlled by traffic on the Waikato Expressway (SH1). Most of the residential dwellings have direct line-of-sight to SH1 and are minimally affected by other local roads.

We deployed three unattended noise loggers to determine the existing sound environment and to calibrate the noise model (Figure 4 on page 15 shows the location of each logger). These loggers measured the ambient levels from 2 December to 10 December 2019. The loggers automatically recorded noise levels in 1-second intervals. The post-processing removed any periods (total of nine events or 36 "15-minute" periods) where the weather was outside the allowable meteorological window ("poor weather" as prescribed in NZS 6801).

Despite the logging being undertaken 3.5 years ago, we consider the ambient noise environment to remain largely similar, and furthermore is unlikely to have become quieter. We have confirmed this with a brief witnessed survey of ambient noise levels on 15 June 2023.

Table 4 overleaf summarises the derived noise levels (excluding those recorded in poor weather) and shows the 15-minute range and overall average per timeframe.

Table 4: Summary of noise levels at the unattended noise logger positions (2019)

Logger Position	Timeframe	Measured Noise Level (dB)			
		L_{A10} (Average)	L_{A10} (15-min interval range)	L_{Aeq} (Average)	L_{Aeq} (15-min interval range)
MP1 – North (Burbush Rd)	Day (7:00am – 10:00pm)	58	48-66	55	46-63
	Night (10:00pm – 7:00am)	55	45-67	52	42-64
	24hour period	57	45-67	**54**	42-64
MP2 – West (Burbush Rd / Exelby Rd)	Day (7:00am – 10:00pm)	56	51-59	54	49-58
	Night (10:00pm – 7:00am)	54	49-61	51	45-58
	24hour period	56	49-62	**54**	45-59
MP3 – North (Te Wetini Dr)	Day (7:00am – 10:00pm)	60	34-70	57	32-66
	Night (10:00pm – 7:00am)	54	18-69	52	17-64
	24hour period	58	18-70	**56**	17-66

Table 5: Summary of noise levels from witnessed noise surveys (2023)

Logger Position	Measurement Duration and Time	Measured Noise Level (dB)			
		L_{A10} (Average)	L_{A10} (15-min interval range)	L_{Aeq} (Average)	L_{Aeq} (15-min interval range)
MP1 – North (Burbush Rd)	15 mins, 12:03 – 12:38	49	48- 49	48	48-49
MP3 – North (Te Wetini Dr)	15 mins, 12:03 – 12:38	64	63-65	61	61

The variation in ambient noise over a 24-hour period is presented overleaf in Figure 3. The graph shows the hourly change in noise level for each logger position.

At MP3 the daily traffic flow pattern is visible with the noise dropping during the night-time, with nearly no local activities present, and picking up in the morning hours (when vehicle traffic volumes on the local roads increase).

Likely, 'natural' noise sources like birdsong and wind in trees have contributed to the measured levels, particularly at the positions further away from SH1 (MP1 and MP2).

Figure 3: Measurement positions hourly variation of the ambient noise level

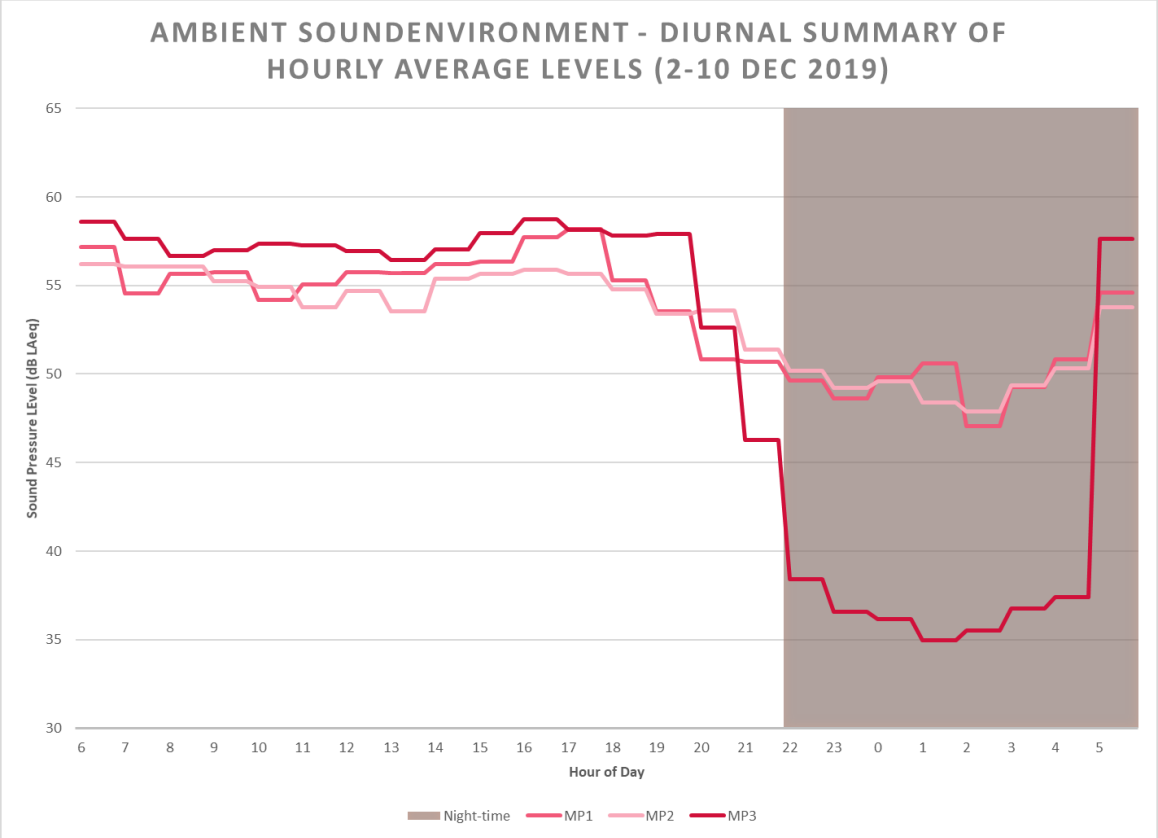
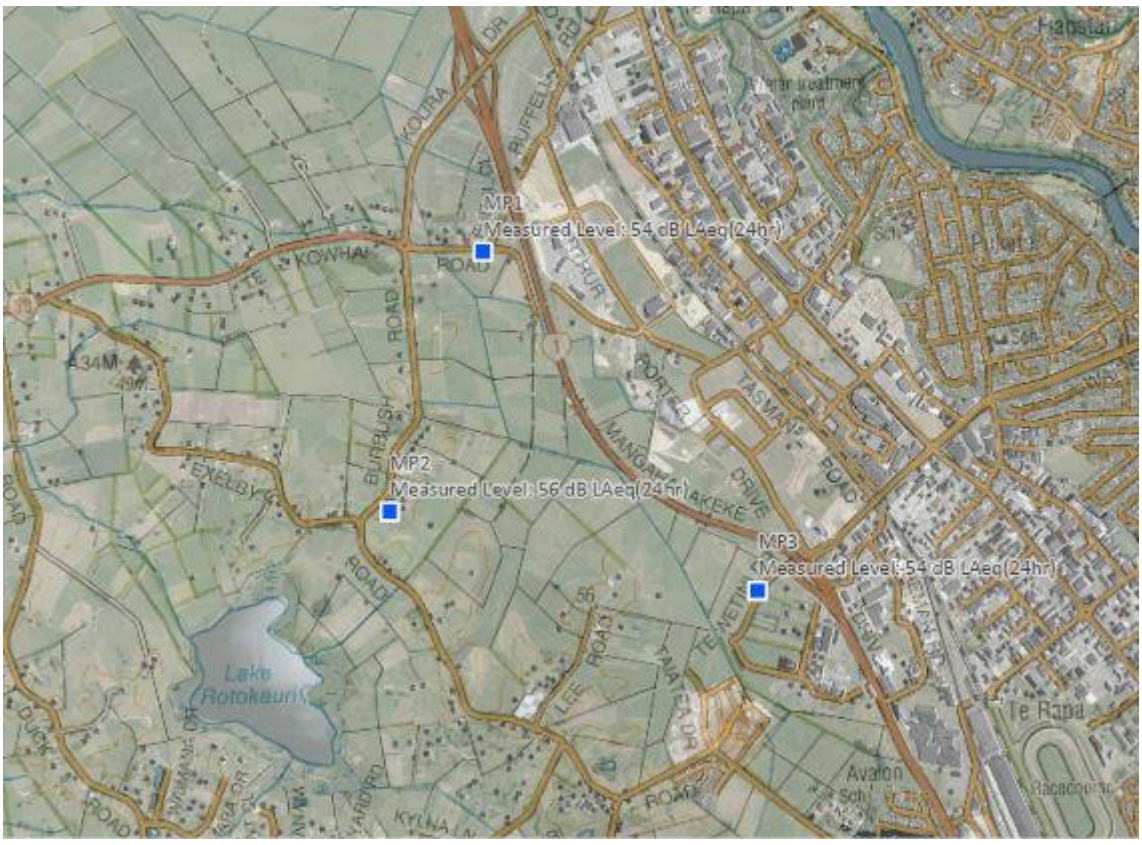


Figure 4: Unattended noise logger positions relative to the project extent



The relative predicted existing noise levels for all PPFs are detailed in Appendix D.

In summary, the local environment is typical of a semi-rural area in close proximity to a metropolitan area with major transportation infrastructure in the vicinity. Noise levels are highly dependent on how close a particular location is to this dominant noise source.

5.0 TRAFFIC NOISE ASSESSMENT

5.1 Project inputs

The proposed alignment and future terrain along and surrounding the alignment was provided by Beca (including that of the Waikato Expressway). The surrounding terrain outside of the Project extents was obtained from Hamilton City Council's LiDAR data set (dated 2019).

The road surface assumed for the project (details provided by Beca) are Asphaltic Concrete (AC) on all roads except for Burbush Road, Chalmers Road and the local road connection to the new Arthur Porter Drive northern section which is chip seal (Grade 3/5). The average speed is understood to be 60 km/h overall and 80 km/h on Te Kowhai East Road.

It is understood that the future urban planning of the area has not progressed to any level of detail. There are no sensitive receivers in the vicinity of the existing rural land (within the assessment buffer zone).

Road surface types for the surrounding roads have been obtained from an online repository that collates all available data from governing body websites (such as Council Road databases, and Waka Kotahi State Highway databases), and on-site observations.

Traffic data for the future Do-nothing and future Do-minimum situations are summarised in the table in Appendix C.

5.2 Modelling methodology

A computer noise model was prepared using the internationally recognised noise modelling software SoundPLAN® (version 9.0). This program utilises the algorithms contained in the UK Department of Transportation's (Welsh Office) "Calculation of Road Traffic Noise" (CoRTN). The calculated results in SoundPLAN include an adjustment for the noise characteristics of the different road surfaces used in New Zealand. These values were then converted from dB $L_{A10\,18hr}$ (CoRTN calculates results using this metric) to dB $L_{Aeq(24hr)}$ to align with the criteria of NZS 6806.

The model was calibrated using the measured results from the long-term noise loggers. The calibration results are shown below in Table 6.

Table 6: Verification of calibrated noise model (rounded)

Logger Position	Measured Result (dB $L_{Aeq(24hr)}$)	Predicted Result (dB $L_{Aeq(24hr)}$)	Accuracy of Model (dB)
MP1	54	53	-1
MP2	48	46	-2
MP3	56	57	+1

As shown, the prediction model underpredicts the noise level by minus 1 and 2 decibels, at logger locations further away from SH1. The prediction model overpredicts by 1 decibel closer to the proposed alignment. However, this is within the accepted tolerance range of ±2 decibels and is, in any case, therefore a conservative noise model. Therefore, it is considered that the model would be appropriate for road traffic noise predictions.

Noise level predictions for all valid PPFs are shown in the table in Appendix D, for all prediction scenarios discussed in Sections 5.3 to 5.4. The calculated noise contours are presented in Appendix E.

5.3 Assessment per NZS 6806

5.3.1 Do-nothing Scenario (applies only to Altered Road sections)

The Do-nothing scenario represents a future scenario where the Project is not implemented (the design is Year 2050), and the existing road layout remains unchanged. Over time, traffic volumes generally increase, and therefore, noise levels also increase. The Do-nothing scenario is used for Altered Roads to determine the effect of the Project, i.e., it is the "baseline" from which a change in noise level is predicted.

Noise levels for the Do-nothing scenario have been predicted and, where relevant, are presented in Table 7 overleaf.

All predicted noise levels are presented in Appendix D and noise contours for all predictions are presented in Appendix E.

5.3.2 Do-minimum Scenario

The Do-minimum scenario represents the scenario when the Project has been implemented, excluding any specific noise mitigation. The exact timing of the arterial routes becoming operational is not yet known and depends on various factors such as the development of the surrounding area and council planning. However, by the time that the Minor Arterial route is constructed, the surrounding area (and associated ambient noise levels) would have changed significantly and cannot be readily compared to the current situation[4].

The Do-minimum scenario only includes the Project roads and any associated road alterations (which are under the control of the relevant roading authority and can, therefore, be mitigated).

However, this would provide a distorted outcome concerning the assessment of traffic noise effects. Therefore, while the assessment in accordance with NZS 6806 has followed the standard approach, Section 5.4 discusses the likely affect the existing roads in the area and planned arterials could have on the noise levels that would be experienced at the PPFs.

The Do-minimum scenarios have been predicted with detailed drawings and tabulated results presented in Appendix D and Appendix E, respectively.

5.3.3 Predicted noise levels for Altered Road sections

Noise levels for the do-nothing and do-minimum scenarios have been predicted to determine if the provisions in NZS 6806 are achieved for the Altered Road sections of the proposed alignment. The results are shown in Table 7 and colour coded showing (where applicable):

- noise criterion Category A (≤64 dB $L_{Aeq(24h)}$) in green,
- noise criterion Category B (64-67 dB $L_{Aeq(24h)}$) in yellow, and
- noise criterion Category C (>67 dB $L_{Aeq(24h)}$) in red

[4] The current situation refers to predicted noise levels based on traffic data at 2020 - This is the most recent data available at the time of writing.

Table 7: Predicted traffic noise levels (dB $L_{Aeq(24h)}$) for PPFs near Altered Road sections of the Project

PPF Street Address	Predicted noise level (dB $L_{Aeq(24hr)}$)		Difference (decibels)
	Do-nothing	Do-minimum	
79 Te Kowhai East Road	55	49	-6
97 Te Kowhai East Road	54	45	-9
244 Te Kowhai Road (SH39)	64	45	-9

Based on the predicted levels, the applicability criteria outlined in Section 3.2.4 are not triggered.

As shown, the Project presents as a net benefit for the receivers. However, the Do-minimum scenario only includes the Project roads and is the distorted outcome referred to in Section 5.3.2. Therefore, in Section 5.4 we discuss the likely affect the existing roads in the area and planned arterials could have on the noise levels that would be experienced at the PPFs.

5.3.4 Predicted noise levels for New Road sections

Only one PPF (27 Burbush Road) is assessed against the New Road criteria.

Noise levels for the Do-minimum scenario and the existing noise environment have been predicted to determine if the provisions in NZS 6806 are achieved for the New Road sections of the proposed alignment. The results are shown in Table 8and colour coded as per Table 7.

Table 8: Predicted traffic noise levels (dB $L_{Aeq(24h)}$) for PPFs near New Road sections of the Project

PPF Street Address	Predicted noise level (dB $L_{Aeq(24hr)}$)		Difference (decibels)
	Do-minimum	Existing Environment	
27 Burbush Road	48	46	2

At 27 Burbush Road the predicted noise levels from the Project:

- are lower than Category A (not exceeding the 57 dB $L_{Aeq(24h)}$ threshold), and
- increase the existing noise environment levels by less than 3 dB.

Based on the predicted levels, the applicability criteria outlined in Section 3.2.4 are not triggered and noise mitigation is not required to be investigated (in accordance with Section 7.2.5 of NZS 6806:2010)

5.3.5 Summary

For all PPFs the applicability criteria outlined in Section 3.2.4 are not triggered and noise levels are predicted to be within Category A.

The predicted noise levels are considered as reasonable and would unlikely adversely affect indoor or outdoor noise-sensitive activities.

5.4 Assessment of traffic noise effects

The Do-minimum scenario generally predicts noise levels that are lower than the Do-nothing scenario, because it investigates only the planned roads (excluding the surrounding network). However, when assessing the effect of overall traffic noise, all traffic contributions in the area are taken into consideration, as this is the noise level that would actually be experienced by future residents.

Therefore, this section of the assessment includes local roads (with the relevant increase in traffic volume to the design year - 2050) in addition to the Project road.

5.4.1 Existing Dwellings

In order to determine the effect of a Project, the noise levels with and without the proposed road need to be compared. For this Project, when considering the noise effects in the context of all road traffic sources (i.e., Project road and all local roads at the design year), the contribution from the Project overall is classified as negligible.

The results are summarised in Table 9 below. The acoustic environment including all road traffic noise sources is described as the "future scenario" and is the combination of the Existing (do nothing 2050) + Do-minimum noise levels

Table 9: Predicted traffic noise levels (dB $L_{Aeq(24h)}$) for Do-Nothing vs Future Scenario

PPF Street Address	Predicted noise level (dB $L_{Aeq(24hr)}$)		Difference (decibels)
	Do-nothing	Future Scenario (Existing in 2050 + Do-minimum)	
27 Burbush Road	49	51	3
79 Te Kowhai East Road	55	51	-4[5]
97 Te Kowhai East Road	54	50	-4[5]
244 Te Kowhai Road (SH39)	64	64	0

Based on the overall moderate traffic noise levels received from all roads, and the low noise contribution as a result of the implementation of the Project only, the acoustic effect from the Project itself is considered to be acceptable and overall generally neutral.

5.4.2 Vacant Land

Noise levels received in vacant land (i.e., land that has no consented developments) due to a proposed new/altered road are not typically assessed as there are no effects at the time of the Project implementation. This is because a new receiver moving into an existing environment does not experience a change in noise level in the same manner as a current PPF would. Additionally, future developments can take into account the traffic noise levels in their design considerations if they wish to do so.

[5] We note that the -4 decibel difference at the Te Kowhai East Road PPFs occurs because there is a discrepancy in the traffic flow data provided. The predicted flows for the section of Te Kowhai East Road (between the Arthur Porter Drive Intersection and the Roger Kaui Place/ Earthmover Crescent roundabout) in the 2050 under the Do-nothing scenario is 9114 AADT (refer Appendix C1), whereas the traffic flow of the Project in this area are only 2000 AADT (1000 NB/1000 SB) (refer Appendix C2).

6.0 CONSTRUCTION NOISE AND VIBRATION

6.1 Duration and Construction Hours

We understand that the duration of construction works will be longer than 20 weeks, commencing approximately in the year 2028-2030.

It is assumed that any works would occur between the hours of 0730 – 1800 hrs Monday to Saturday with no works on Sundays. However, some night-time works may be required to avoid traffic disruption.

6.2 Construction Noise Levels

Common construction equipment for roading projects is set out in Table 10 below. The table also presents the indicative noise levels for each item of equipment at various distances. It is noted that the closest dwelling is approximately 25 metres from the works, and the furthest approximately 190 metres.

Table 10: Indicative construction noise levels with no mitigation

Plant	Sound Power Level dB L_{WA}	dB L_{Aeq} @25 m	dB L_{Aeq} @55 m	dB L_{Aeq} @100 m
Hydraulic excavator	107	74	65	59
Dump truck	108	75	66	60
Roller (non-vibratory)	103	70	61	55
SP compactor	100	67	58	52
Loader	112	79	70	64
Bitumen emulsion	94	61	52	46
Hotmix application	100	67	58	52

The above sound levels show that the relevant daytime construction noise criterion of 70 dB L_{Aeq} can generally be achieved at dwellings 50 metres or more from the construction site without mitigation, and around 25 meters with effective use of mitigation measures, such as temporary construction barriers or placement of equipment, providing up to 10 decibels of shielding.

6.3 Construction Vibration Levels

The closest dwelling is approximately 25 m from the potential construction sites. At that distance, based on measurements of construction activities and guideline values set out in the relevant Standards, the vibration limits outlined in Section 3.3.2 can be complied with when using the common construction equipment listed above.

6.4 Construction Noise and Vibration Management

Measures to mitigate potential adverse effects from construction noise are discussed below.

6.4.1 Notification

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

Any persons affected by noise levels higher than the construction noise limits would need to be advised of the proposed works, including timing. This generally includes all dwellings within 50 metres of the proposed works for Monday to Saturday construction activities, and all dwellings within 400 metres of the proposed works for Sunday and night-time construction activities.

Notification should be provided to those households before works are carried out, through letter drops or similar. A contact phone number should be available to residents should they have concerns about the works or require further information.

6.4.2 Barriers

Placing temporary noise barriers, such as sheets of plywood or construction noise curtains, between dwellings and the construction activities can reduce noise levels by up to 10 decibels. However, due to the linear nature of the works, barriers are generally only recommended where particular events would occur in one location for an extended period, where non-compliance may be possible or be site-specific (e.g., concrete sawing).

6.4.3 Avoidance of Unnecessary Noise

At many construction sites, it can be observed that some construction practices unnecessarily increase noise levels. Examples include the sounding of horns and the utilisation of tonal reversing alarms. Those issues can be avoided, or noise levels reduced, using changed construction site management, fitting of mufflers to trucks and the replacement of tonal reversing alarms with broadband reversing alarms.

6.4.4 Construction Noise and Vibration Management Plan

A construction noise and vibration management plan (CNVMP) is recommended, which contains information regarding on-site management, mitigation options, communication procedures, and complaints procedures.

The recommended contents of a CNVMP are set out in NZS 6803:1999 Section 8 and Annex E. The CNVMP should contain, but not be limited to:

- A summary of the Project noise criteria
- A summary of construction noise assessments/predictions
- General construction practices, management and mitigation
- Noise management and mitigation measures specific to activities and receiving environments
- Monitoring and reporting requirements
- Procedures for handling complaints
- Procedures for review of the CNMP throughout the Project

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

6.5 Assessment of Construction Noise and Vibration Effects

Construction activity which complies with the construction noise and vibration limits in Section 3.3 is considered to be acceptable.

Some construction activities may just exceed the noise limits from time to time. In these situations, all practicable options should be investigated and implemented to mitigate the noise impact as much as practicable. For roading projects of this magnitude, it is considered that noise effects are generally acceptable provided that the construction activity causing the impact is managed appropriately. In any case, a CNVMP is recommended to be developed and implemented to guide methods to manage and mitigate construction noise and vibration.

7.0 CONCLUSION

We carried out an assessment of noise and vibration effects for the proposed new arterial development within the Rotokauri Structure Plan Area.

For all PPFs the applicability criteria outlined in Section 3.2.4 are not triggered and noise levels are predicted to be within Category A without specific noise mitigation.

The Project will allow access for future developments to commence once the sections of the road are completed. This would also lead to an increase in traffic in the vicinity of the area that will alter the noise environment received at the PPFs. Overall the operational effects from the proposed project (alteration to existing roads and newly built roads) are considered as acceptable and neutral for the existing PPFs that are clustered in Rotokauri Rise.

Construction works at distances of more than 50 metres of any building can comply with the daytime construction noise limits without mitigation. Construction works at distances of more than 400 metres of any building can comply with the night time construction noise limits without mitigation. For those dwellings that are closer, mitigation and management measures have been discussed to reduce the construction noise impact.

A CNVMP is recommended to be implemented for each stage of the works, at the beginning of the Project and throughout the entire construction period of each step, to ensure that construction noise and vibration can be managed to acceptable levels. If new buildings have been established at the time of the construction, these will need to be taken into consideration and development works managed to achieve, as far as practicable, compliance with the relevant construction noise and vibration criteria.

APPENDIX A GLOSSARY OF TERMINOLOGY

Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{A10,18h}$	The average of the 18 one-hour L_{A10} values between 6am and midnight (0600 – 0000 hrs).
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (24 h) would represent a period of 24 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
NZS 6801:2008	New Zealand Standard NZS 6801:2008 *"Acoustics – Measurement of environmental sound"*
NZS 6802:2008	New Zealand Standard NZS 6802:2008 *"Acoustics – Environmental Noise"*
NZS 6806:2010	New Zealand Standard NZS 6806:2010 *"Acoustics - Road-traffic noise - New and altered roads"*
Design-Year	A point in time not less than 10 years but not more than 20 years after the opening of the Project to the public.
Do-Nothing Scenario	The situation at Design Year assuming no alterations are made to the existing road.
Do-Minimum Scenario	The situation at Design Year assuming the Project is constructed but excluding any specific noise mitigation measures such as noise control barriers or low noise road surfaces.

APPENDIX B ROUTE ALIGNMENT, ASSESSMENT EXTENT AND IDENTIFIED PPFS

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ROTOKAURI ARTERIAL DEVELOPMENT PROJECT

NZS6806 SCREENING ASSESSMENT FOR THE PROPOSED ROTOKAURI ARTERIAL ROADS DEVELOPMENT

Proposed Arterial Road Alignment Sections

- Section 1 - Part A - Minor Arterial
- Section 1 - Part B - Minor Arterial
- Section 1 - Part C - Minor Arterial
- Section 2 - Te Kowhai East Road Extension
- Section 3 - Chalmers Road Extension
- Proposed Arterial Road Alignment
- Rotokauri_100m_buffer_from_road_edge

Existing PPF Building Structures

PPF underlaying land-use zoning

- Commercial
- Residential

Zoning (Plan Change 12)

- General Residential Zone
- Large Lot Residential Zone
- Medium Density Residential Zone
- High Density Residential Zone; Residential Zone - High Density Residential Zone
- Industrial Zone
- Te Rapa North Industrial Zone
- Industrial Amenity Protection Area
- Ruakura Industrial Park
- Logistics Zone
- Business 1 Zone - Commercial Fringe
- Business 2 Zone - Events Facilities Fringe
- Business 3 Zone - Sub-Regional Centre
- Business 4 Zone - Large Format Retail
- Business 5 Zone - Suburban Centre Core
- Business 6 Zone - Neighbourhood Centre
- Business 7 Zone - Frankton Commercial Fringe
- Sports and Recreation Open Space Zone
- Neighbourhood Open Space Zone
- Natural Open Space Zone
- Destination Open Space Zone
- Ruakura Open Space
- Natural Open Space - Waikato River and Lakes
- Central City Zone
- Community Facilities Zone
- Future Urban Zone
- Knowledge Zone
- Major Facilities Zone
- Rototuna Town Centre
- Transport Corridor Zone

Client:
Beca

Authors:
Nicole.Paddison

Date of Issue:
29/06/2023 10:13 pm

Date of Issue:
Dw05_r01 20190530

Drawing Details:
Scale:
Projection:
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SoundPLAN Details:
Calculation Method: CoRTN 1988
Result File Name: RRKL3010.res

Map Notes / Comments:
This map is for graphical purposes only. While every effort has been made to ensure that the data are accurate and reliable, Marshall Day Acoustics cannot assume liability for errors or omissions in the data graphically represented.
The noise contours were created by interpolations of calculated grid points (spacing typically 5-25m), with varying interpolation accuracy. Precise noise levels at specific locations, can be made available at request if not included in the projects point receiver calculations.

Te Kowhai Rd
Mangaharakeke Dr
Arthur Porter Dr
Earthmover Cres
The Boulevard
Te Rapa Rd
Maui St
Tawn Pl
Church Rd
Roger Kaui Pl
Te Rapa Station
Te Awa The Base
Northgate
Clem Newby Rd
Tasman Rd
Burbush Rd
Chalmers Rd
Wairere Dr
Te Wetini Dr
Gilchrist St
Akoranga Rd
Exelby Rd
Burbush
Lee Rd
N

APPENDIX C PROJECT ALIGNMENT TRAFFIC DATA

C1 Existing Traffic and Future Do-Nothing Traffic Data

Road Name	Section	Speed (km/h)	"Existing" AADT (2020)	AADT (2030)	"Do-Nothing" AADT (2050)	HCV%	Surface
Arthur Porter Ave	Te Wetini Dr to Toolshed	50	7,102	9,112	13,132	13	AC – Grade 14
	Toolshed to Chalmers Rd	50	6,048	7,862	11,491	4	AC – Grade 14
	Chalmers Rd to Te Kowhai East Rd	50	6,450	8,276	11,927	8	Chipseal Grade 4
Te Kowhai East Road	Te Rapa Rd to Arthur Porter Dr (Intersection)	60	7,540	9,674	13,941	14	AC – Grade 14
	Arthur Porter Dr to Roger Kaui Pl/ Earthmover Cres roundabout	80	4,929	6,800	9,114	10	Chipseal Grade 3/5
Te Kowhai Road	From roundabout to village	80	53	68	98	10	Chipseal Grade 15
	From roundabout westward	80	6,162	7,906	11,393	17	Chipseal Grade 3/5
Koura Drive	From Roundabout to Waikato Expressway	80	3,928	5,010	7,172	17	Chipseal Grade 5
Burbush Road	Roundabout southward to Excelby Rd	80	954	1,224	1,764	2	Chipseal Grade 3
Exelby Road	Burbush Rd to Rotokauri Rd	80	954	1,224	1,764	10	Chipseal Grade 3/5
Rotokauri Road	Excelby Rd to Taiatea Dr roundabout	80	1,238	1,588	2,289	6	Chipseal Grade 3/5
	Taiatea Dr roundabout to Baverstock Rd	60	1,955	2,508	3,614	10	Chipseal Grade 3/5
	Baverstock Rd to Lugton St	50	6,100	7,827	11,280	3	Chipseal Grade 3/5
	Lugton St to Avalon Dr	50	5,182	6,649	9,582	3	SMA - 10
Taiatea Drive	Round about northward	35	1,238	1,588	2,289	6	Chipseal Grade 3/5
Mangaharakeke Drive	Northbound – Avalon Dr roundabout to turnoff	80	21,126	27,280	39,586	6	SMA – 10
	Southbound – turn-on to Avalon Dr roundabout	80	21,618	27,914	40,507	9	SMA – 10
	Turn-off to Te Wetini Drive (NB)	80	13,189	16,921	24,386	9	SMA – 10
	Turn-on from Te Wetini Drive (SB)	80	14,094	18,083	26,060	9	SMA – 10
Waikato Expressway	Northbound	100	7,661	9,829	14,165	9	OGPA-10
	Southbound	100	7,967	10,222	14,731	16	OGPA-10
Te Wetini Drive	Roundabout to Intersection	50	2,650	3,400	4,900	4	AC Grade 15

C2 Do-minimum Traffic Data

Road Name	Section	Direction	Speed (km/h)	"Do-Minimum" AADT (2050)	HCV%	Surface
Minor Arterial	Taiatea Dr to Chalmers Rd	NB	60	5,000	5	Chipseal Grade 4/6
		SB	60	2,000	5	Chipseal Grade 4/6
	Chalmers Rd to Te Kowhai East Rd	NB	60	1,000	5	Chipseal Grade 4/6
		SB	60	1,000	5	Chipseal Grade 4/6
	Te Kowhai East Road to Burbush Rd	NB	60	4,000	5	Chipseal Grade 4/6
		SB	60	2,000	5	Chipseal Grade 4/6
Te Kowhai East Road	Minor Arterial to Arthur Porter Dr Intersection	EB	80	4,000	8	Chipseal Grade 4/6
		WB	80	5,000	8	Chipseal Grade 4/6
	Arthur Porter Dr Intersection to Tasman Rd	EB	80	3,000	14	Chipseal Grade 4/6
		WB	80	3,000	14	Chipseal Grade 4/6
	Tasman Rd to The Boulevard roundabout	EB	80	7,000	14	Chipseal Grade 4/6
		WB	80	9,000	14	Chipseal Grade 4/6
	The Boulevard roundabout to Te Rapa round about	EB	80	9,000	14	Chipseal Grade 4/6
		WB	80	10,000	14	Chipseal Grade 4/6
Arthur Porter Drive	North of Intersection	NB	50	1,000	8	Chipseal Grade 4/6
		SB	50	1,000	8	Chipseal Grade 4/6
	South of Intersection	NB	50	2,000	8	Chipseal Grade 4/6
		SB	50	2,000	8	Chipseal Grade 4/6
Chalmers Road Extension	Minor Arterial to Chalmers Rd	EB	50	2,000	4	Chipseal Grade 4/6
		WB	50	2,000	4	Chipseal Grade 4/6
Te Wetini Drive	Minor Arterial to Te Wetini Dr roundabout	EB	50	5,000	4	Chipseal Grade 3/5
		WB	50	5,000	4	Chipseal Grade 3/5

APPENDIX D CALCULATED NOISE LEVEL AT ALL PPFS

PPF Address	Existing Noise Level (2020)	Future Existing Level (2030)	Do-Nothing Scenario (2050)	Road Section Status	Do- Minimum	Assessment of Effect Future Scenario (Existing + Do-Minimum)
27 Burbush Rd, Burbush	46	48	49	New Road	48	51
79 Te Kowhai East Road	52	53	55	Altered Road	49	51
97 Te Kowhai East Road	51	52	54	Altered Road	45	50
244 Te Kowhai Road (SH39)	62	63	64	Altered Road	45	64

APPENDIX E PREDICTED TRAFFIC NOISE CONTOURS

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ROTOKAURI ARTERIAL DEVELOPMENT PROJECT

EXISTING TRAFFIC NOISE LEVELS (FUTURE YEAR - 2030)

Calculated 2020 Ambient Noise Level (dB $L_{Aeq(24hr)}$) based on the calibrated existing roads within the project area.
PPF's within 100m of Road Centre Line and the associated buffer is overlaid.

Existing PPF Building Structures
PPF underlaying land-use zoning
- Commercial
- Residential
- Existing Road Alignment

RRLK3012 - Predicted Noise Level dB (LAeq(24hr)
Predicted $L_{Aeq(24hr)}$
- 50 - 55 dB
- 55 - 60 dB
- 60 - 65 dB

Client:
Beca
Authors:
Nicole.Paddison
Date of Issue:
29/06/2023 8:57 pm
Date of Issue:
Dw07_r01 20190530

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Map Notes / Comments:
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The noise contours were obtained by interpolations of calculated grid points (spacing typically 5-25m), with varying interpolation accuracy. Precise noise levels at specific locations can be made available if required if not included in the projects point receiver calculations.

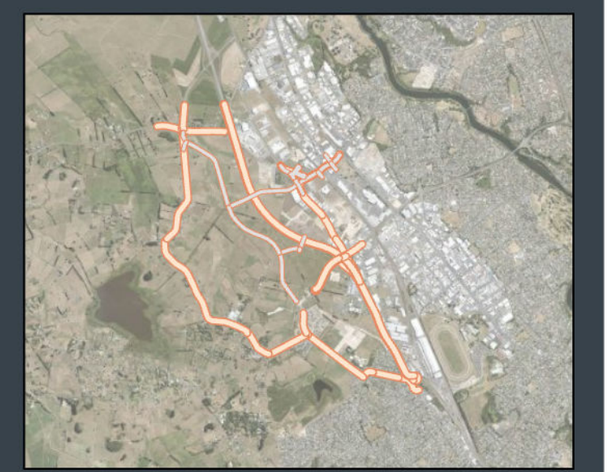
ROTOKAURI ARTERIAL DEVELOPMENT PROJECT

NZS6806 DO-MINIMUM ASSESSMENT (FUTURE YEAR - 2050)

Calculated 2020 Ambient Noise Level (dB $L_{Aeq(24hr)}$) based on the calibrated existing roads within the project area.
PPF's within 100m of Road Centre Line and the associated buffer is overlaid.

Existing PPF Building Structures
PPF underlaying land-use zoning
- Commercial
- Residential
- Existing Road Alignment
- Proposed Arterial Road Alignment

RRLK4002 - Predicted Noise Level
dB LAeq (24hr)
- 50 - 55 dB
- 55 - 60 dB
- 60+ dB



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Nicole.Paddison
Date of Issue:
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Dw09_r01 20190530

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The noise contours were obtained by interpolation of calculated grid points (spacing typically 5-10m), with varying interpolation accuracy. Precise noise levels at specific locations, can be made available at request if not included in the projects point receiver calculations.

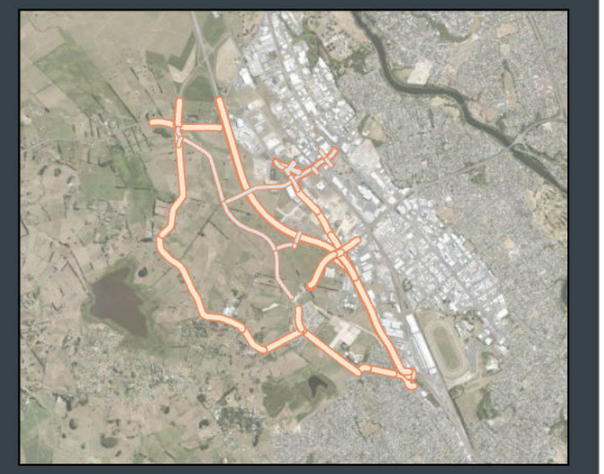
ROTOKAURI ARTERIAL DEVELOPMENT PROJECT

ASSESSMENT OF EFFECTS (FUTURE YEAR - 2050)

Calculated 2020 Ambient Noise Level (dB $L_{Aeq(24hr)}$) based on the calibrated existing roads within the project area.
PPF's within 100m of Road Centre Line and the associated buffer is overlaid.

Existing PPF Building Structures
PPF underlaying land-use zoning
- Commercial
- Residential
- Proposed Arterial Road Alignment
- Existing Road Alignment

RRLK4001 - Predicted Noise Level
dB LAeq (24hr)
- 50 - 55 dB
- 55 - 60 dB
- 60+ dB



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Date of Issue:
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