Appendix Y

Noise and Vibration

Acoustics Assessment

Peka Peka to North Otaki Expressway

Scheme Assessment Report Addendum

30 NOVEMBER 2011

Prepared for

NZ Transport Agency

20 Ballance Street
PO Box 5084, Lambton Quay
Wellington 6145

42176987

NZ TRANSPORT AGENCY
WAKA KOTAHI

OPUS

URS

Project Manager:

Michael Smith
Acoustics Engineer

URS New Zealand Limited

Level 1, 31 Orchard Road
Christchurch Airport 8053
PO Box 4479, Christchurch 8140
New Zealand

T: 64 3 374 8500
F: 64 3 377 0655

Principal-In-Charge:

Dr Stephen Chiles
Principal

Author:

Michael Smith
Acoustics Engineer

Reviewer:

Dr Stephen Chiles
Principal

Approved for issue by:

David Dunlop
Opus International
Consultants

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Table of Contents

Table of Contents

Tables

Table of Contents

Figures

Appendices

Glossary

Abbreviation	Meaning
AADT	Annual average daily traffic
AC	Asphaltic concrete
AEE	Assessment of effects on the environment
BCR	Benefit-cost ratio
BPO	Best practicable option
CRTN	Calculation of road traffic noise
dB	Decibels
EPA	Environmental Protection Authority
GIS	Geographic information system
HV	Heavy vehicle
Hz	Hertz
km	Kilometre
km/h	Kilometres per hour
NoR	Notice of requirement
NZS	New Zealand Standard
NZTA	NZ Transport Agency
OGPA	Open graded porous asphalt
PPF	Protected premises and facilities
PPM	Planning policy manual [NZTA]
RoNS	Road of national significance
RMA	Resource Management Act 1991
SAR	Scheme assessment report
SARA	Scheme assessment report addendum
SH1	State Highway 1
SMA	Stone mastic asphalt
vpd	Vehicles per day

Glossary

Term	Definition
Alignment	The horizontal or vertical geometric form of the centre line of the carriageway.
Annual average daily traffic	The total volume of traffic passing a roadside observation point over the period of a calendar year, divided by the number of days in that year (365 or 366 days). Measured in vehicles per day.
Benefit-cost ratio	The ratio that compares the benefits accruing to land transport users and the wider community from implementing a project or providing a service, with that project's or service's costs.
Carriageway	That portion of the road devoted particularly to the use of travelling vehicles, including shoulders.
Centreline	The basic line, at or near the centre or axis of a road or other work, from which measurements for setting out or constructing the work can conveniently be made.
Chip seal	A wearing course consisting of a layer or layers of chips originally spread onto the pavement over a film of freshly sprayed binder and subsequently rolled into place.
Designation	Defined in section 166 of the RMA as: "a provision made in a district plan to give effect to a requirement made by a requiring authority under section 168 or section 168A or clause 4 of schedule 1."
Design speed	A speed fixed for the design of minimum geometric features of a road.
Design year	The predicted year in which the design traffic volume would be reached.
Expressway	A road mainly for through traffic, usually dual carriageway, with full or partial control of access. Intersections are generally grade separated.
Free-field (Noise)	Description of a location which is at least 3.5 metres from any significant sound reflecting surface other than the ground.
$L_{Aeq(24h)}$	Time-average sound level over a twenty-four hour period, measured in dB.
Local road	A road (other than a State highway) in the district, and under the control, of a territorial authority, as defined in Section 5 of the Land Transport Management Act 2003.
Notice of requirement	A notice given to a territorial authority (under section 168 of the RMA) or by a territorial authority (under section 168A of the RMA) of a requirement for land, water, subsoil or airspace to be designated.
Outline plan	A plan of the public work, project, or work to be constructed on designated land provided to a territorial authority, pursuant to section 176A of the RMA, prior to the work being undertaken.
Road reserve	A legally described area within which facilities such as roads, footpaths and associated features may be constructed and maintained for public travel.
Traffic volume	The number of vehicles flowing in both directions past a particular point in a given time (e.g. vehicles per hour, vehicles per day).
Vehicles per day	The number of vehicles observed passing a point on a road in both directions for 24 hours.

Executive Summary

Introduction

This technical report documents the assessment of noise and vibration from road and rail traffic for the Peka Peka to North Otaki Project. This assessment includes both the expressway and new local arterial, where it is being altered. This report provides details of the criteria adopted, an assessment of existing and future conditions, and proposed mitigation where appropriate. The level of detail is appropriate for a Social and Environmental Assessment (SEA) in accordance with NZTA minimum standard Z/19.

Criteria

Road-traffic noise has been assessed against NZS 6806:2010 and the Kapati Coast District Plan. Costs of indicative mitigation have been compared with Transit Noise Guidelines as required by the NZTA Value Assurance Committee. Rail noise and vibration have been considered, with potential mitigation identified.

Existing environment

The route closely follows the existing state highway through both rural and urban areas. A number of the Protected Premises and Facilities (PPFs) affected by this project are already subject to high levels of road-traffic noise. A noise survey has been performed to quantify this existing exposure, and provide the baseline required to determine noise limits from the district plan. Rail noise measurements have also been undertaken.

Modelling

Acoustics computer modelling has been conducted using an assessment year of 2026. The modelling includes the existing situation and the future scenario without the Project (do-nothing), the scenario with the Project (do-minimum), and various noise mitigation options.

Design and mitigation

Noise mitigation options have been considered in accordance with the method set by NZS 6806. This report outlines an indicative noise mitigation solution, which includes 6.3 km of open graded porous asphalt (PA-10) on the expressway and 114 m length of 2 metre high noise barrier. If the project proceeds these mitigation options will need to be assessed by all relevant members of the project team to determine the best practicable option for noise mitigation.

1

Introduction

1.1 Project description

The planned upgrading of State Highway 1 (SH1) between Peka Peka and North Otaki is part of the Wellington Northern Corridor Road of National Significance (RoNS) – a planned four-lane expressway from Wellington Airport to Levin. The project location is shown in Figure 2-1.

SH1 is the major route in and out of Wellington, linking the centres of Palmerston North, Wanganui and Levin with Wellington. By improving transport networks through the Kapiti Coast, this project will contribute to economic growth and productivity.

Currently the Peka Peka to North Otaki section of SH1 has a relatively poor and worsening safety record. It also experiences high levels of congestion during peak periods, weekends and holiday periods. This congestion is compounded by a high proportion of local traffic, and an increasing level of shopping-generated parking and pedestrian movements in the Otaki urban area. A bypass of Otaki, and the provision of a high-standard highway through the area will increase the efficiency of movements between Wellington and the North, will ease local congestion, improve safety, and will facilitate local, regional and national economic development.

The scope of this project is therefore to construct a high-quality four-lane expressway bypassing the township of Otaki and the settlement of Te Horo. Together with the MacKays to Peka Peka section to the south, it forms the Kapiti Expressway and when both sections are completed will provide a superior transport corridor providing much improved, reliable and safer journeys through the Kapiti Coast.

The existing state highway will become a local road, referred to in this report as the new local arterial.

The North Island Main Trunk rail line will be realigned through Otaki in order to accommodate the proposed expressway.

Figure 1-1 Project location

1.2 Acoustics assessment

1.2.1 2002 Scheme Assessment Report (SAR)

A scheme assessment report was been prepared in 2002 as a deliverable under Transit New Zealand's Contract No PSW-13 – North Otaki to Peka Peka Road. Malcolm Hunt Associates prepared the acoustics assessment as part of the 2002 SAR. In 2003 an addendum to the scheme assessment report was prepared to consider the western 'Te Waka alignment' favoured by submitters during consultation. The assessment concluded that this alignment was less favourable than the board preferred alignment.

1.2.2 2011 Scheme Assessment Report Addendum (SARA)

The project is now being developed as part of the Roads of National Significance programme, and a further scheme assessment report addendum has been prepared. Four road corridors have been considered, with further stakeholder consultation, however the preferred alignment from the 2002 scheme remains largely intact. More detailed work on interchange design and east-west linkages along the route has been conducted.

URS has conducted an acoustics assessment for the 2011 SARA, which is documented in this technical report. The scope of this work was to:

- Measure existing noise levels,
- Predict and assess future road-traffic noise levels, and
- Determine potential measures to avoid, remedy or mitigate potential operational road-traffic noise effects.

A comprehensive study has been undertaken to address this scope and is presented in this report. The work was conducted between January and August 2011.

To accommodate the expressway, a section of the North Island Main Trunk rail line will be realigned in Otaki. A preliminary assessment of rail noise and vibration has been performed to identify potential effects resulting from this realignment. Further assessment and consultation with KiwiRail will be required during the AEE stage.

Road-traffic vibration has been considered for the Waterview Connection and Transmission Gully Projects. The investigations performed on those two projects indicate that this is not a significant issue for PPFs greater than 10 metres from the alignment, and will not been considered further for this project.

The NZTA has standard methods for managing construction noise and vibration effects for roading projects. The likely construction techniques for this project can be considered 'business as usual' and further assessment is not required during the scheme assessment.

1.2.3 Assessment of Environmental Effects (AEE)

The SARA has been prepared to inform the NZTA of the acoustics issues associated with this project. It is structured to provide the pertinent technical details succinctly, and does not include in depth discussion of basic concepts and criteria. This report will provide the technical basis for the future acoustics reports supporting the AEE, but will require modification.

1 Introduction

Key reporting requirements that are not included in this SARA but will be included in acoustics reports in support of the AEE are:

- Appropriateness of criteria will be discussed in detail (NZS 6806 and district plan),
- Comparison with Transit Guidelines will be omitted,
- Development of the best practicable option will be documented,
- Effects will be assessed and rated for all PPFs,
- Rail noise and vibration will be assessed, and
- Construction noise and vibration will be addressed as a separate report.

This SARA provides an indication of the road-traffic noise mitigation measures likely to be required. However the best practicable option (BPO) for noise mitigation will be determined in accordance with NZS 6806 by the project team during the AEE stage, with input from NZTA national and regional office staff. The acoustics parameters only form a portion of this work, with input from other specialists and stakeholders considered.

2 Site description / existing environment

2.1 Overview

The Peka Peka to North Otaki route closely follows the existing state highway, with the environments ranging from rural to urban. A noise survey has included measurements at two locations over a week to capture temporal variations, and also spot measurements at six other locations to capture spatial variations.

For the existing state highway, acoustics computer modelling has been used to predict existing road-traffic noise levels to supplement measurements. This also forms the basis for comparisons with modelling of the new expressway.

2.2 Road-traffic noise

2.2.1 Procedure

Two noise loggers were used over a period of one week. Loggers were configured to continuously make consecutive fifteen minute measurements. A portable sound analyser was used to conduct 'spot' fifteen minute daytime measurements at additional positions. The measurement locations are shown in Figure 2-1, with spot and logger measurements shown with different symbols. During these times observations were made to identify dominant noise sources. All measurements were selected to be free-field. Measurement locations are listed in Table 2-1. Measurements were performed in general accordance with NZS 6801 and assessed using NZS 6806.

Table 2-1 Noise measurement locations

Noise loggers			Spot measurements		
Dates	Address	Notes	Date/time	Address	Notes
10–18/2/11	50 County Road, Otaki	Steady level from distant traffic	10/2/11 1415h	20 Peka Peka Road	Combination of distant and local traffic noise
10–18/2/11	903 SH1, Te Horo	Partially shielded by fences	10/2/11 1445h	9 Te Kowhai Road	SH1 dominant
			10/2/11 1645h	50 County Road	SH1 dominant
			11/2/11 0745h	15 Otaki Gorge Road	SH1 dominant
			11/2/11 0830h	9 Old Hautere Road	SH1 dominant
			11/2/11 0910h	97 Gear Road	SH1 dominant

Equipment

The following instrumentation was used for the survey:

- One Acoustical Research Laboratories Type EL316 noise logger,
- One Acoustical Research Laboratories Type Ngara noise logger, and
- One Brüel & Kjær Type 2250 sound level analyser.
- One Brüel & Kjær Type 4231 calibrator

2 Site description / existing environment

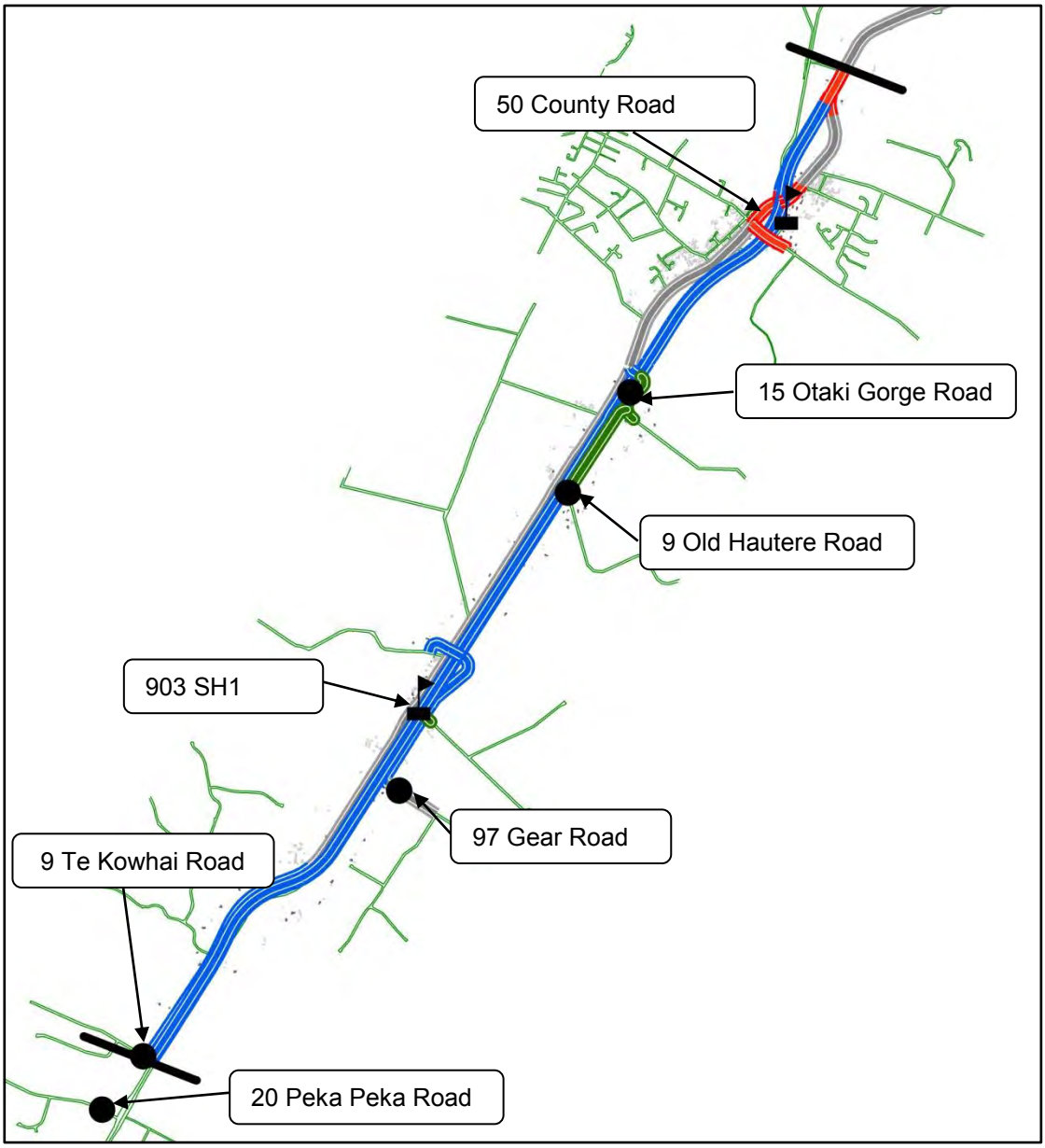


Figure 2-1 Measurement locations

Meteorological conditions

During the survey, meteorological data was obtained from the nearest weather station at Paraparaumu Airport. This is some distance from the project location, although no significant adverse weather conditions (high wind or rainfall) were encountered which would require exclusion of data. There has been no apparent influence of insect noise on the measurements (e.g. cicadas).

Traffic data

For measurements dominated by road-traffic noise from existing State Highway 1, the results have been adjusted to account for the actual traffic flow during the survey. This has been done by using the

daily traffic counts from the nearest permanent count station and adjusting the noise measurements to correspond to the 2010 Average Annual Daily Traffic (AADT).

Analysis

All data from each noise logger location has been averaged to obtain the $L_{Aeq(24h)}$ noise level at that location. For spot measurements, the daily variations in noise levels at the nearest noise logger location have been used to estimate the $L_{Aeq(24h)}$ noise level. This has resulted in a correction of –3dB between the daytime $L_{Aeq(15min)}$ spot measurements and the 24h average.

Uncertainty

By performing a measurement, the true value of a parameter is only known to within a measurement uncertainty. An uncertainty budget is presented in Table 2-2 for the noise survey, based on the methodology proposed by Craven and Kerry[1].

Table 2-2 Measurement uncertainty budget

Source of uncertainty	Value (half width)	Conversion	Distribution	Standard uncertainty
Source				
Traffic flow	1000 in 22000	0.2 dB	Rectangular	0.11 dB
% HGV and Mean speed	5% at 90km/hr to 15% at 110km/hr	3.1 dB	Rectangular	1.8 dB
Transmission path				
Weather	3 dB	3.0 dB	Rectangular	1.7 dB
Ground	min inc in weather			
Topography	No change	0.0 dB	Rectangular	0.0 dB
Receiver				
Position	1 m in 100 m	0.9 dB	Rectangular	0.50 dB
Instrumentation	1.9 dB	1.9 dB	Rectangular	1.1 dB
Background	Minimal			
Reflective surfaces	1.25 dB	1.25 dB	Rectangular	0.72 dB
Combined uncertainty				2.9 dB
Expanded uncertainty (95% confidence)				5.7 dB

2.2.2 Results

Table 2-2 shows the measurement results and also gives the modelled existing noise level for the same positions. According to NZS 6806 these should be within 2 dB, and where this is not the case the reasons are given in the table. Full results from the survey have also been prepared in a suitable format for the NZTA noise monitoring database.

[1] N.J. Craven and G. Kerry. *A good practice guide on the sources and magnitude of uncertainty arising in the practical measurement of environmental noise*. University of Salford. 2001.

Table 2-3 Measurement results

Dates	Address	Type	$L_{Aeq(24h)}$	Modelled	Comment
10–18/2/11	50 County Road, Otaki	Logger	54 dB	58 dB	Two rows of trees provides slight shielding from state highway
10–18/2/11	903 SH1, Te Horo	Logger	65 dB	65 dB	-
10/2/11 1415h	20 Peka Peka Road	Spot	59 dB	56 dB	Traffic from Peka Peka Road was not modelled
10/2/11 1445h	9 Te Kowhai Road	Spot	55 dB	60 dB	Measurement position was partially shielded from State highway
10/2/11 1645h	50 County Road	Spot	53 dB	58 dB	Significant variation in daily pattern
11/2/11 0745h	15 Otaki Gorge Road	Spot	58 dB	60 dB	-
11/2/11 0830h	9 Old Hautere Road	Spot	55 dB	58 dB	Significant variation in daily pattern
11/2/11 0910h	97 Gear Road	Spot	47 dB	53 dB	Measurement position did not have full field of view of state highway

2.3 Rail noise

2.3.1 Procedure

Rail noise measurements to determine train characteristics were performed at a single location, which was chosen to minimise noise from other sources and also to avoid terrain screening. The chosen location was at Taylors Road, north of Otaki. Measurements were taken approximately 16 metres from the railway. The measurements were conducted in general accordance with NZS 6801[2]. The measurement commenced when the train was able to be seen or heard. The measurement duration at night was longer due to the lower background noise levels.

Equipment

The following instrumentation was used for the survey:

- One Brüel & Kjær Type 2250 sound level analyser.
- One Brüel & Kjær Type 4231 calibrator

2.3.2 Results

The results of the rail noise measurements are presented in Table 2-4. The results are in terms of the sound exposure level (SEL) and a 1-hour time-average noise level ($L_{Aeq(1h)}$), assuming only a single rail movement.

[2] NZS 6801:2008, Acoustics – Measurement of environmental sound

2 Site description / existing environment

Table 2-4 Rail noise measurement results

Location	Distance to track	Data	SEL	$L_{Aeq(1h)}$
The Overlander (south bound)	16 m	10/02/2011 1800h	95 dB	59 dB
Capital Connection (north bound)	16 m	10/02/2011 1840h	100 dB	65 dB
Freight train (south bound)	16 m	10/02/2011 2150h	102 dB	66 dB

The reference train level used in the KiwiRail reverse sensitivity guidelines (Section 4.1) state that by default train noise shall be deemed to be 70 dB $L_{Aeq(1hr)}$ at 12 metres from the closest rail track. This is consistent with the measurements taken in Otaki at 16 m, assuming there are two freight movements in an hour or multiple passenger train movements. The distance correction is discussed further in Section 4.3.

3

Road-traffic noise

3.1 Assessment standards

3.1.1 NZS 6806:2010

Criteria

The criteria and assessment method used by the NZTA for road-traffic noise are set out in NZS 6806:2010. The method provides performance targets and requires assessment of a number of different options for noise mitigation. These options are subject to an integrated design process in which the costs and benefits are considered.

For Peka Peka to North Otaki the following noise criteria from NZS 6806 are applicable:

Table 3-1 NZS 6806 noise criteria

Category	Criterion	Altered roads	New road
A	Primary	64 dB $L_{Aeq(24h)}$	57 dB $L_{Aeq(24h)}$
B	Secondary	67 dB $L_{Aeq(24h)}$	64 dB $L_{Aeq(24h)}$
C	Internal	40 dB $L_{Aeq(24h)}$	40 dB $L_{Aeq(24h)}$

Rural/urban

In accordance with NZS 6806, all properties within 100 metres of the alignment in urban areas and 200 metres in rural areas have been considered when identifying PPFs. Figure 3-1 shows the urban areas for the Otaki and Te Horo settlements as defined by Statistics New Zealand from the 2006 census.

3 Road-traffic noise

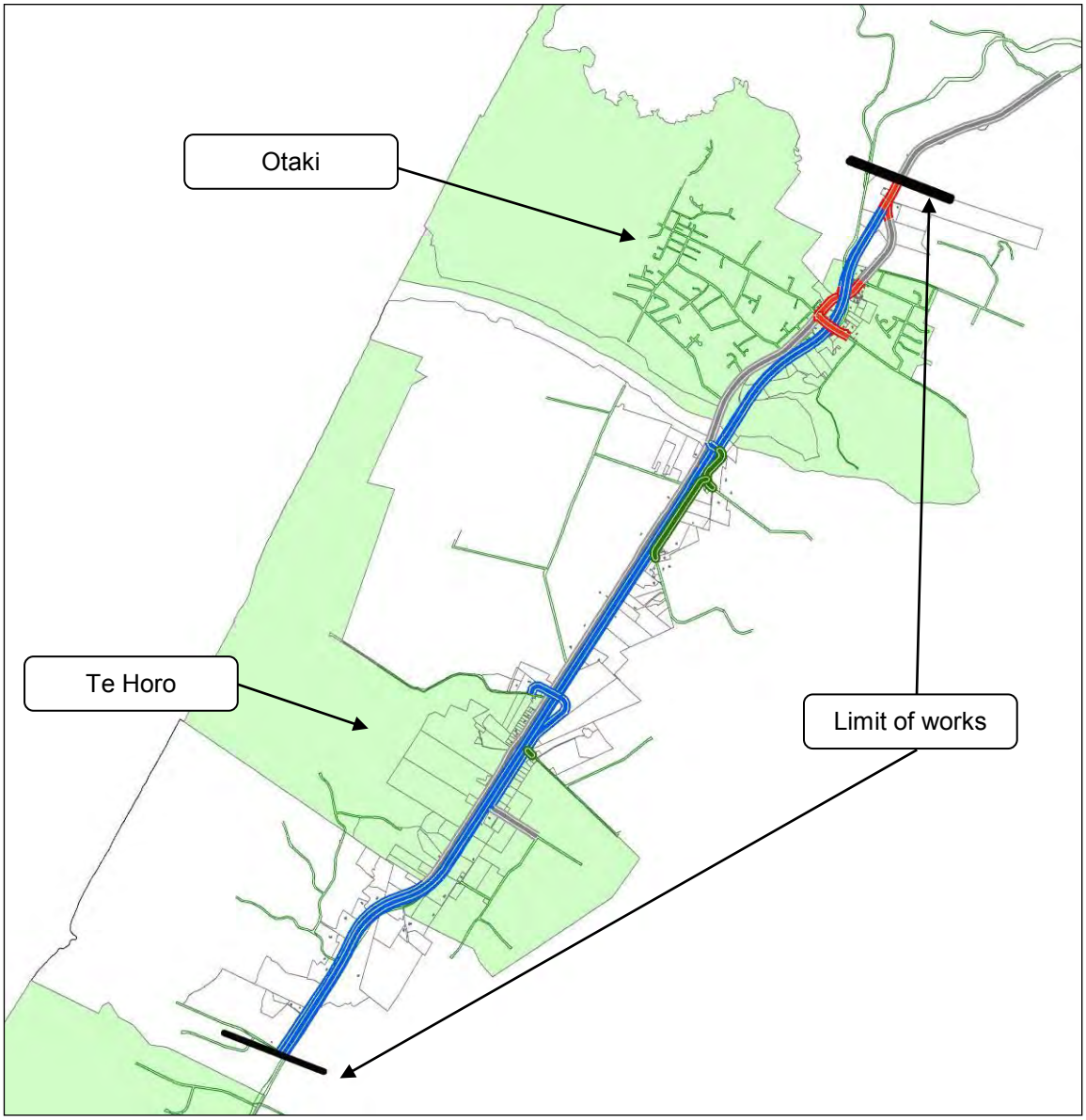


Figure 3-1 Statistical areas

Special case

This project does not fit cleanly within the NZS 6806 definitions of new and altered road, which determine the noise criteria. NZS 6806 defines a new road as any road which is to be constructed where no previously formed legal road existed. The expressway fits this definition and is therefore a new road for the purposes of NZS 6806, other than at tie-ins with existing roads. However, new roads are typically formed in greenfield areas, where the existing environment is not dominated by significant road-traffic noise and hence are subject to relatively stringent criteria. On the other hand, the duplication of an existing road would be considered an alteration to the road, and as the area would already be subject to road-traffic noise, more lenient criteria apply. In some respects a duplication is more representative of this project than a new road.

3 Road-traffic noise

Section 6.2.1c of NZS 6806 states that for any PPFs which are significantly affected by noise from another existing road in the vicinity, it may be appropriate to apply different criteria. This clause is applicable in this instance to PPFs near the existing state highway, and in these cases the altered road criteria are appropriate, even though the expressway is a new road. The following have been applied to identify PPFs where the altered road criterion is applied:

- Within 100 metres of the existing state highway in Otaki which is being altered as part of this project, and
- Where the predicted existing road-traffic noise level is 64 dB or greater.

The expressway running parallel to the new local arterial also requires special attention for noise mitigation design. Section 6.2.2 of NZS 6806 states that:

> *"Where PPFs are affected by noise from an existing road, mitigation is only required for road-traffic noise generated on the new or altered road"*

In many cases, placing a noise barrier immediately adjacent to the expressway, between the main alignment and the railway/new local arterial, would not prove effective as PPFs remain exposed the noise from traffic on the existing road. For this reason, during the mitigation design noise from the new local arterial (existing state highway) has been included for the purposes of determining the best practicable option. However, in accordance with NZS 6806, the noise level results in Section 3.3 only include the new and altered roads.

Figures 3-2 to 3-5, indicate the status of new and altered roads along the route, and PPFs where the altered road criteria have been applied. The figures show roads colour coded as:

- Blue – new road
- Red – altered road
- Grey – existing road
- Green – new road with AADT less than 2000 vpd (not modelled)

PPFs are colour coded:

- Blue – NZS 6806 new road criteria applied
- Red – NZS 6806 altered road criteria applied
- Grey – beyond the 100/200 m distance from the road for consideration under NZS 6806

3 Road-traffic noise

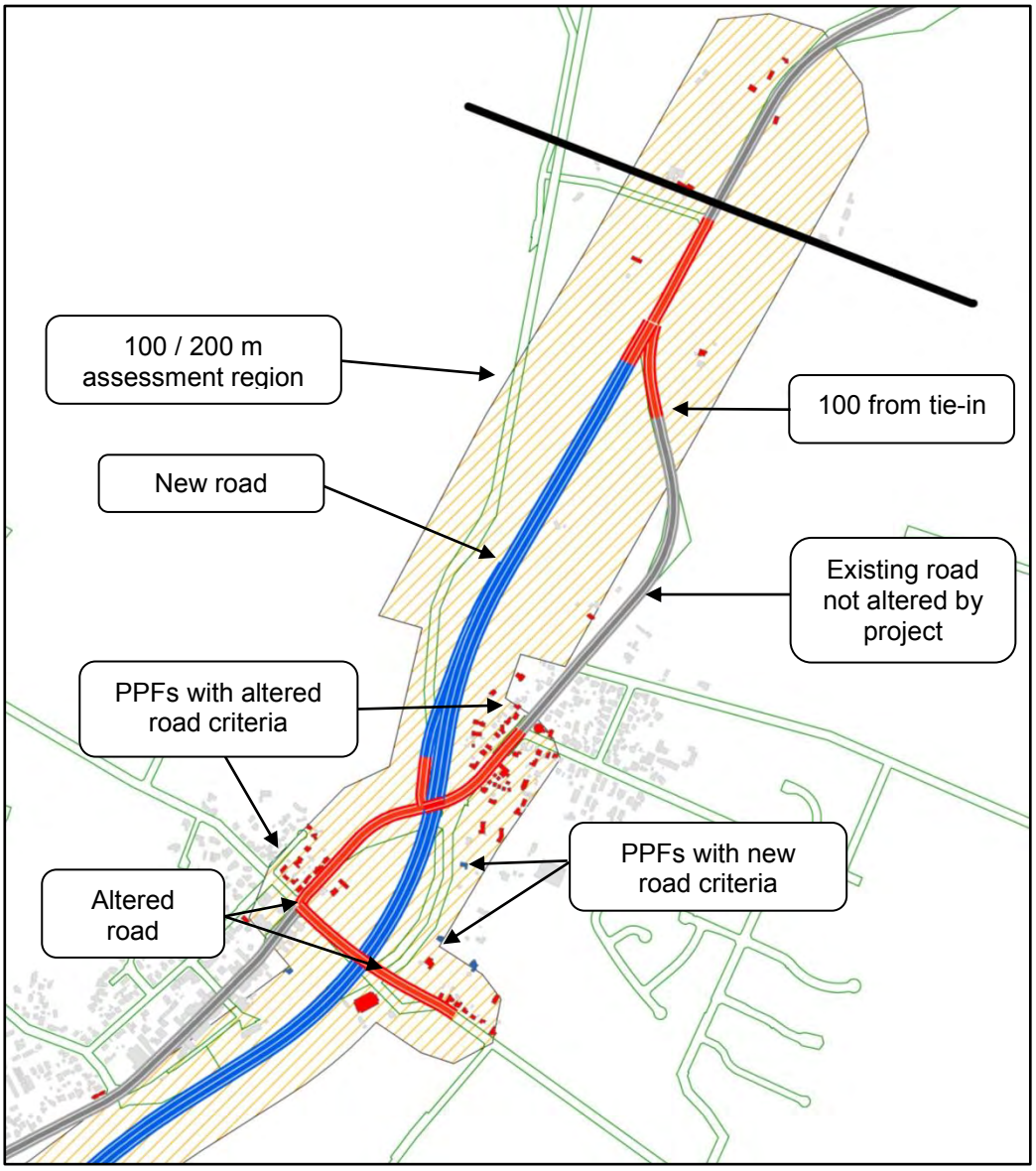


Figure 3-2 New and altered roads – Otaki Township

3 Road-traffic noise

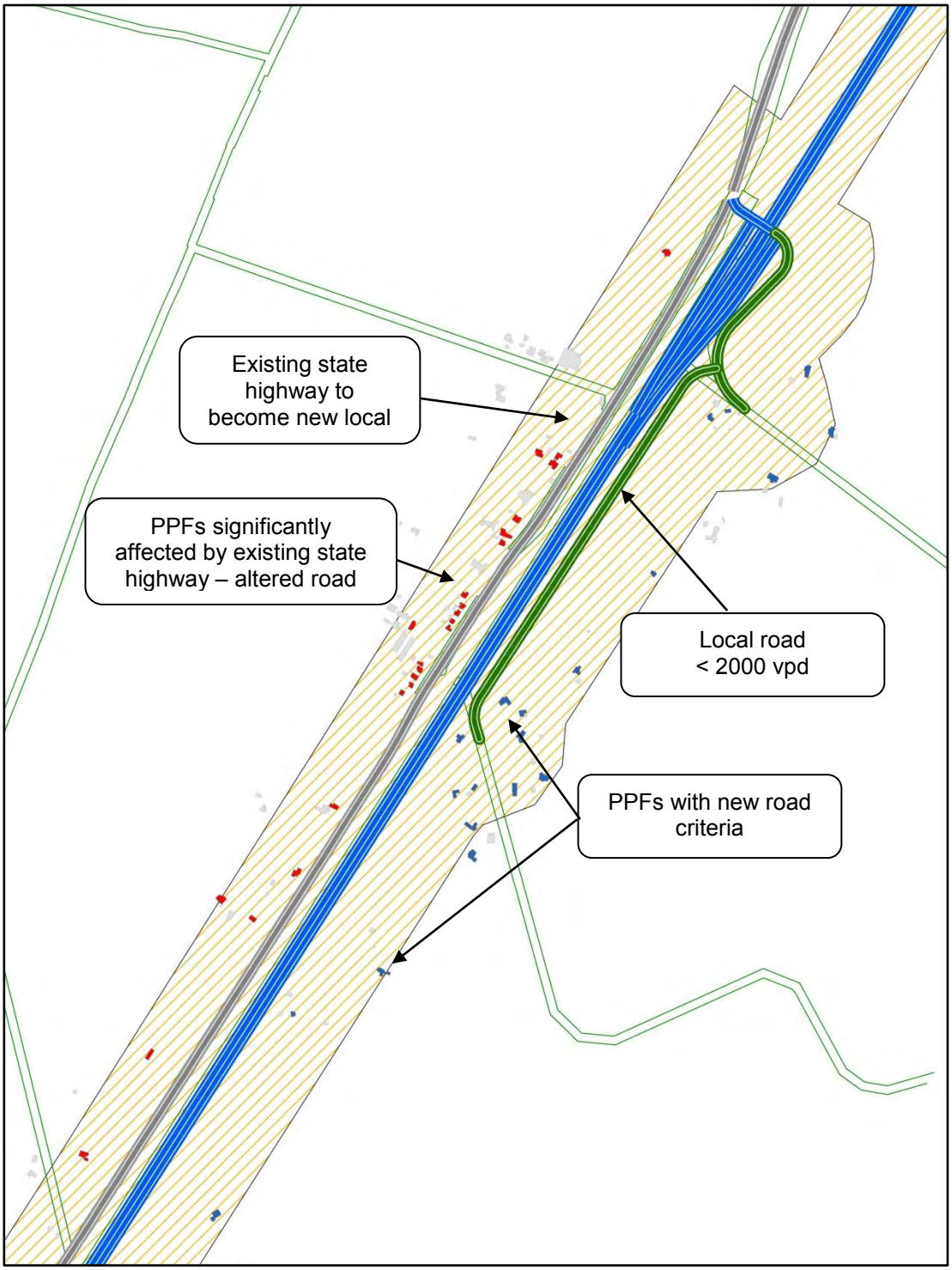


Figure 3-3 New and altered roads – Otaki Gorge Road

3 Road-traffic noise

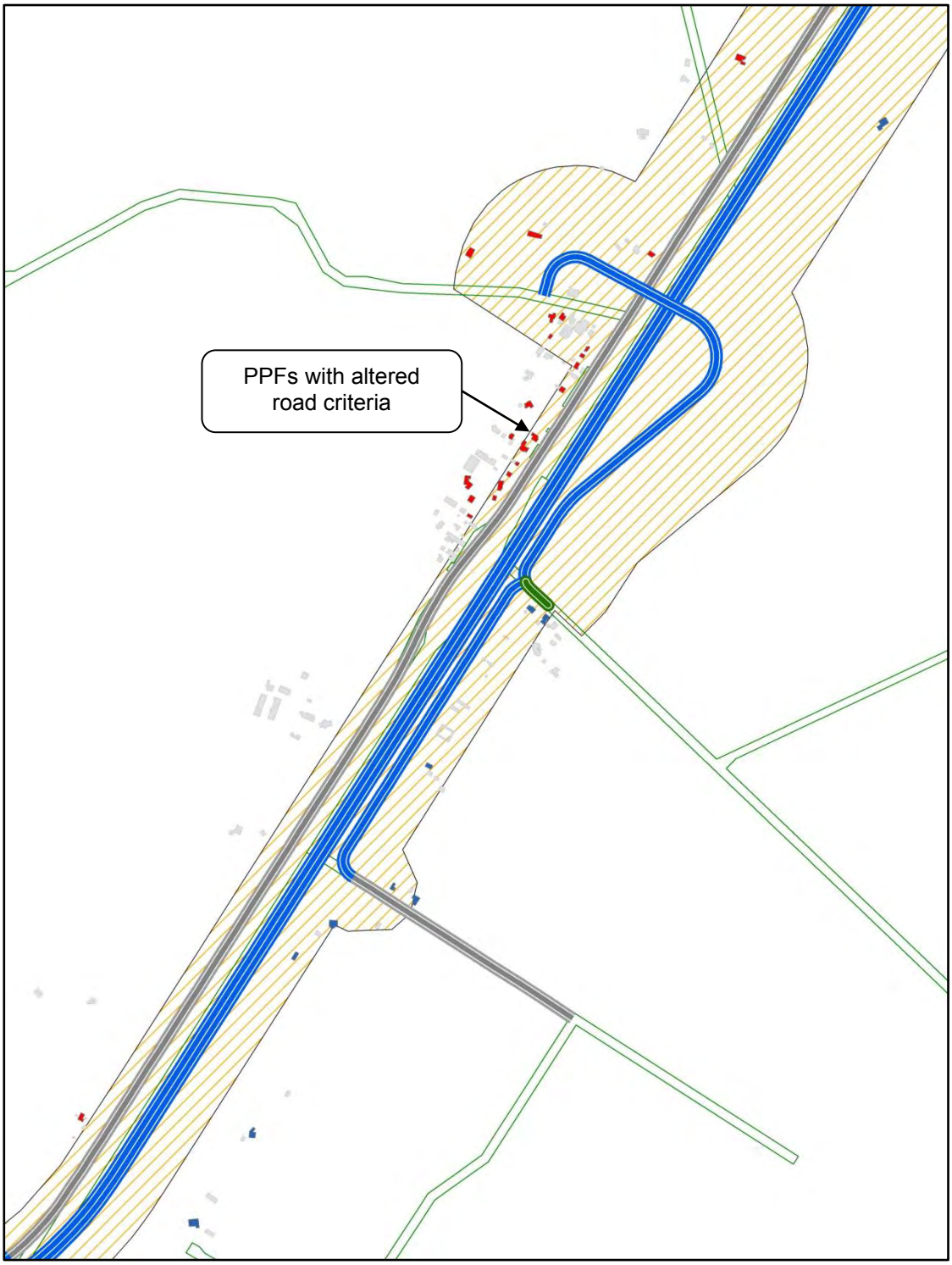


Figure 3-4 New and altered roads – Te Horo

3 Road-traffic noise

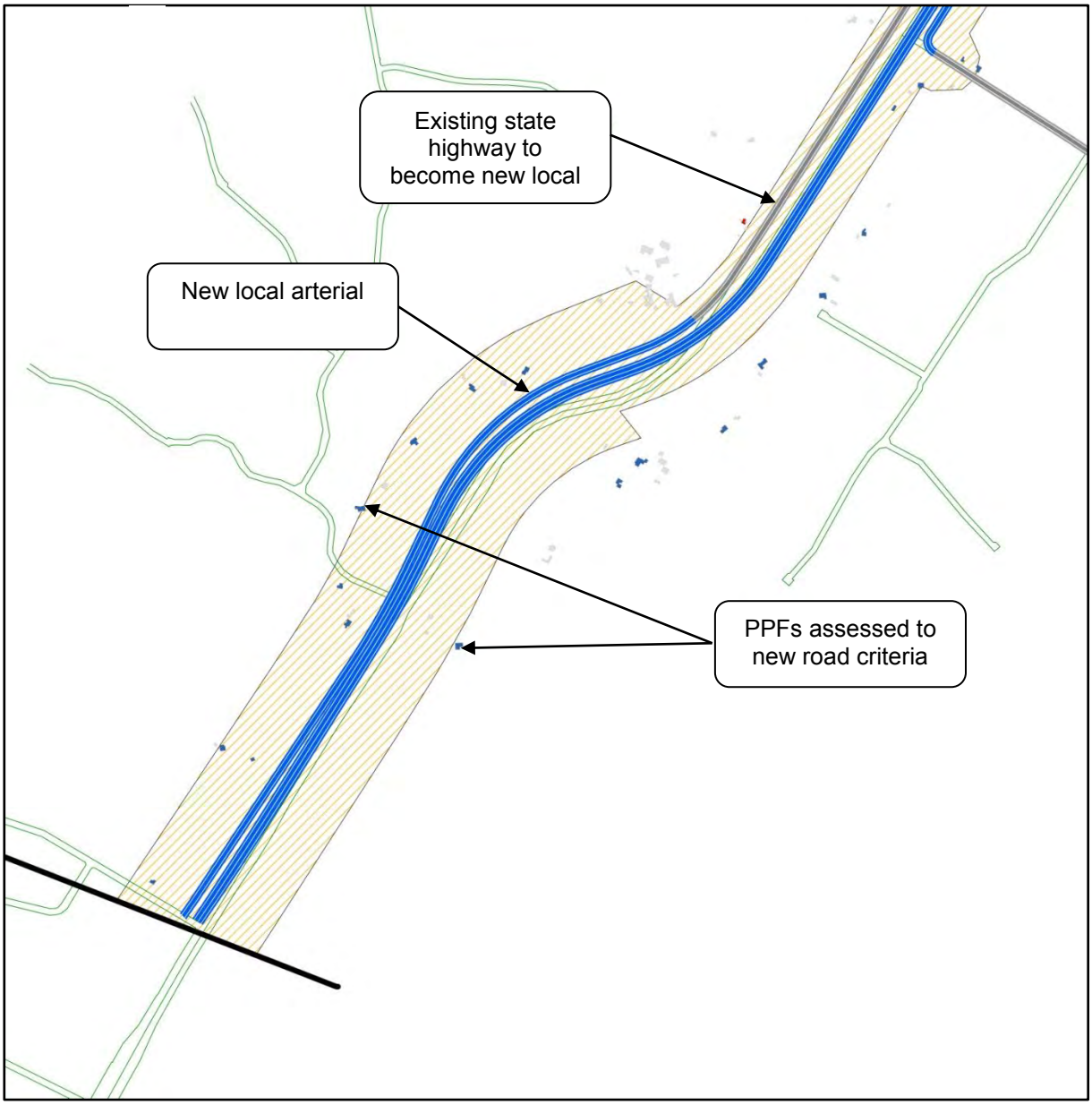


Figure 3-5 New and altered roads – South of Marycrest

3.1.2 Transit Noise Guidelines

The assessment method used by the NZTA for noise from new and altered roads changed in 2010 from the Transit Guidelines to NZS 6806:2010. There is currently a transitional period during which projects are to be assessed using the new method, but a comparison with the old criteria should be reported to the VAC. Estimates of costs for both NZS 6806 and Transit Guidelines mitigation for this project have been uploaded to the NZTA Acoustics website[3].

In the Transit Guidelines there is an average noise design criterion. For each location by a road, the average noise design level relates to the existing ambient noise level, as shown in Table 3-2.

[3] http://www.acoustics.nzta.govt.nz

3 Road-traffic noise

Table 3-2 Transit Guidelines - design levels

Noise Area	Ambient Noise Level*	Average Noise Design Level*
Low	Less than 40.5 dB $L_{Aeq(24h)}$ 40.5 – 47.5 dB $L_{Aeq(24h)}$	52.5 dB $L_{Aeq(24h)}$ Ambient + 12 dB
Medium	47.5 – 56.5 dB $L_{Aeq(24h)}$	59.5 dB $L_{Aeq(24h)}$
High	56.5 – 64.5 dB $L_{Aeq(24h)}$ 64.5 – 67.5 dB $L_{Aeq(24h)}$ More than 67.5 dB $L_{Aeq(24h)}$	Ambient + 3 dB 67.5 dB $L_{Aeq(24h)}$ Ambient

*Levels adjusted to free-field levels for consistency with NZS 6806. Original façade levels are 2.5 dB higher.

3.1.3 Kapiti Coast District Plan

The Kapiti Coast District Plan contains a series of objectives, policies and rules detailing the requirement to manage the effects of road-traffic noise on noise-sensitive activities in areas zoned rural in the district plan. This zoning is different to the Statistics New Zealand areas shown in Figure 3-1 and the majority of the PPFs for this project are in district plan rural zoned areas, with the exception of the residential and commercial zones in Otaki, which are highlighted in Figure 3-6.

Controlled Activity Standard D.2.2.2 for the Rural Zone states that new roads with a traffic volume exceeding 5,000 vehicles per day (AADT) shall be designed and constructed so that traffic noise levels at 10 years following opening of the route shall not exceed the noise limits in Table 3-2. The values in the District Plan are presented as façade levels which are 2.5 dB higher, consistent with Transit Guidelines. While Transit Guidelines are not referenced in the District Plan, the limits presented are identical.

Figure 3-6 District plan zones

3.2 Predictions

A detailed acoustics model has been developed to predict road-traffic noise. This section details the modelling procedure, inputs, and assumptions.

3 Road-traffic noise

Procedures

Prior to considering noise mitigation, existing, do-nothing and do-minimum noise levels were predicted at all PPFs. Predictions were made at all facades of individual buildings, with the building level stated being the highest of any facade. After identifying all PPFs which were in NZS 6806 categories B and C, the project was split into seven assessment areas labelled Areas A to G. The locations of the assessment areas are shown in Figure 3-7.

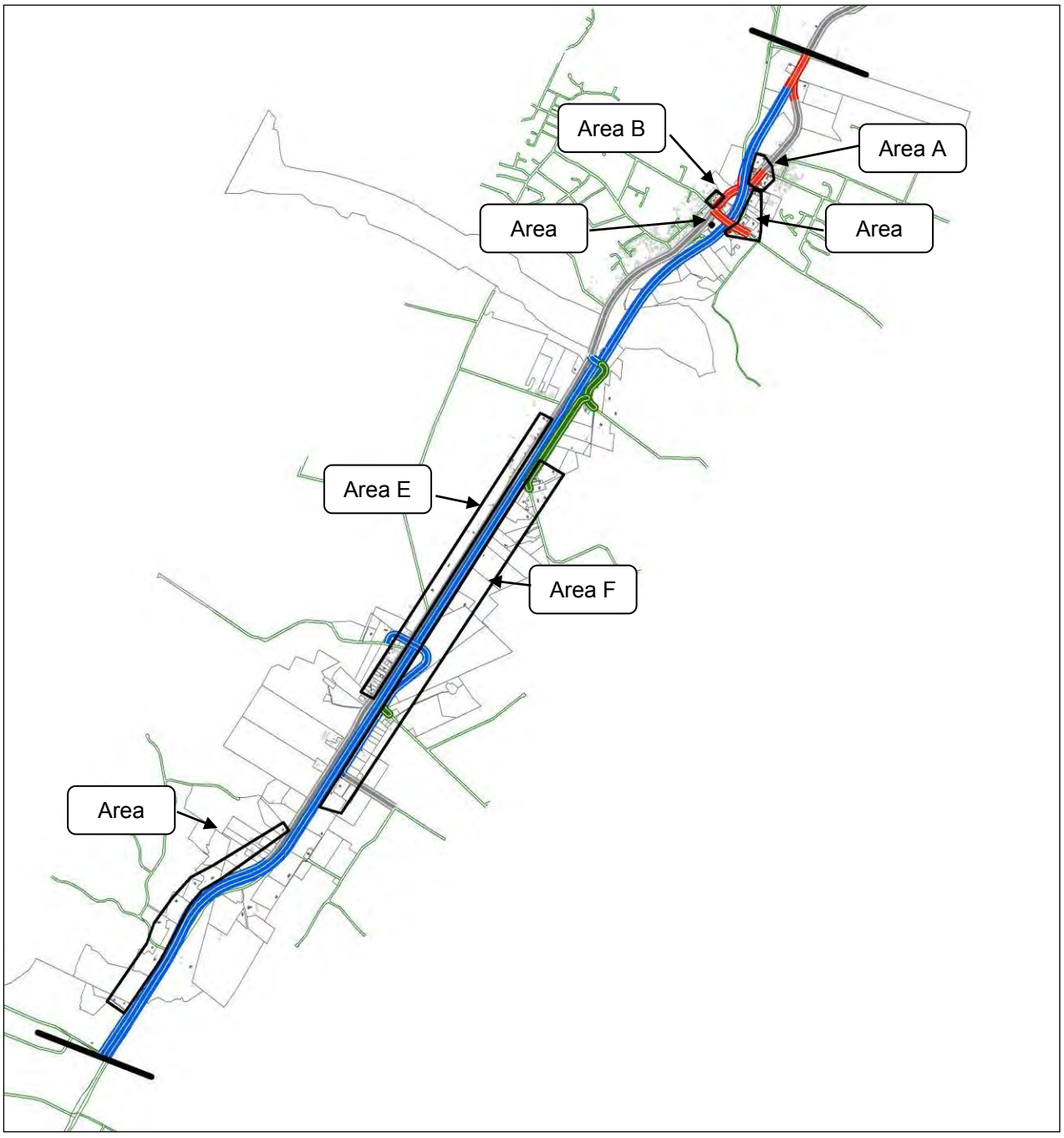


Figure 3-7 Assessment areas

3 Road-traffic noise

The noise mitigation options considered for each area are detailed in Table 3-3 and a summary matrix of all the assessment scenarios considered is provided in Table 3-4.

Table 3-3 Mitigation options

Area	Project section	Noise mitigation options
A	North of Otaki Ramp	1. 3 m high barrier roadside of expressway 2. 5 m high barrier roadside of expressway 3. Open graded porous asphalt surface to expressway 4. Open graded porous asphalt surface to expressway and 3 m high barriers
B	Main Street, Otaki	1. 2 m high barrier on property boundary 2. Asphaltic concrete surface to local arterial
C	230 Main Highway, Otaki	1. 5 m high barrier railside 2. 3 m high barrier roadside of expressway 3. Open graded porous asphalt surface to expressway
D	East Otaki	1. 3 m high barrier roadside of expressway 2. Open graded porous asphalt surface to expressway 3. Open graded porous asphalt surface to expressway, asphaltic concrete to Rahui Road and 3 m high barriers
E	Otaki Gorge to Te Horo (West)	1. 3 m high barriers roadside of expressway 2. 5 m high roadside of local road 3. Open graded porous asphalt surface to expressway 4. Open graded porous asphalt surface to expressway and new local arterial
F	Otaki Gorge to Te Horo (East)	1. 3 m high barriers roadside of expressway 2. 5 m high barriers outside of swale 3. Open graded porous asphalt surface to expressway 4. Building modification to Category C PPFs 5. Combination of 3, 4 and 5 metre high barriers roadside of expressway to meet Transit Guidelines
G	South of Marycrest	1. 3 m high barriers roadside of expressway 2. 5 m high barriers roadside of local road 3. Open graded porous asphalt surface to expressway 4. 3 m high barriers roadside of expressway to meet Transit Guidelines

3 Road-traffic noise

Table 3-4 Assessment scenarios

Scenario	Year	Assessment Area						
		A	B	C	D	E	F	G
Existing	2010	✓	✓	✓	✓	✓	✓	✓
Do-nothing	2026	✓	✓	✓	✓	✓	✓	✓
Do-minimum	2026	✓	✓	✓	✓	✓	✓	✓
Mitigation Option 1	2026	✓	✓	✓	✓	✓	✓	✓
Mitigation Option 2	2026	✓	✓	✓	✓	✓	✓	✓
Mitigation Option 3	2026	✓		✓	✓	✓	✓	✓
Mitigation Option 4	2026	✓				✓	✓	✓
Mitigation Option 5	2026						✓	

Software and settings

Table 3-5 lists the key model settings.

Table 3-5 Model settings

Parameter	Setting/source
Software	Cadna/A v4.1.137
Algorithm	CRTN[4]
Parameter	$L_{Aeq(24h)}$ (taken as $L_{10(18h)}$ – 3 dB)
Receiver height	1.5 m (4.5 m upper floors) – most exposed façade
Sound contour grid height	1.5 m
Sound contour grid resolution	20 m
Buildings	Within 200 metres of alignment
Receivers and grid position	Free-field

The 2026 traffic volumes used in this assessment are presented in Table 3-6, based on traffic modelling from the MacKays to Peka Peka Alliance. NZS 6806 requires a design year of 10–20 years after the expected opening to be used, however this information was not available at the time of the report. A design year of 2031 will be used during the AEE. Traffic data in 2010 was not available for Gear Road, and has not been included in the modelling of the 'existing' scenario.

[4] Calculation of Road Traffic Noise (CRTN). UK Department of Transport and the Welsh Office. ISBN 0115508473. 1988

3 Road-traffic noise

Table 3-6 Road surface and traffic parameters

	Existing (2010)				Do-nothing (2026)				Do-minimum (2026)			
Section	**Surface**	**Speed**	**AADT**	**HV**	**Surface**	**Speed**	**AADT**	**HV**	**Surface**	**Speed**	**AADT**	**HV**
Expressway												
North of Taylors Road	Grade 2/4	100 kph	16,800	10	Grade 2/4	100	17,204	11.9	Grade 2/4	100	17,152	23.6
Otaki on-ramp NB									Grade 2/4	70	2,984	24.5
Otaki off-ramp SB									Grade 2/4	70	3,088	23.3
North of Otaki on-ramp NB									Grade 2/4	70	8,738	24.3
North of Otaki on-ramp SB									Grade 2/4	70	5,505	22.3
North of Otaki Gorge Road NB									Grade 2/4	100	5,755	24.2
North of Otaki Gorge Road SB									Grade 2/4	100	5,505	22.3
Otaki Gorge off-ramp NB									Grade 2/4	70	3,807	30.5
Otaki Gorge on-ramp SB									Grade 2/4	70	3,782	32.1
North of Peka Peka Road NB									Grade 2/4	100	9,562	26.7
North of Peka Peka Road SB									Grade 2/4	100	9,287	26.3
New local arterial												
South of Te Manuao Rd	Grade 2/4	50	16,800	10	Grade 2/4	50	18,221	12.2	Grade 2/4	50	5,514	17.0
North of Mill Road	Grade 2/4	50	16,800	10	Grade 2/4	50	18,221	12.2	Grade 2/4	50	7,763	20.6
North of Riverbank Road	Grade 2/4	50-70	16,800	10	Grade 2/4	50–70	19,208	17.9	Grade 2/4	50–70	4,682	24.1
North of Otaki Gorge Road	Grade 2/4	100	16,800	10	Grade 2/4	100	21,686	20.5	Grade 2/4	100	9,711	27.5
North of School Road	Grade 2/4	100	16,800	10	Grade 2/4	100	21,283	22.8	Grade 2/4	100	2,673	18.7
Mary Crest	Grade 2/4	80	16,800	10	Grade 2/4	80	21,426	24.2	Grade 2/4	80	3,727	18.7
North of Peka Peka Road	Grade 2/4	100	16,800	10	Grade 2/4	100	21,398	24.4	Grade 2/4	100	4,268	16.9
Local roads												
Rahui Road	Grade 2/4	50	2488	2.5	Grade 2/4	50	3451	24	Grade 2/4	50	3451	24
Overbridge at Otaki Gorge Rd					Grade 2/4				Grade 2/4	50	4,510	28.4
Gear Rd	Grade 2/4	N/A	N/A	N/A	Grade 2/4	50	2,444	11.9	Grade 2/4	50	2,661	17.1
Overbridge at School Rd					Grade 2/4				Grade 2/4	50	4,211	15.8

Road-traffic noise has not been considered from the following roads as the design year AADT is less than 2000 vpd.

Table 3-7 Excluded roads

Road	AADT (do-minimum)
Otaki Gorge Road	520
Old Hautere Road	501
School Road	1668

Input data

- Topographic contours have been imported directly from the project GIS at 1 metre intervals.
- Building outlines have been imported from KCDC and two-story building identified from Google Streetview. All buildings have been modelled as 5 metres uniform height for single storey buildings and 7.5 metres uniform height for two storey buildings.
- Road alignments have been imported from the project GIS as centrelines and road widths. Each two-lane carriageway has been modelled as a separate road. Gradients have been calculated by the acoustics software, and have been manually disabled for downhill sections. On and off ramps have been modelled as a separate road. The existing state highway and local arterial roads only have one lane in each direction so these have each been modelled as a single road.
- All bridges have been configured to be 'self-screening' roads, which blocks the sound of that road passing through them. All bridges have been designed with an 800 mm high concrete safety barrier along the edges of the bridges.
- Surfaces of existing roads have been assumed to be a chip seal, and have been modelled as a grade 2/4 seal. For all new roads the do-minimum scenario has assumed that all parts of the road will be a grade 2/4 chip seal. In investigating mitigation options alternative surfaces have been tested in the acoustics model. The road surface correction includes a –2 dB adjustment for a reference asphaltic concrete road surface[5], and corrections for other surfaces have been calculated separately[6]. A –3 dB correction is required to covert the CRTN output of $L_{A10(18h)}$ to the NZS 6806 assessment criteria $L_{Aeq(24h)}$. This has also been included in the road-surface correction.
- Traffic data has been provided for all roads as the Average Annual Daily Traffic (AADT) and percentage of heavy vehicles. This has been provided separately for each carriageway. All traffic data has been provided for the design year of 2026, together with existing data for 2010.

[5] Research Report 28. Traffic noise from uninterrupted traffic flows, Transit, 1994
[6] Research Report 326: Road surface effects on traffic noise: Stage 3 – Selected bituminous mixes. Land Transport New Zealand, 2007

3.3 Results

Predicted road-traffic noise levels at all PPFs are shown in Table 3-8. The cells are colour coded according to the NZS 6806 category: category A – green, category B – orange, and category C - red. Noise contour plots for the indicative BPO are presented in Appendix C.

The development of the indicative BPO shown in this table is detailed in the following section. It is important to note that these levels only include contributions from the expressway, and parts of the local arterial where the alignment will be altered. Area 'X' receivers have not been considered for noise mitigation because they either meet category A in the do-minimum scenario, or they exceed the 100/200 m PPF catchment distance by a small margin. While NZS 6806 does not require these to be assessed, these have been listed for completeness.

Table 3-8 Predicted noise levels, dB $L_{Aeq(24h)}$

Area	Address	Type	Existing (2010)	Do-nothing (2026)	Do-minimum (2026)	Indicative BPO (2026)
A	266 Main Hwy	Altered	58 dB	59 dB	58 dB	56 dB
A	268 Main Hwy	Altered	69 dB	69 dB	66 dB	65 dB
A	270 Main Hwy	Altered	53 dB	53 dB	53 dB	52 dB
A	270B Main Hwy	Altered	52 dB	53 dB	52 dB	50 dB
A	272 Main Hwy	Altered	52 dB	53 dB	52 dB	50 dB
A	270A Main Hwy bld1	Altered	69 dB	70 dB	64 dB	64 dB
A	270A Main Hwy bld2	Altered	68 dB	68 dB	64 dB	63 dB
A	270A Main Hwy bld5	Altered	67 dB	68 dB	64 dB	63 dB
A	270A Main Hwy bld6	Altered	58 dB	59 dB	55 dB	54 dB
A	270A Main Hwy bld7	Altered	54 dB	54 dB	53 dB	51 dB
A	270A Main Hwy bld8	Altered	52 dB	53 dB	50 dB	49 dB
A	270A Main Hwy bld9	Altered	51 dB	51 dB	50 dB	48 dB
A	270A Main Hwy bld4	Altered	52 dB	52 dB	51 dB	49 dB
A	270A Main Hwy bld3	Altered	58 dB	58 dB	55 dB	55 dB
A	276 Main Hwy	Altered	67 dB	68 dB	60 dB	59 dB
A	3C Te Manuao Rd	Altered	54 dB	54 dB	51 dB	50 dB
A	3A Te Manuao Rd	Altered	52 dB	52 dB	49 dB	47 dB
A	3B Te Manuao Rd	Altered	52 dB	52 dB	48 dB	45 dB
A	5 Te Manuao Rd	Altered	50 dB	51 dB	47 dB	45 dB
A	269 Main Hwy	Altered	64 dB	65 dB	64 dB	60 dB
A	273 Main Hwy	Altered	65 dB	65 dB	60 dB	60 dB
A	275A Main Hwy	Altered	53 dB	53 dB	66 dB	62 dB
A	277A Main Hwy	Altered	51 dB	52 dB	66 dB	62 dB
A	271 Main Hwy	Altered	55 dB	56 dB	64 dB	60 dB
A	275 Main Hwy	Altered	66 dB	66 dB	60 dB	60 dB
A	277 Main Hwy	Altered	64 dB	65 dB	55 dB	55 dB
A	281 Main Hwy	Altered	64 dB	65 dB	54 dB	53 dB
A	283 Main Hwy	Altered	63 dB	64 dB	52 dB	49 dB

3 Road-traffic noise

Area	Address	Type	Existing (2010)	Do-nothing (2026)	Do-minimum (2026)	Indicative BPO (2026)
A	285 Main Hwy	Altered	65 dB	65 dB	51 dB	50 dB
A	287 Main Hwy	Altered	62 dB	62 dB	53 dB	50 dB
A	291 Main Hwy	Altered	51 dB	51 dB	60 dB	57 dB
A	291A Main Hwy	Altered	54 dB	54 dB	56 dB	53 dB
A	286 Main Highway	Altered	67 dB	68 dB	53 dB	52 dB
B	17 Hariata St	Altered	51 dB	52 dB	51 dB	50 dB
B	15 Hariata St	Altered	56 dB	57 dB	56 dB	55 dB
B	9 Mill Rd	Altered	57 dB	58 dB	57 dB	56 dB
B	5 Hariata St	Altered	52 dB	52 dB	52 dB	51 dB
B	1 Hariata St	Altered	49 dB	50 dB	50 dB	48 dB
B	280 Mill Rd	Altered	54 dB	56 dB	53 dB	52 dB
B	282 Mill Rd	Altered	56 dB	57 dB	55 dB	52 dB
B	286 Mill Rd	Altered	70 dB	71 dB	67 dB	67 dB
B	288 Mill Rd	Altered	68 dB	68 dB	65 dB	60 dB
B	290-292 Mill Rd	Altered	69 dB	70 dB	66 dB	61 dB
B	294-296 Mill Rd	Altered	68 dB	68 dB	65 dB	61 dB
C	230 Main Hwy	New	55 dB	57 dB	59 dB	56 dB
D	46 County Rd	New	55 dB	56 dB	62 dB	59 dB
D	50 County Rd	Altered	58 dB	58 dB	58 dB	56 dB
D	52 County Rd	Altered	51 dB	51 dB	53 dB	52 dB
D	26 County Rd	New	47 dB	48 dB	54 dB	52 dB
D	22 County Rd	New	49 dB	50 dB	58 dB	54 dB
D	12 County Rd	Altered	49 dB	50 dB	58 dB	55 dB
D	60 Rahui Rd	Altered	47 dB	49 dB	51 dB	49 dB
D	66 Rahui Rd	Altered	60 dB	63 dB	54 dB	53 dB
D	64 Rahui Rd	Altered	56 dB	59 dB	51 dB	51 dB
D	62 Rahui Rd	Altered	57 dB	60 dB	55 dB	55 dB
D	58 Rahui Rd	Altered	57 dB	60 dB	58 dB	57 dB
D	56 Rahui Rd	Altered	58 dB	61 dB	60 dB	60 dB
D	54 Rahui Rd	Altered	59 dB	62 dB	63 dB	63 dB
D	52 Rahui Rd	Altered	59 dB	62 dB	64 dB	63 dB
D	35 Rahui Rd (Old Dairy Factory)	Altered	60 dB	63 dB	66 dB	62 dB
E	901 SH1	Altered	66 dB	68 dB	62 dB	58 dB
E	903 SH1	Altered	65 dB	67 dB	62 dB	58 dB
E	907 SH1	Altered	66 dB	69 dB	63 dB	58 dB
E	913 SH1	Altered	66 dB	69 dB	62 dB	58 dB
E	893 SH1	Altered	61 dB	63 dB	59 dB	55 dB
E	899 SH1	Altered	59 dB	60 dB	58 dB	54 dB
E	901A SH1	Altered	56 dB	58 dB	56 dB	52 dB
E	909 SH1	Altered	69 dB	72 dB	64 dB	60 dB
E	915 SH1	Altered	69 dB	72 dB	63 dB	59 dB

3 Road-traffic noise

Area	Address	Type	Existing (2010)	Do-nothing (2026)	Do-minimum (2026)	Indicative BPO (2026)
E	915A SH1	Altered	57 dB	60 dB	57 dB	53 dB
E	921 SH1	Altered	59 dB	62 dB	59 dB	54 dB
E	931 SH1	Altered	66 dB	69 dB	62 dB	58 dB
E	939 SH1	Altered	63 dB	66 dB	60 dB	56 dB
E	941 SH1	Altered	65 dB	68 dB	62 dB	57 dB
E	3 Te Horo Beach Rd	Altered	65 dB	68 dB	62 dB	58 dB
E	3 Te Horo Beach Rd	Altered	53 dB	56 dB	56 dB	52 dB
E	11 Te Horo Beach Rd	Altered	53 dB	55 dB	55 dB	52 dB
E	13 Te Horo Beach Rd	Altered	52 dB	55 dB	54 dB	53 dB
E	961 SH1	Altered	68 dB	71 dB	63 dB	59 dB
E	12 Te Waka Rd	Altered	61 dB	62 dB	59 dB	55 dB
E	1039 SH1	Altered	61 dB	62 dB	59 dB	55 dB
E	1081 SH1	Altered	64 dB	66 dB	61 dB	56 dB
E	1083 SH1	Altered	69 dB	70 dB	62 dB	58 dB
E	1081 SH1	Altered	57 dB	58 dB	56 dB	52 dB
E	1115 SH1	Altered	67 dB	69 dB	62 dB	57 dB
E	1127 SH1	Altered	66 dB	67 dB	61 dB	56 dB
E	1147 SH1	Altered	68 dB	70 dB	61 dB	57 dB
E	1149 SH1	Altered	68 dB	69 dB	61 dB	56 dB
E	1149 SH1	Altered	68 dB	69 dB	61 dB	56 dB
E	1153 SH1	Altered	66 dB	67 dB	59 dB	54 dB
E	1155 SH1	Altered	57 dB	59 dB	55 dB	51 dB
E	1165 SH1	Altered	69 dB	71 dB	60 dB	56 dB
E	1167 SH1	Altered	68 dB	70 dB	59 dB	55 dB
E	1169 SH1	Altered	69 dB	70 dB	60 dB	55 dB
E	1171 SH1	Altered	69 dB	71 dB	60 dB	56 dB
E	1173 SH1	Altered	66 dB	68 dB	59 dB	55 dB
E	1189 SH1	Altered	68 dB	69 dB	60 dB	55 dB
E	1191 SH1	Altered	68 dB	70 dB	60 dB	55 dB
E	1195 SH1	Altered	67 dB	68 dB	60 dB	55 dB
E	1209 SH1	Altered	67 dB	68 dB	58 dB	54 dB
E	1215 SH1	Altered	66 dB	68 dB	58 dB	54 dB
E	1217 SH1	Altered	58 dB	59 dB	55 dB	50 dB
F	80 Gear Rd	New	59 dB	60 dB	65 dB	60 dB
F	82 Gear Rd	New	57 dB	58 dB	61 dB	57 dB
F	97 Gear Rd	New	62 dB	63 dB	56 dB	53 dB
F	63 Gear Road	New	61 dB	63 dB	59 dB	56 dB
F	45 Gear Rd	New	58 dB	59 dB	63 dB	60 dB
F	30 School Rd	New	56 dB	57 dB	63 dB	59 dB
F	34 School Rd	New	54 dB	56 dB	60 dB	56 dB
F	990B SH1	New	54 dB	55 dB	58 dB	54 dB
F	56 Old Hautere Road	New	54 dB	55 dB	58 dB	53 dB

3 Road-traffic noise

Area	Address	Type	Existing (2010)	Do-nothing (2026)	Do-minimum (2026)	Indicative BPO (2026)
F	22 Old Hautere Road	New	55 dB	57 dB	60 dB	56 dB
F	28 Old Hautere Road	New	55 dB	56 dB	59 dB	54 dB
F	14 Old Hautere Road	New	59 dB	60 dB	67 dB	63 dB
F	9 Old Hautere Road	New	56 dB	58 dB	61 dB	57 dB
F	15 Old Hautere Road	New	54 dB	55 dB	57 dB	52 dB
F	11 Old Hautere Rd	New	53 dB	55 dB	56 dB	51 dB
F	19 Old Hautere Rd	New	53 dB	54 dB	56 dB	52 dB
F	36 Old Hautere Rd	New	54 dB	55 dB	57 dB	53 dB
F	33 Old Hautere Rd	New	53 dB	54 dB	55 dB	51 dB
F	23 Old Hautere Rd	New	51 dB	52 dB	53 dB	48 dB
F	46 Old Hautere Rd	New	53 dB	54 dB	56 dB	51 dB
F	1070 SH1	New	57 dB	58 dB	63 dB	58 dB
G	497 SH1 (bld2)	New	57 dB	59 dB	61 dB	61 dB
G	497 SH1 (bld1)	New	55 dB	56 dB	58 dB	58 dB
G	551 SH1	New	60 dB	61 dB	63 dB	63 dB
G	25 Te Hapua Rd	New	57 dB	59 dB	60 dB	60 dB
G	36 Te Hapu Rd	New	55 dB	56 dB	57 dB	57 dB
G	621 SH1	New	57 dB	58 dB	61 dB	61 dB
G	633 SH1	New	46 dB	48 dB	50 dB	50 dB
G	635 SH1	New	48 dB	49 dB	52 dB	52 dB
G	737 SH1	Altered	63 dB	65 dB	61 dB	56 dB
X	18-20 Te Kowhai Road	New	56 dB	57 dB	57 dB	57 dB
X	564 SH1	New	48 dB	50 dB	52 dB	52 dB
X	670 SH1	New	57 dB	58 dB	57 dB	57 dB
X	664 SH1	New	56 dB	57 dB	56 dB	55 dB
X	33 Sutton Rd	New	55 dB	56 dB	57 dB	56 dB
X	35 Sutton Rd	New	57 dB	58 dB	60 dB	59 dB
X	38 Sutton Rd	New	54 dB	56 dB	59 dB	56 dB
X	36 Sutton Rd	New	55 dB	56 dB	59 dB	55 dB
X	32 Otaki Gorge Rd	New	55 dB	56 dB	56 dB	54 dB
X	34 Otaki Gorge Rd	New	52 dB	54 dB	53 dB	52 dB
X	1277 SH1	Altered	61 dB	63 dB	55 dB	55 dB
X	151-153 Main Hwy	Altered	68 dB	69 dB	59 dB	59 dB
X	12 Dunstan St	Altered	53 dB	54 dB	50 dB	47 dB
X	260 Main Hwy (Otaki Motel 2)	Altered	61 dB	62 dB	59 dB	59 dB
X	260 Main Hwy (Otaki Motel)	Altered	64 dB	64 dB	61 dB	61 dB
X	299 State Hwy	Altered	63 dB	63 dB	49 dB	46 dB
X	82 State Hwy	Altered	59 dB	59 dB	59 dB	59 dB
X	85 State Hwy	Altered	61 dB	62 dB	62 dB	62 dB
X	115 State Hwy	Altered	63 dB	64 dB	60 dB	60 dB
X	134 State Hwy	Altered	71 dB	72 dB	55 dB	55 dB

Area	Address	Type	Existing (2010)	Do-nothing (2026)	Do-minimum (2026)	Indicative BPO (2026)
X	139 State Hwy	Altered	65 dB	65 dB	51 dB	51 dB
X	141 State Hwy	Altered	67 dB	67 dB	51 dB	51 dB
X	143 State Hwy	Altered	68 dB	68 dB	51 dB	51 dB
X	12 Te Horo Beach Rd	Altered	52 dB	55 dB	57 dB	55 dB
X	40 Te Horo Beach Rd	Altered	50 dB	52 dB	53 dB	50 dB
X	53 Otaki Gorge Rd	New	51 dB	53 dB	53 dB	52 dB
X	65 Otaki Gorge Rd	New	50 dB	51 dB	51 dB	50 dB
X	44 Otaki Gorge Rd	New	51 dB	52 dB	52 dB	50 dB
X	38 Otaki Gorge Rd	New	53 dB	54 dB	54 dB	51 dB

3.4 Mitigation options

For each mitigation option listed in Table 3-3 the road-traffic noise levels have been predicted and benefit-cost ratio (BCR) calculated. For calculating the BCR, the local arterial has been included in the noise model, even where the alignment is not being altered. On the basis of this analysis and the four assessment factors detailed below, an indicative mitigation measure has been selected. This section describes the indicative mitigation measures and the reasons for the selection. The indicative option is shaded in the assessment matrices. Full details of the options considered are provided in Appendix A.

The following matrix has been used to determine four objective assessment factors for each mitigation option considered.

Table 3-9 Acoustics assessment matrix

Impact Key	NZS 6806 compliance	Structural mitigation	BCR	Transit Guidelines Cost (for NZTA internal monitoring)
+ + +	All in Cat A	> 5 dB	>1.5	< -30%
+ +	Cat A & 5% or fewer in Cat B	5 dB	1.25-1.5	-21% to -30%
+	All in Cat A or B	4 dB	1-1.24	-11% to -20%
o	-	3 dB	0.75-0.99	-10% to 10%
-	5% or fewer in Cat C	2 dB	0.5-0.74	11% to 20%
- -	10% or fewer in Cat C	1 dB	0.25-0.49	21% to 30%
- - -	More than 10% in Cat C	0 dB	<0.25	> 30%

The key in Figure 3-8 explains the symbology used in the mitigation diagrams in this section.

3 Road-traffic noise

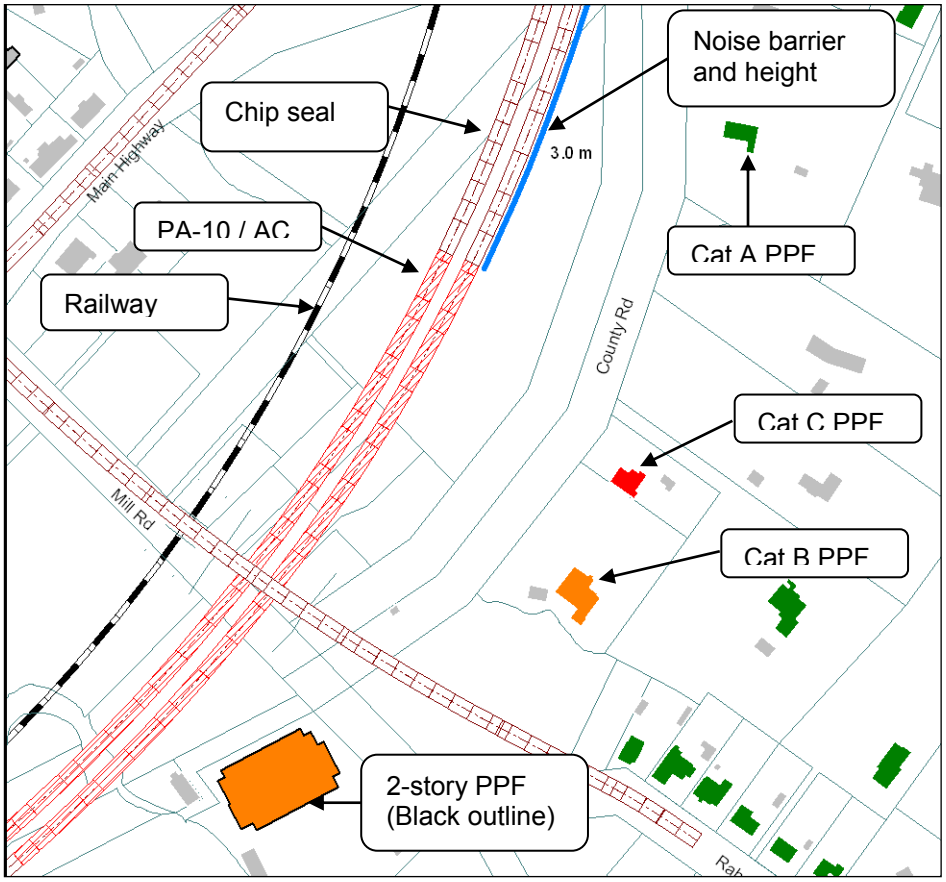


Figure 3-8 Mitigation diagram key

3 Road-traffic noise

3.4.1 Otaki Township

Area A – North Otaki

In this area, the main alignment passes under Bridge 2 where the local arterial follows the alignment of the existing state highway. Properties are subject to noise from both the expressway and the local arterial.

Options considered include roadside noise barriers along the expressway, including options with a barrier on the median strip, and the use of low-noise road surfaces. The expressway is in cut relative to the nearest properties, reducing the effect of roadside noise barriers. The position of houses at the top of the cut prevents barriers in that location.

The indicative mitigation option for this location is the use of low-noise road surface (OGPA/PA-10). The reasons are:

- All PPFs are category A (altered road) with the exception of two properties which front the local arterial.
- The barriers tested do not provide efficient mitigation due to the topography.
- The use of noise barriers for Area D immediately to the south is not effective, and therefore the continuation of low-noise road surface from Area D into Area A has practical benefits.

Figure 3-9 Area A – North Otaki – indicative option

3 Road-traffic noise

Table 3-10 Assessment matrix – Area A – North Otaki

	Existing	Do-Nothing	Do-minimum	Option 1	Option 2	Option 3	Option 4
Road surface	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	420 m × PA-10	315 m × PA-10
Barriers				300 m × 3 m	300 m × 5 m		280 m × 3 m
Key parameters							
PPFs Cat A	23	20	28	30	31	31	31
PPFs Cat B	7	7	5	3	2	2	2
PPFs Cat C	3	6	0	0	0	0	0
Cost				$120,000	$150,000	$147,000	$222,600
Benefit				$252,720	$312,768	$313,848	$329,184
BCR				2.11	2.09	2.14	1.48
Meets Transit Guidelines			No	No	No	No	Yes
Acoustics assessment							
Compliance with NZS 6806 noise criteria, and requirement for building-modification measures				+	+	+	+
Achievement of the NZS 6806 structural mitigation performance standards				-	-	-	-
Value for money, including maintenance costs and consideration of benefit cost analysis				+++	+++	+++	++
Difference in cost compared to Transit Guidelines (criteria for NZTA internal monitoring purposes)				+++	+++	+++	N/A

3 Road-traffic noise

Area B – Main Street

The extent of work for this project includes Main Street in Otaki to just north of Mill Road. There are four properties to the west of Main Street which are category C without mitigation. A 2 metre high noise barrier has been selected as the preferred option. This is likely to be a solid timber fence. There is currently a boundary fence in this location, however there are a large number of gaps and it would not provide a high degree of noise reduction. Access to all four properties is from Mill Road, although the legal status of this needs to be confirmed.

The reasons for this selection are:

- Three of the four PPFs become category A (altered road). The fourth property is a two-story building and becomes category B
- The barrier would replace an existing fence so should not have any significant impacts.

Figure 3-10 Area B – Otaki Main Street – indicative option

3 Road-traffic noise

Table 3-11 Assessment matrix – Area B – Otaki Main Street

	Existing	Do-Nothing	Do-minimum	Option 1	Option 2
Road surface	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	440 m × AC
Barriers				115 m × 2 m	
Key parameters					
PPFs Cat A	7	7	7	10	11
PPFs Cat B	0	0	4	1	0
PPFs Cat C	4	4	0	0	0
Cost				$27,360	$61,600
Benefit				$68,904	$119,664
BCR				2.52	1.94
Meets Transit Guidelines			Yes	Yes	Yes
Acoustics assessment					
Compliance with NZS 6806 noise criteria, and requirement for building-modification measures				++	+++
Achievement of the NZS 6806 structural mitigation performance standards				-	o
Value for money, including maintenance costs and consideration of benefit cost analysis				+++	+++
Difference in cost compared to Transit Guidelines (criteria for NZTA internal monitoring purposes)				---	---

3 Road-traffic noise

Area C - 230 Main Highway

This PPF does not form a cluster and is required by NZS 6806 to have a 5 dB reduction for any mitigation to be considered. The roadside and railside barriers considered do not provide this level of reduction. If this PPF was considered in isolation, the do-minimum would be maintained. This is indicated in the figure below.

However, if the recommended mitigation for areas A and D is adopted, this PPF will benefit from the selection of a low-noise road surface, and become category A.

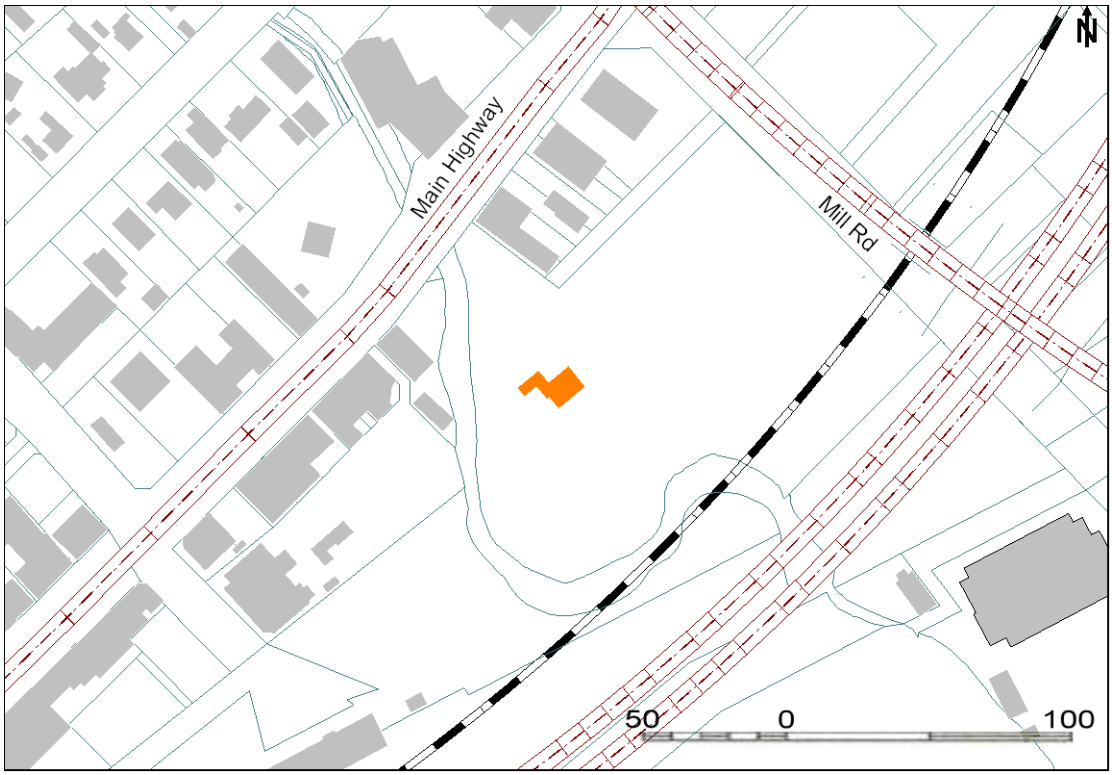


Figure 3-11 Area C – 230 Main Highway – do-minimum option

3 Road-traffic noise

Table 3-12 Assessment matrix – Area C – 230 Main Highway

	Existing	Do-Nothing	Do-minimum	Option 1	Option 2	Option 3
Road surface	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	250 m × PA-10
Barriers				200 m × 5 m	170 m × 3m	
Key parameters						
PPFs Cat A	1	1	0	1	1	1
PPFs Cat B	0	0	1	0	0	0
PPFs Cat C	0	0	0	0	0	0
Cost				$100,000	$68,000	$87,500
Benefit				$12,528	$9,072	$13,392
BCR				0.13	0.13	0.15
Meets Transit Guidelines			No	Yes	Yes	Yes
Acoustics assessment						
Compliance with NZS 6806 noise criteria, and requirement for building-modification measures				+++	+++	+++
Achievement of the NZS 6806 structural mitigation performance standards				o	o	o
Value for money, including maintenance costs and consideration of benefit cost analysis				---	---	---
Difference in cost compared to Transit Guidelines (criteria for NZTA internal monitoring purposes)				---	N/A	--

3 Road-traffic noise

Area D - East Otaki

The properties along County and Rahui Roads, including the Old Dairy Factory events centre, have been considered as a single assessment area. The predicted levels for properties on Rahui Road are significantly affected by the local road. All PPFs within 100 metres of Rahui Road are subject to altered road criteria.

Noise barriers immediately adjacent to the expressway have been considered along with low-noise road surfaces. The indicative mitigation option is low-noise road surface (PA-10) along this section of the expressway because:

- Barriers do not effectively screen both carriageways, as a number of the receivers are elevated.
- All PPFs will be categories A and B.
- The use of PA-10 allows a continuous solution through areas A and D

The BCR for PA-10 is poor and this option requires review at the mitigation workshop.

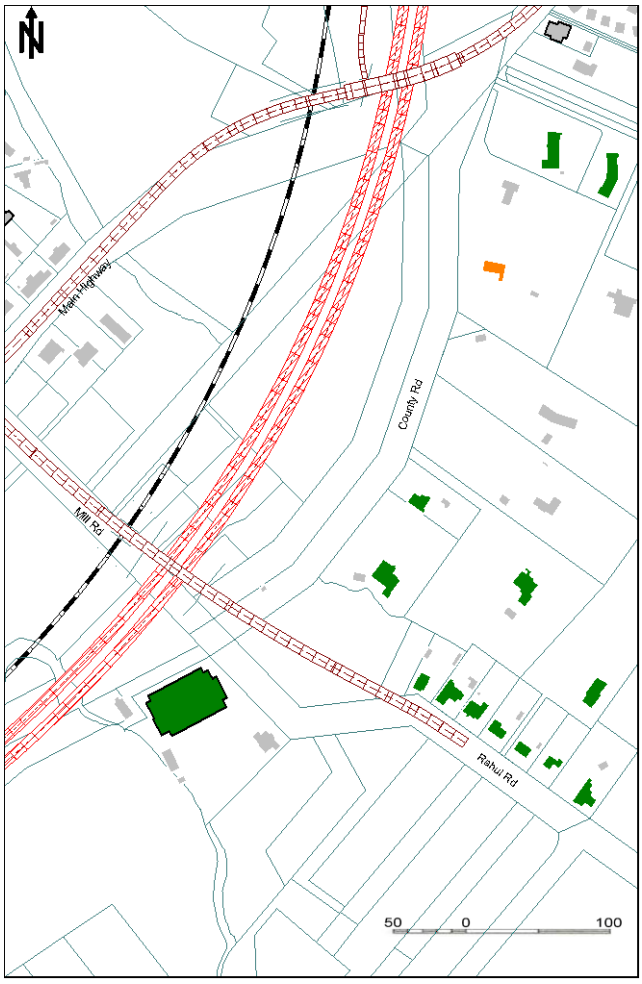


Figure 3-12 Area D – East Otaki – indicative option

3 Road-traffic noise

Table 3-13 Assessment matrix – Area D – East Otaki

	Existing	Do-Nothing	Do-minimum	Option 1	Option 2	Option 3
Road surface	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	630 m × PA-10	440 m × PA-10 + 420 m × AC-10
Barriers				365 m × 3 m		360 m × 3 m
Key parameters						
PPFs Cat A	15	15	12	14	14	14
PPFs Cat B	0	0	3	1	1	1
PPFs Cat C	0	0	0	0	0	0
Cost				$146,000	$220,500	$295,600
Benefit				$98,280	$145,530	$166,530
BCR				0.67	0.66	0.56
Meets Transit Guidelines			No	No	No	Yes
Acoustics assessment						
Compliance with NZS 6806 noise criteria, and requirement for building-modification measures				+	+	+
Achievement of the NZS 6806 structural mitigation performance standards				--	-	-
Value for money, including maintenance costs and consideration of benefit cost analysis				-	-	-
Difference in cost compared to Transit Guidelines (criteria for NZTA internal monitoring purposes)				+++	++	N/A

3.4.2 Otaki River to Te Horo

This area comprises two separate groups of PPFs: those to the west of the existing state highway which are currently subject to relatively high levels of road-traffic noise, and those to the east which generally have larger setbacks and a lower existing noise level. As discussed in Section 3.1.1, the altered and new road criteria will be applied to these groups respectively.

Area E – West

With the application of the altered road criteria, the majority of PPFs fall within Category A, including contributions from the local arterial. In developing the mitigation options, noise barriers of different heights were tested between the expressway and local arterial and also to the west of the local arterial. The application of a low-noise road surface to the expressway alone and also to the local arterial was investigated.

Area F – East

Most PPFs to the east are Category B. Noise barriers close to the road, and larger barriers on bunds set further back were tested, but did not prove to be efficient.

There are two Category C PPFs for the do-minimum scenario, which would require building-modification mitigation, unless other mitigation is implemented.

Combined

The use of a low-noise road surface (PA-10) results in a benefit to PPFs both east and west of the expressway. The BCR in accordance with NZS 6806 considering the benefit to both sides is 0.49, and while not a compelling economic case, suggests that this mitigation option could be considered further. At this stage, this has been selected as the indicative mitigation to ensure the costs are included.

3 Road-traffic noise

Figure 3-13 Areas E and F – north of Te Horo – indicative option

3 Road-traffic noise

Figure 3-14 Area E and F – Te Horo – Indicative option

3 Road-traffic noise

Table 3-14 Assessment matrix – Area E – Otaki Gorge to Te Horo (west)

	Existing	Do-Nothing	Do-minimum	Option 1	Option 2	Option 3	Option 4
Road surface	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	3750 m × PA-10	3750 m × PA-10 to expressway and arterial
Barriers				3600 m × 3 m	1250 m × 5 m		
Key parameters							
PPFs Cat A	15	13	37	42	40	41	42
PPFs Cat B	14	5	5	0	2	1	0
PPFs Cat C	13	24	0	0	0	0	0
Cost				$1,440,000	$1,233,540	$1,312,500	$1,968,750
Benefit				$567,864	$445,392	$588,168	$785,160
BCR				0.39	0.36	0.45	0.40
Meets Transit Guidelines			Yes	Yes	Yes	Yes	Yes
Acoustics assessment							
Compliance with NZS 6806 noise criteria, and requirement for building-modification measures				+	+	++	+++
Achievement of the NZS 6806 structural mitigation performance standards				-	-	-	+
Value for money, including maintenance costs and consideration of benefit cost analysis				--	--	--	--
Difference in cost compared to Transit Guidelines (criteria for NZTA internal monitoring purposes)				---	---	---	---

3 Road-traffic noise

Table 3-15 Assessment matrix – Area F – Otaki Gorge to Te Horo (east)

	Existing	Do-Nothing	Do-minimum	Option 1	Option 2	Option 3	Option 4	Option 5
Road surface	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	4400 m × PA-10	Grade 2/4 chip	Grade 2/4 chip
Barriers				2300 m × 3 m	1900 m × 5 m			120 m × 3 m 410 m × 4 m 745 m × 5 m
Building modification							2 PPFs	
Key parameters								
PPFs Cat A	16	13	6	11	12	12	6	8
PPFs Cat B	5	8	13	10	9	9	13	13
PPFs Cat C	0	0	2	0	0	0	2	0
Cost				$925,600	$1,469,565	$1,540,000	$30,000	$804,625
Benefit				$213,150	$239,820	$304,500	$13,020	$144,060
BCR				0.23	0.16	0.20	0.43	0.18
Meets Transit Guidelines			No	Yes	Yes	Yes	No	Yes
Acoustics assessment								
Compliance with NZS 6806 noise criteria, and requirement for building-modification measures				+	+	+	-	+
Achievement of the NZS 6806 structural mitigation performance standards				-	-	o	N/A	-
Value for money, including maintenance costs and consideration of benefit cost analysis				---	---	---	--	---
Difference in cost compared to Transit Guidelines (criteria for NZTA internal monitoring purposes)				-	---	---	+++	N/A

3 Road-traffic noise

Table 3-16 Assessment matrix – Otaki Gorge to Te Horo (combined)

	Existing	Do-Nothing	Do-minimum	Option 3
Road surface	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	PA-10
Barriers				
Key parameters				
PPFs Cat A	31	26	43	53
PPFs Cat B	19	13	18	10
PPFs Cat C	13	24	2	0
Cost				$ 1,837,500
Benefit				$ 892,668
BCR				0.49
Meets Transit Guidelines			No	Yes
Acoustics assessment				
Compliance with NZS 6806 noise criteria, and requirement for building-modification measures				+
Achievement of the NZS 6806 structural mitigation performance standards				O
Value for money, including maintenance costs and consideration of benefit cost analysis				-
Difference in cost compared to Transit Guidelines (criteria for NZTA internal monitoring purposes)				---

3 Road-traffic noise

3.4.3 South of Marycrest

This area comprises a number of scattered properties generally remote from the local arterial and main alignment. None of the PPFs form a cluster. The dwellings to the west are generally raised and in some instances do not have line of sight to the project roads.

The preferred option is to maintain the do-minimum of grade 2/4 chip seal and no noise barriers, as:

- All PPFs are in NZS 6806 categories A and B,
- A barrier has limited effectiveness due to the topography, and
- Low-noise road surfaces have limited effectiveness unless extended over a significant length of the expressway and local arterial.

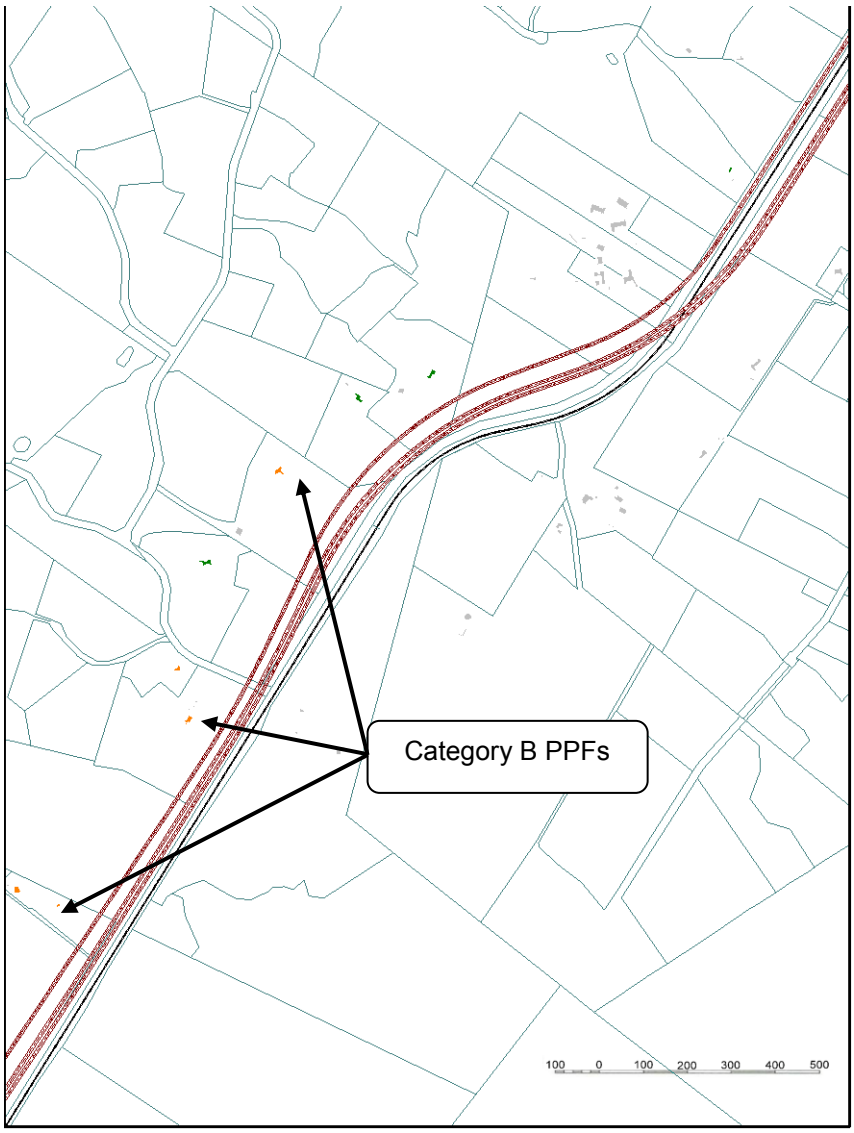


Figure 3-15 Area G – South of Marycrest - indicative option

3 Road-traffic noise

Table 3-17 Assessment matrix – Area G – South of Marycrest

	Existing	Do-Nothing	Do-minimum	Option 1	Option 2	Option 3	Option 4
Road surface	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	Grade 2/4 chip	2600 m × PA-10	Grade 2/4 chip
Barriers				1380 m × 3 m	740 m × 5 m		660 m × 3 m
Key parameters							
PPFs Cat A	8	4	3	4	5	5	3
PPFs Cat B	2	6	6	5	4	4	6
PPFs Cat C	0	0	0	0	0	0	0
Cost				$551,600	$368,500	$912,450	$265,600
Benefit				$55,296	$66,744	$91,152	$17,496
BCR				0.10	0.18	0.10	0.07
Meets Transit Guidelines			No	No	No	Yes	Yes
Acoustics assessment							
Compliance with NZS 6806 noise criteria, and requirement for building-modification measures				+	+	+	+
Achievement of the NZS 6806 structural mitigation performance standards				--	-	-	--
Value for money, including maintenance costs and consideration of benefit cost analysis				---	---	---	---
Difference in cost compared to Transit Guidelines (criteria for NZTA internal monitoring purposes)				---	---	---	N/A

3.5 Summary

Indicative mitigation has been selected using the process outlined in NZS 6806, with the results shown in Table 3-18.

Table 3-18 Indicative noise mitigation

Area	Project section	Indicative noise mitigation option
A	North of Otaki Ramp	Open graded porous asphalt surface to expressway
B	Main Street, Otaki	114 m long, 2 m high barrier on property boundary
C	230 Main Highway, Otaki	Open graded porous asphalt surface to expressway*
D	East Otaki	Open graded porous asphalt surface to expressway*
E	Otaki Gorge to Te Horo (West)	Open graded porous asphalt surface to expressway*
F	Otaki Gorge to Te Horo (East)	Open graded porous asphalt surface to expressway* OR building modification to 2 PPFs
G	South of Marycrest	Do-minimum

* Low BCR to be subject to further investigation.

The total length of open graded porous asphalt would be 6.3 km over the four lanes of the expressway.

4

Rain noise and vibration

4.1 Criteria

There are no standardised criteria for noise from rail lines in New Zealand. We understand that KiwiRail has been developing a reverse sensitivity policy. This policy has similar aims and methods to the NZTA reverse sensitivity policy. The KiwiRail policy includes a buffer area of up to 40 metres from the rail corridor, where development is discouraged, and a rail noise effects zone which continues up to 80 metres from the nearest track edge.

- Buffer zone. Noise and vibration effects may be significant and buildings to be designed to achieve 35 dB $L_{Aeq(1hr)}$ inside bedrooms, 40 dB $L_{Aeq(1hr)}$ inside other habitable spaces, and 60 dB $L_{Aeq(1hr)}$ in any primary outdoor amenity area. Vibration should achieve Class C vibration limits in NS 8176E:2005[7].
- Effects zone. Standard building construction will generally provide acceptable results, however consideration should be given to the amount of glazing on facades facing the railway.

This reverse sensitivity policy does not apply to new and altered railways, but the criteria do provide a reference.

4.2 Vibration

There are no PPFs within 40 metres of the rail corridor.

4.3 Predictions

Train noise levels have been predicted at four different distances, as shown in Table 4-1. This assumes a train noise level of 70 dB $L_{Aeq(1hr)}$ at 12 metres and 3 dB per doubling decay up to 30 metres from the track, and 6 dB per doubling thereafter.

Table 4-1 Predicted rail noise levels

Distance from track edge	Indicative rail noise level, $L_{Aeq(1h)}$
40 metres	64 dB
60 metres	60 dB
80 metres	58 dB
100 metres	56 dB

Only three PPFs fall within the 80 metre buffer zone, as shown in shown in Figure 4-1.

[7] Norwegian Standard NS 8176E:2005 *Measurement of vibration in buildings from landbased transport and guidance to evaluation of its effects on human beings*

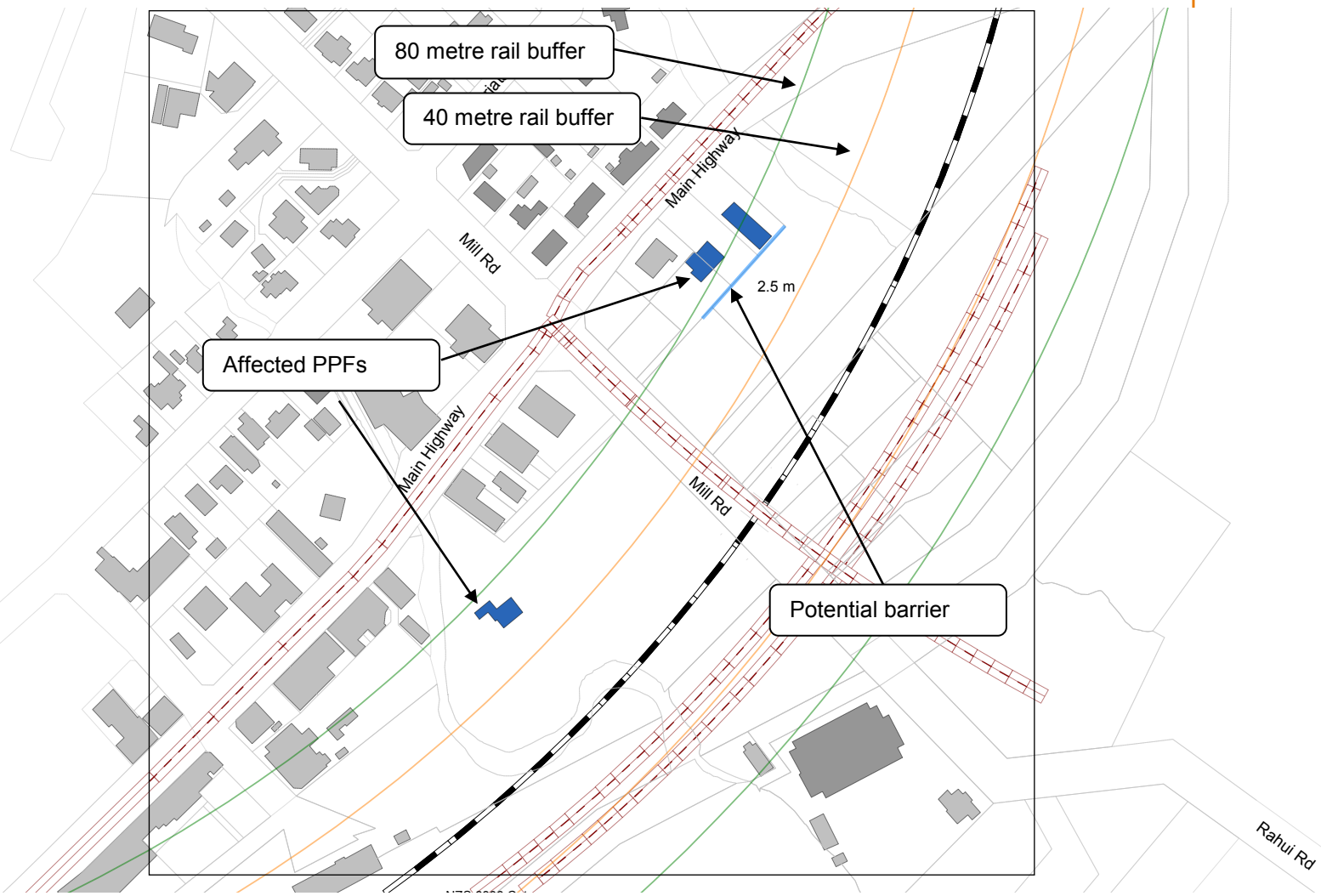


Figure 4-1 Railway buffer distance

4.4 Mitigation

Consideration should be given to providing a 2.5 metre high noise barrier (fence) on the property boundary of all PPFs within 80 metres of the railway. We note there is no obvious location for the noise barrier at 230 Main Highway. Inspection of the eastern facade is recommended in addition to consultation with the owner regarding potential barrier locations. Due to the height of locomotives it is considered impracticable to provide shielding adjacent to the rail corridor. This mitigation will be considered further during the AEE phase and will include consultation with KiwiRail, to confirm appropriate criteria. An indicative cost for barriers by the three PPFs is included in the PSF13 entry shown in Appendix B.

A reduction in road-traffic noise from the expressway will result from the introduction of the rail noise barrier. As the two motel buildings are already category A without mitigation, and subject to road-traffic noise from the local arterial, this benefit is expected to be minimal.

5

Addressing effects and meeting requirements

This section summarises the mitigation employed throughout the project to mitigate adverse noise effects in accordance with NZS 6806 and the rail noise criteria. Indicative costs are included in the PSF13 in Appendix B.

Table 5-1 Indicative BPO scenario – low-noise road surfaces

Location	Surface	Length
Otaki Township (01300-02350)	Open graded porous asphalt (PA-10)	1050 m
Te Horo Area (04350-09600)	Open graded porous asphalt (PA-10)	5250 m

Table 5-2 Indicative BPO scenario – barriers

Location	Side	Type	Length (m)	Height (m)
Otaki Main Street (road-traffic noise)	West	Timber	114	2.0
Otaki Motel (rail noise)	East	Timber	70	2.5

If a low noise surfaces is not adopted in the Te Horo area, building modification will be required at the properties listed in Table 5-3.

Table 5-3 Potential building modification requirements

Location
80 Gear Road
14 Old Hautere Road

6

Limitations

URS New Zealand Limited (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of the NZ Transport Agency connection with the designation of Peka Peka to North Otaki Expressway and the local roads. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Acoustics Scope dated July 2010.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between July 2011 and November 2011 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

A

Appendix A Mitigation options

Figure A-1 Area A – Do minimum

Figure A-2 Area A – Option 1 – 3 m high barrier roadside

Appendix A - Mitigation options

Figure A-3 Area A – Option 2 – 5 m high barrier

Figure A-4 Area A – Option 3 – PA-10 to expressway

Appendix A - Mitigation options

Figure A-5 Area A – Option 4 – PA-10 and 3 m high barrier

Appendix A - Mitigation options

Figure A-6 Area B – Do minimum

Figure A-7 Area B – Option 1 – 2 m high barrier

Appendix A - Mitigation options

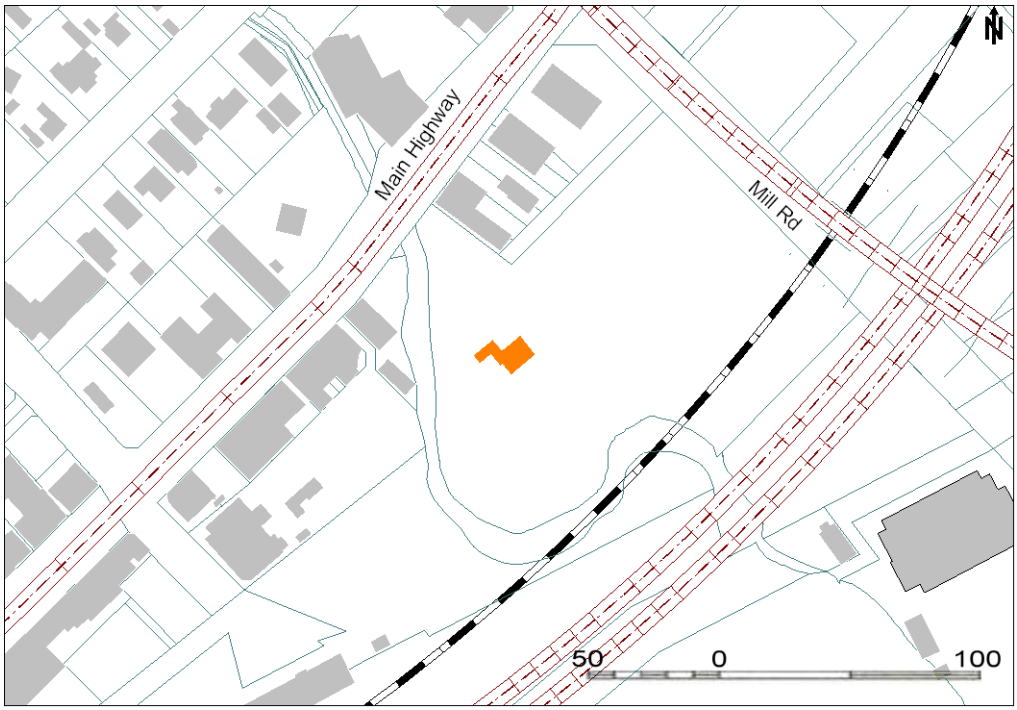


Figure A-8 Area C – Do minimum

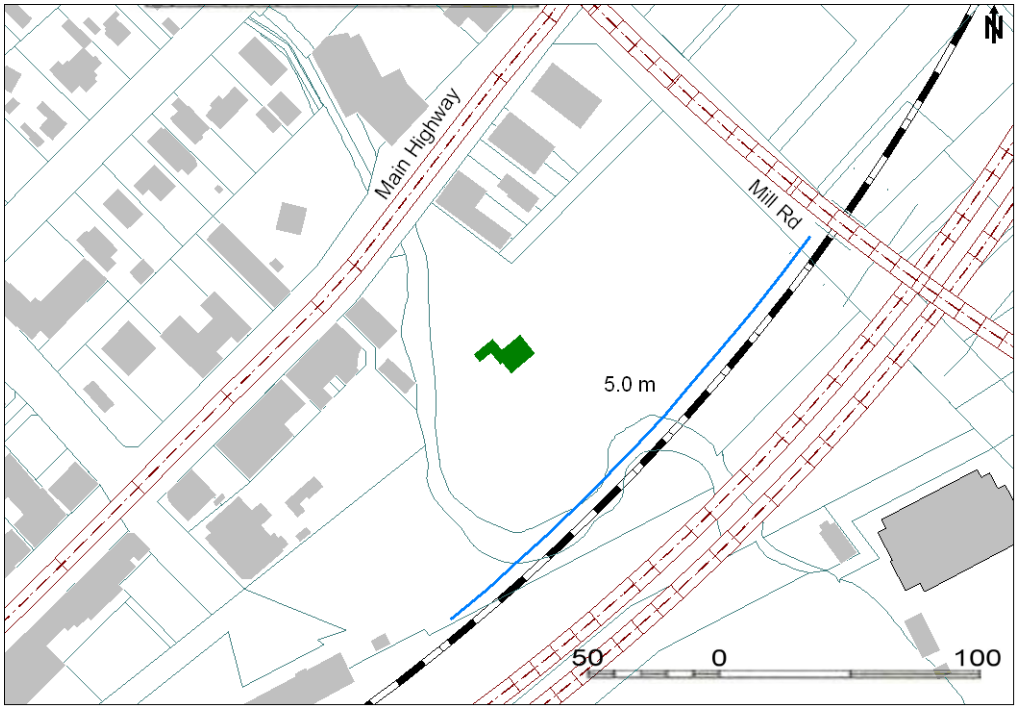


Figure A-9 Area C – Option 1 – 5 m high barrier railside

Appendix A - Mitigation options

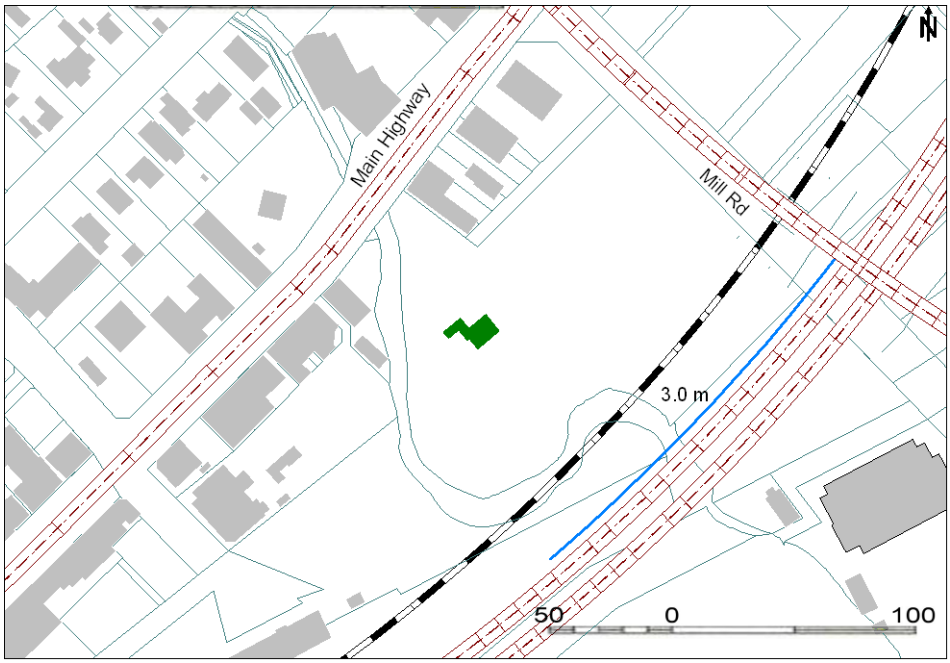


Figure A-10 Area C – Option 2 – 3 m high barrier

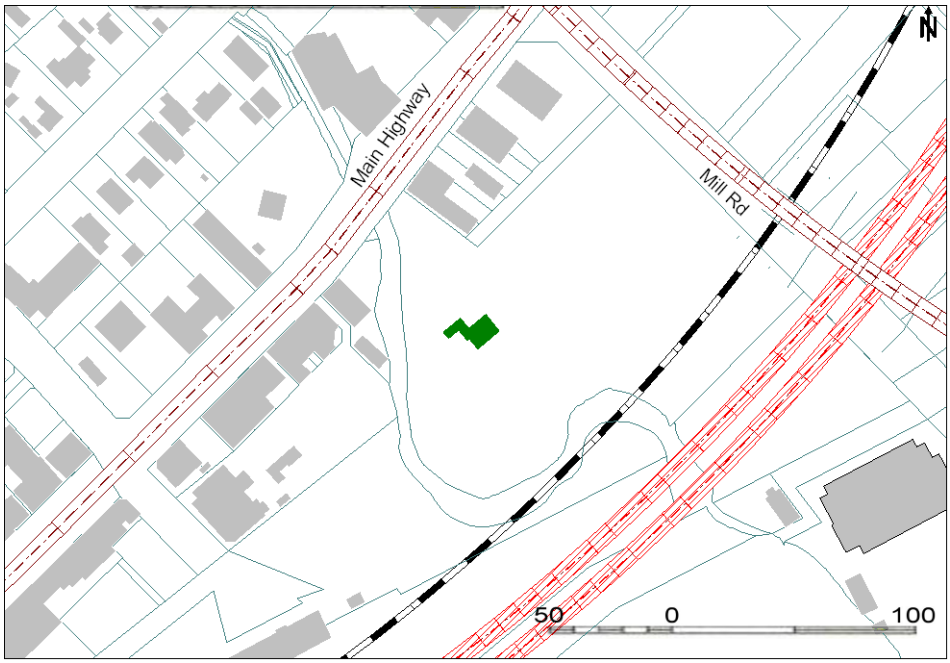


Figure A-11 Area C – Option 3 – continuous PA-10

Appendix A - Mitigation options

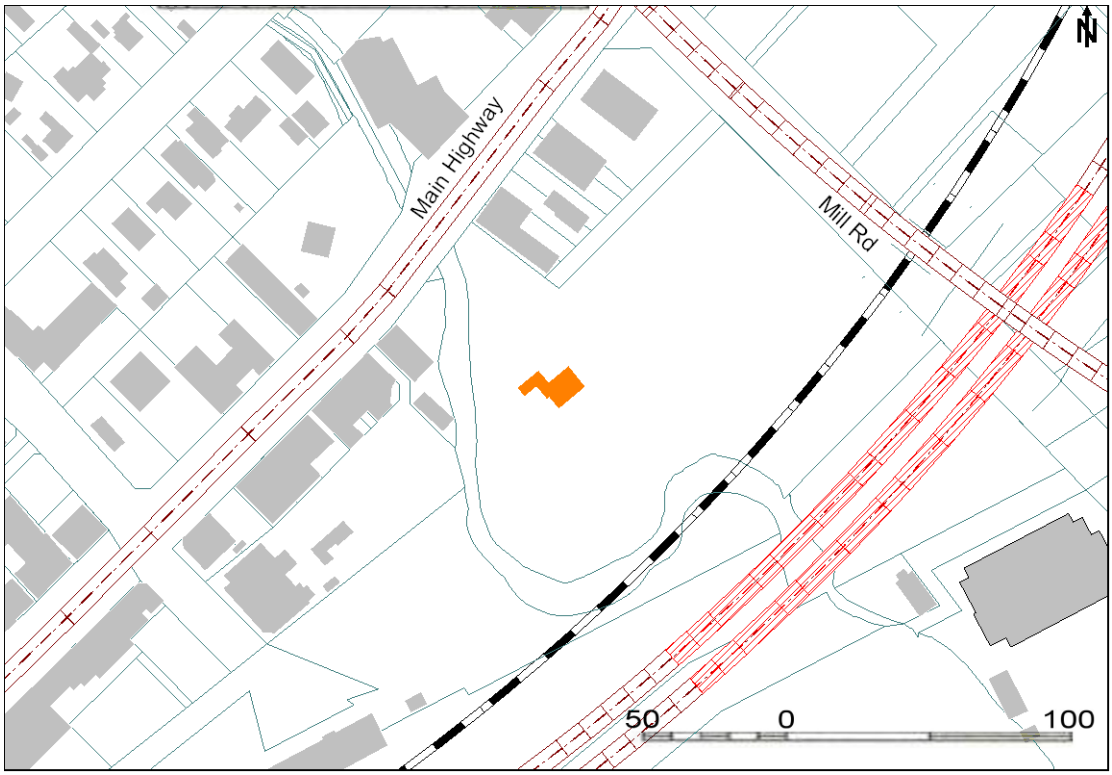


Figure A-12 Area C – Option 4 – PA-10 segment

Appendix A - Mitigation options

Figure A-13 Area D – Do minimum

Appendix A - Mitigation options

Figure A-14 Area D – Option 1 – 3 m high barriers

Appendix A - Mitigation options

Figure A-15 Area D – Option 2 – PA-10

Appendix A - Mitigation options

Figure A-16 Area D – Option 2 – PA-10, AC and noise barriers

Appendix A - Mitigation options

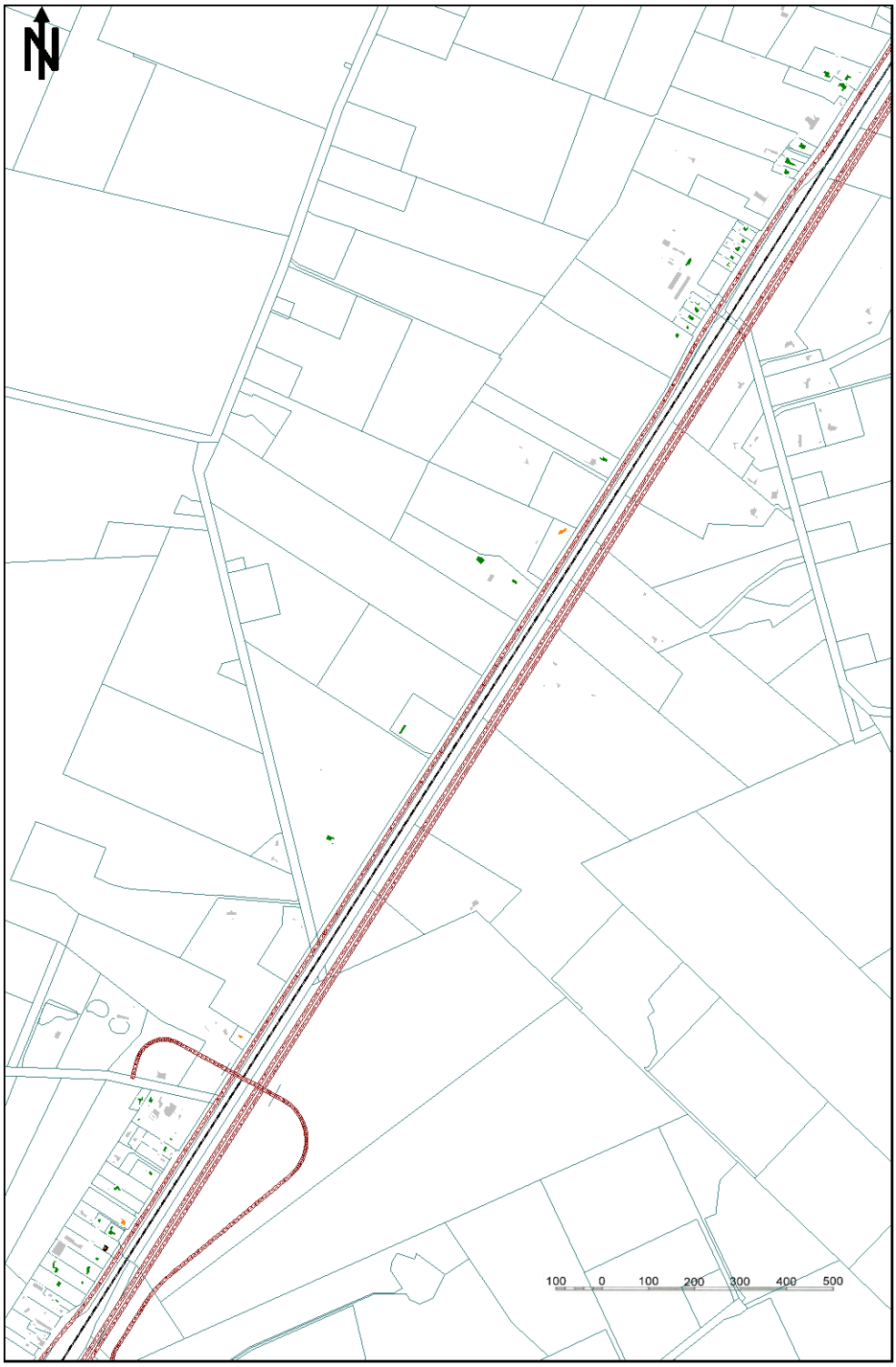


Figure A-17 Area E – Do minimum

Appendix A - Mitigation options

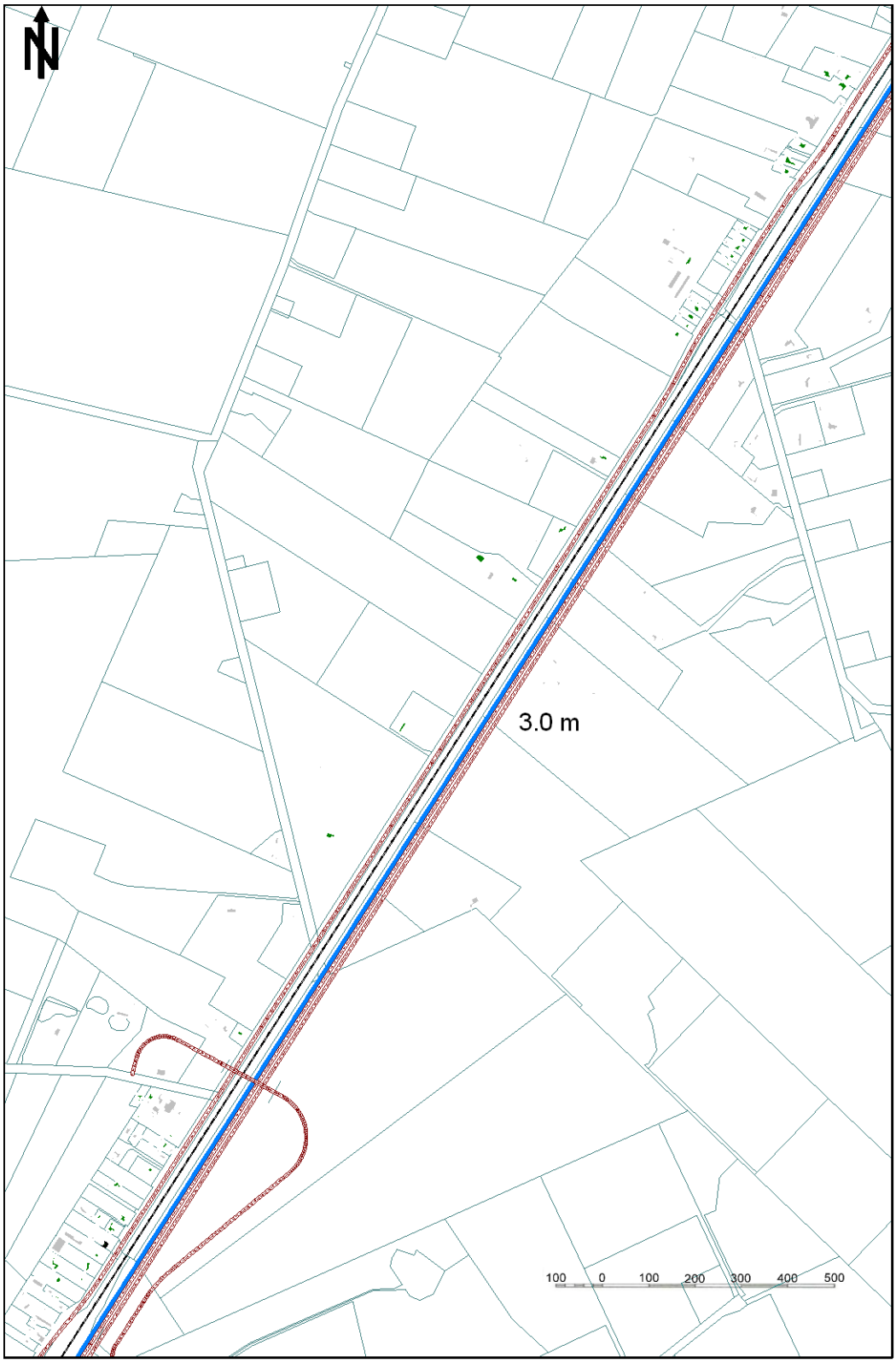


Figure A-18 Area E – Option 1 – barriers adjacent expressway

Appendix A - Mitigation options

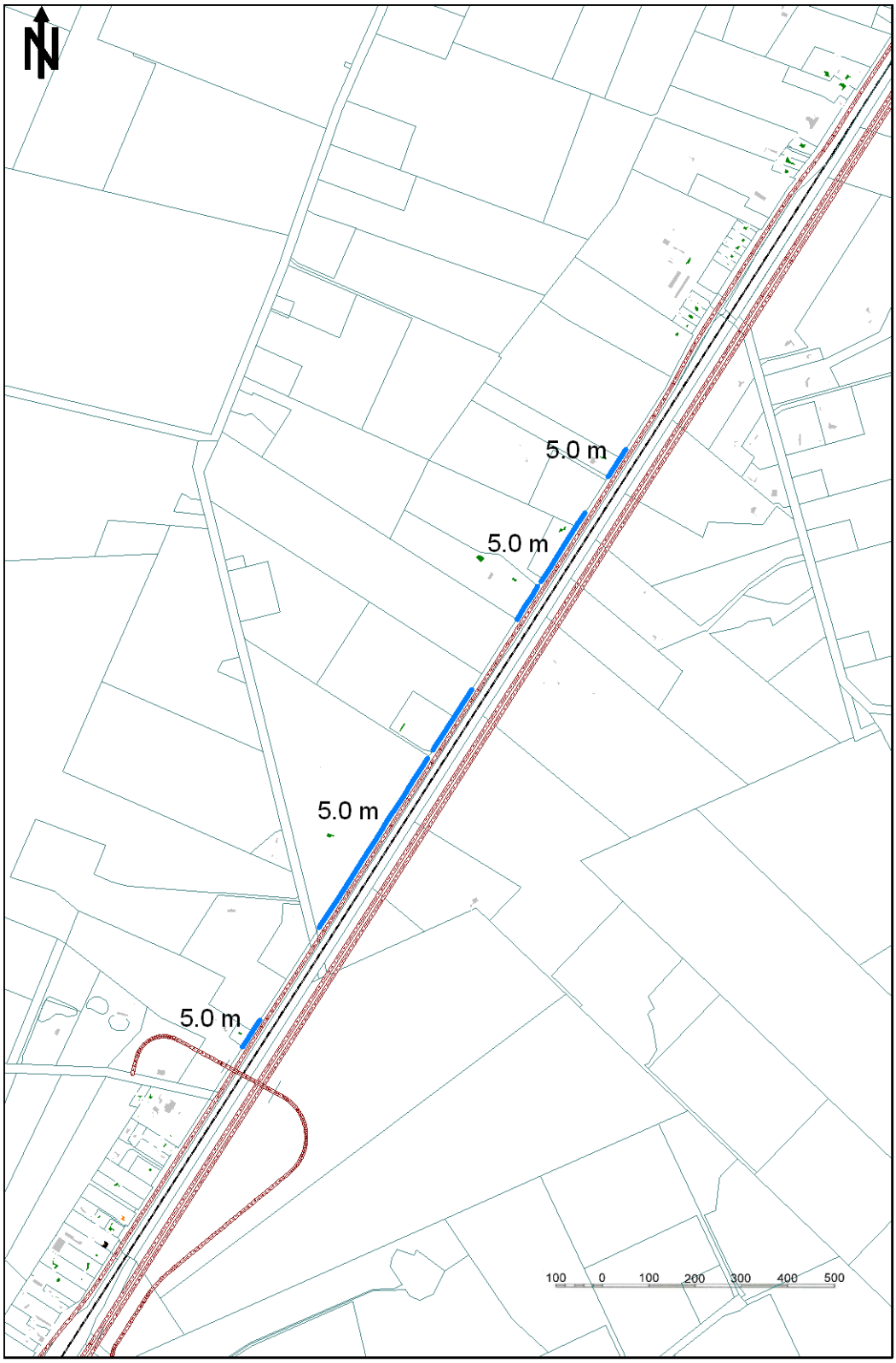


Figure A-19 Area E – Option 2 – barriers west of local arterial

Appendix A - Mitigation options

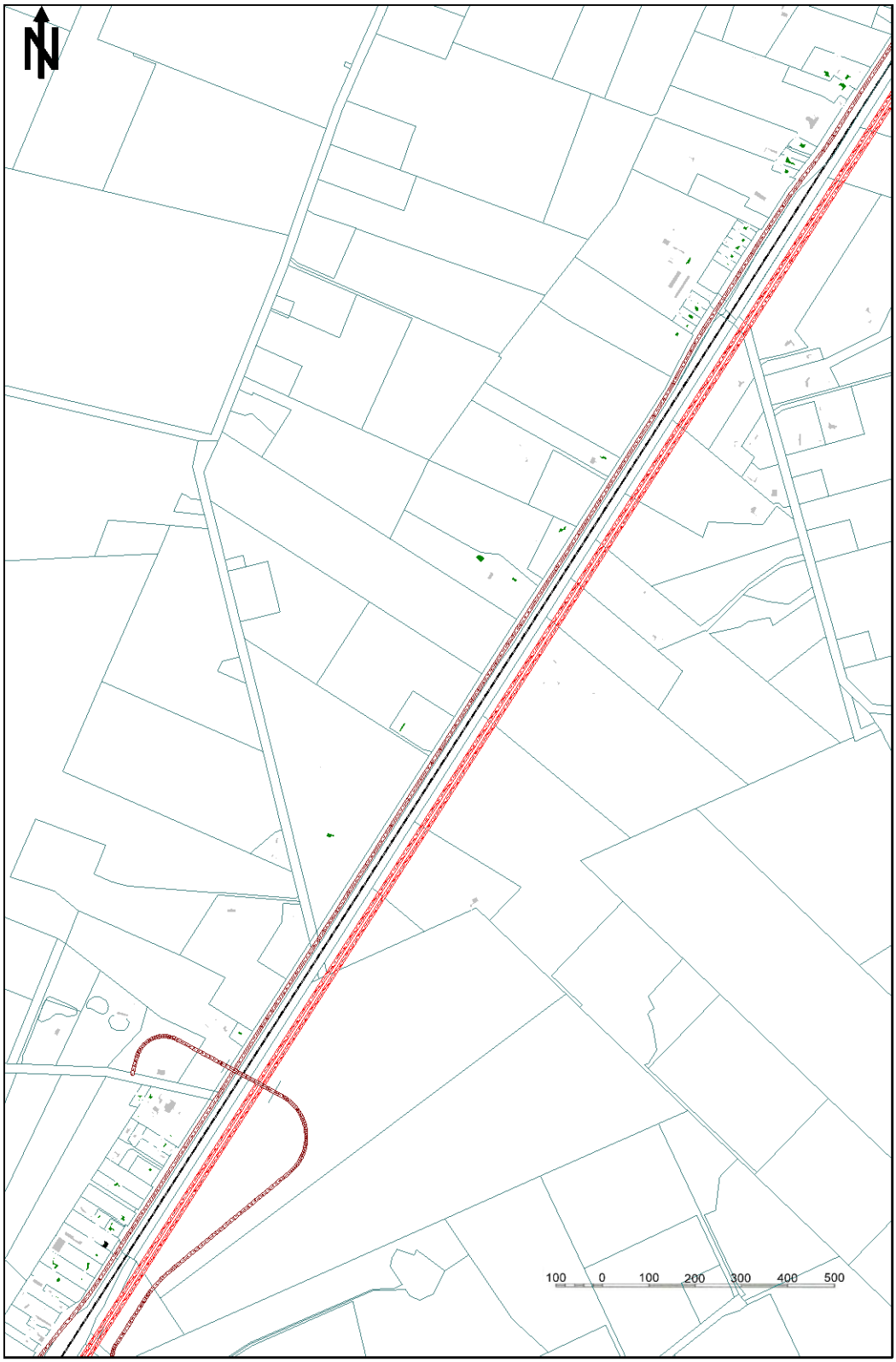


Figure A-20 Area E – Option 3 – PA-10 to expressway

Appendix A - Mitigation options

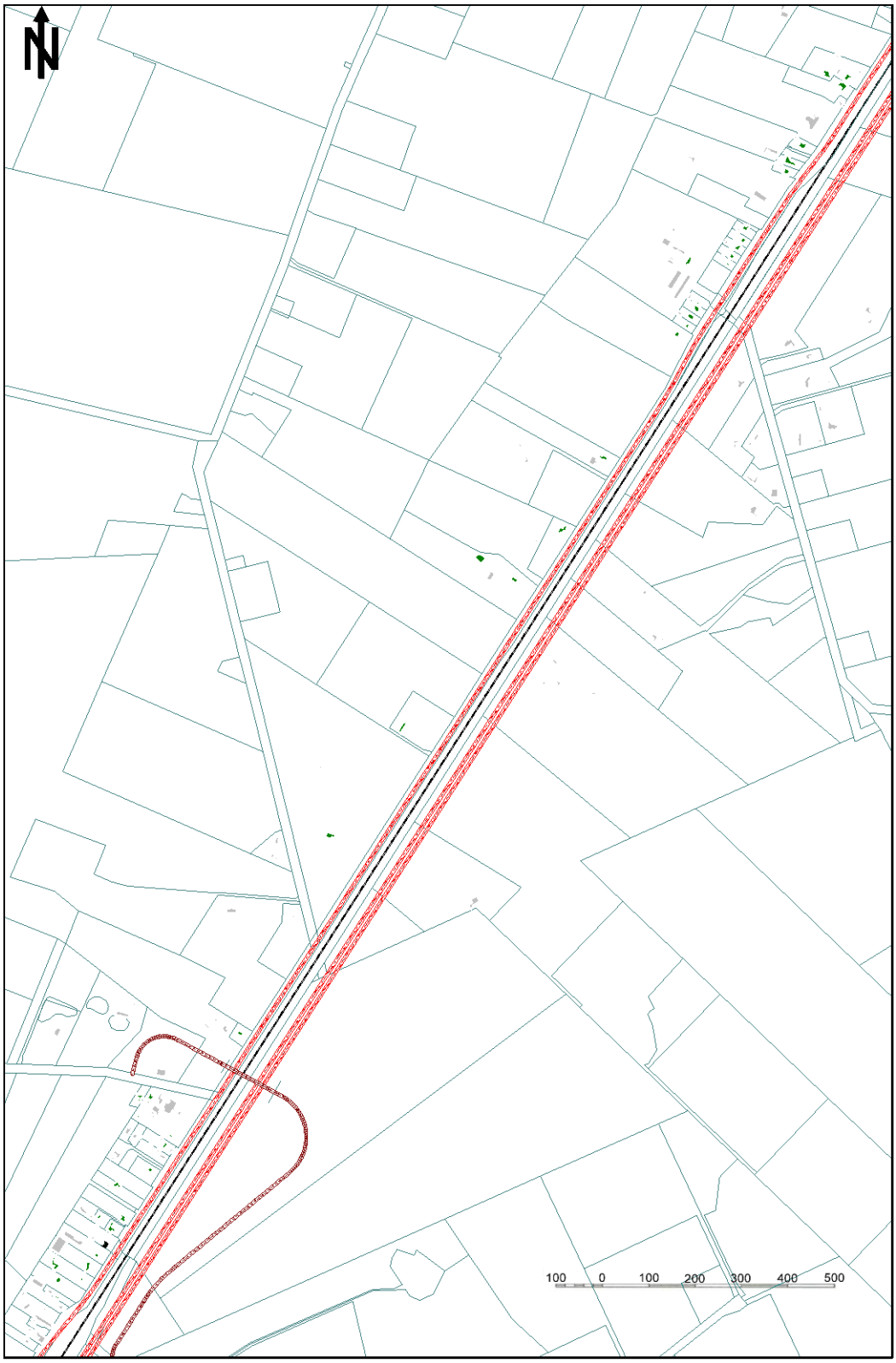


Figure A-21 Area E – Option 4 – PA-10 to expressway and local arterial

Appendix A - Mitigation options

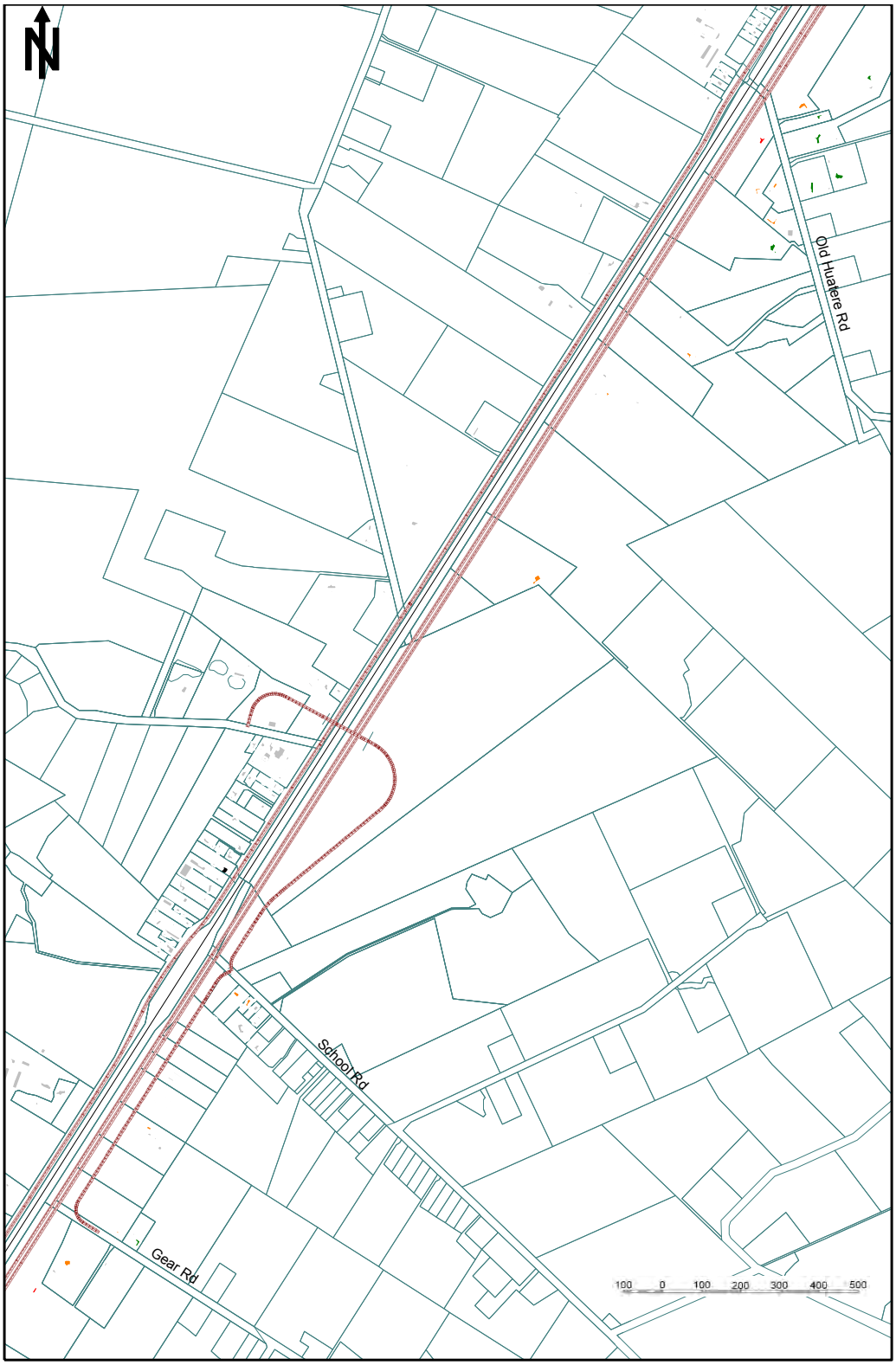


Figure A-22 Area F – Do minimum

Appendix A - Mitigation options

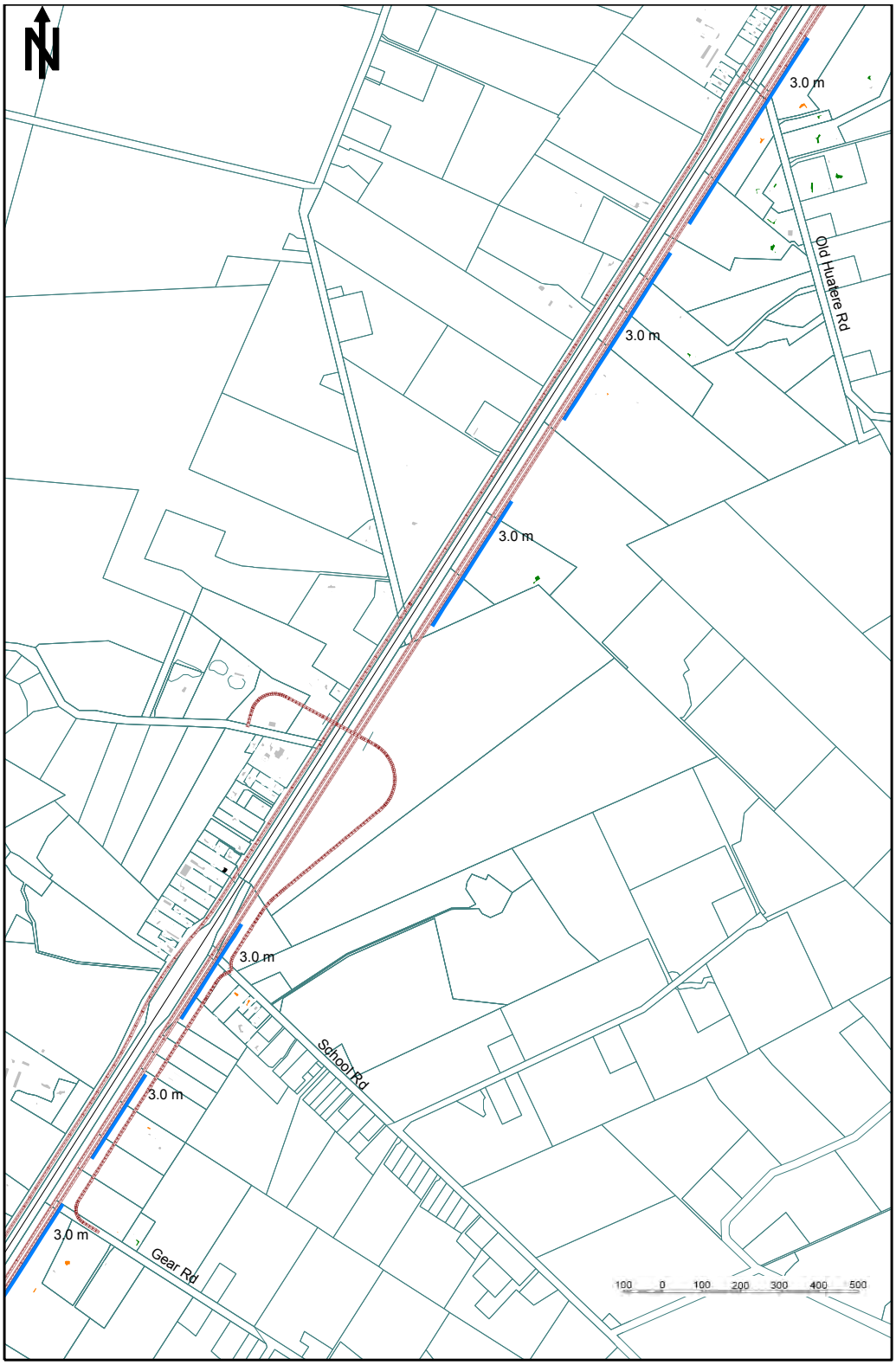


Figure A-23 Area F – Option 1 – 3 m high barriers

Appendix A - Mitigation options

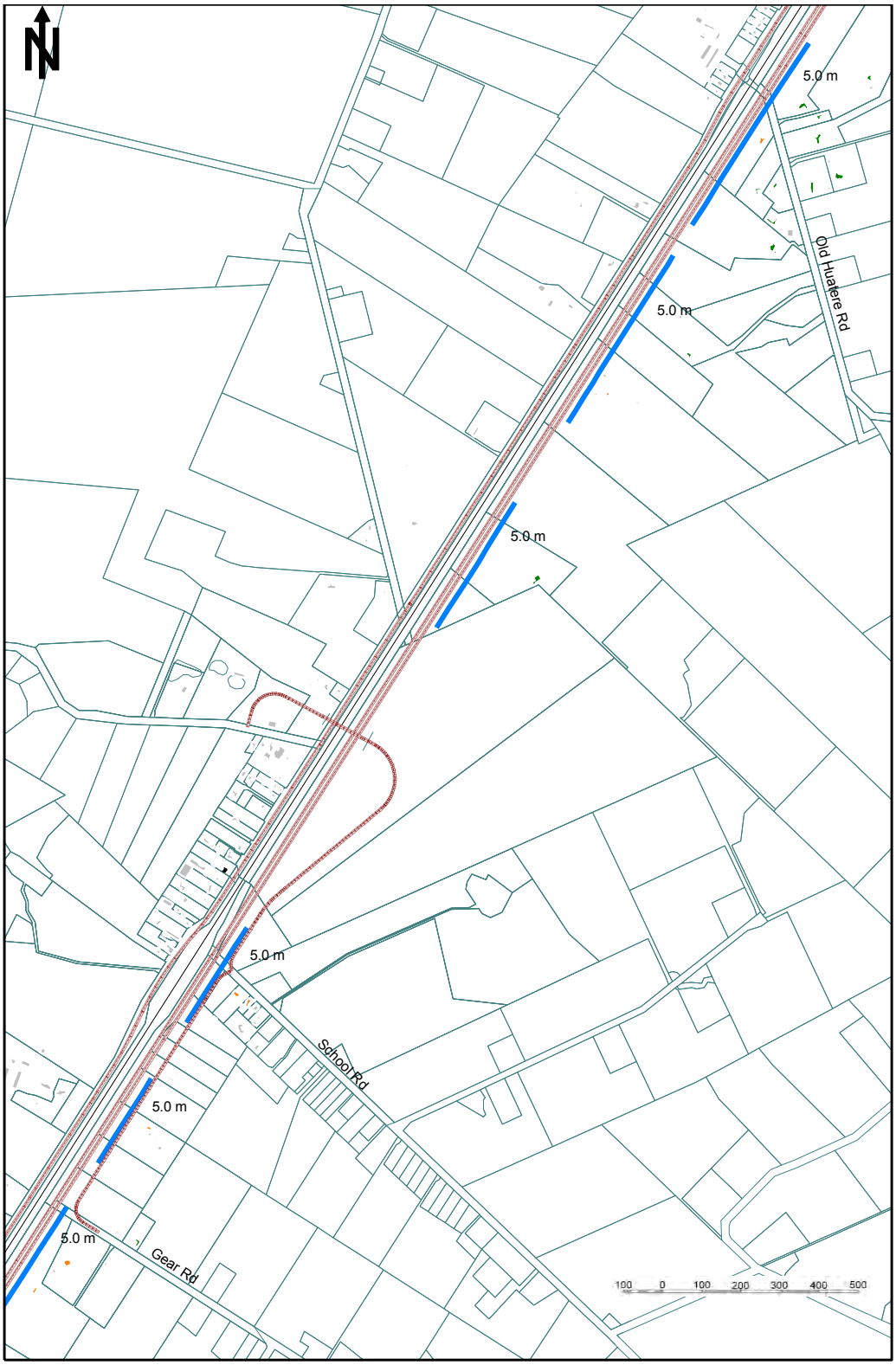


Figure A-24 Area F – Option 2 – 5 m high barriers

Appendix A - Mitigation options

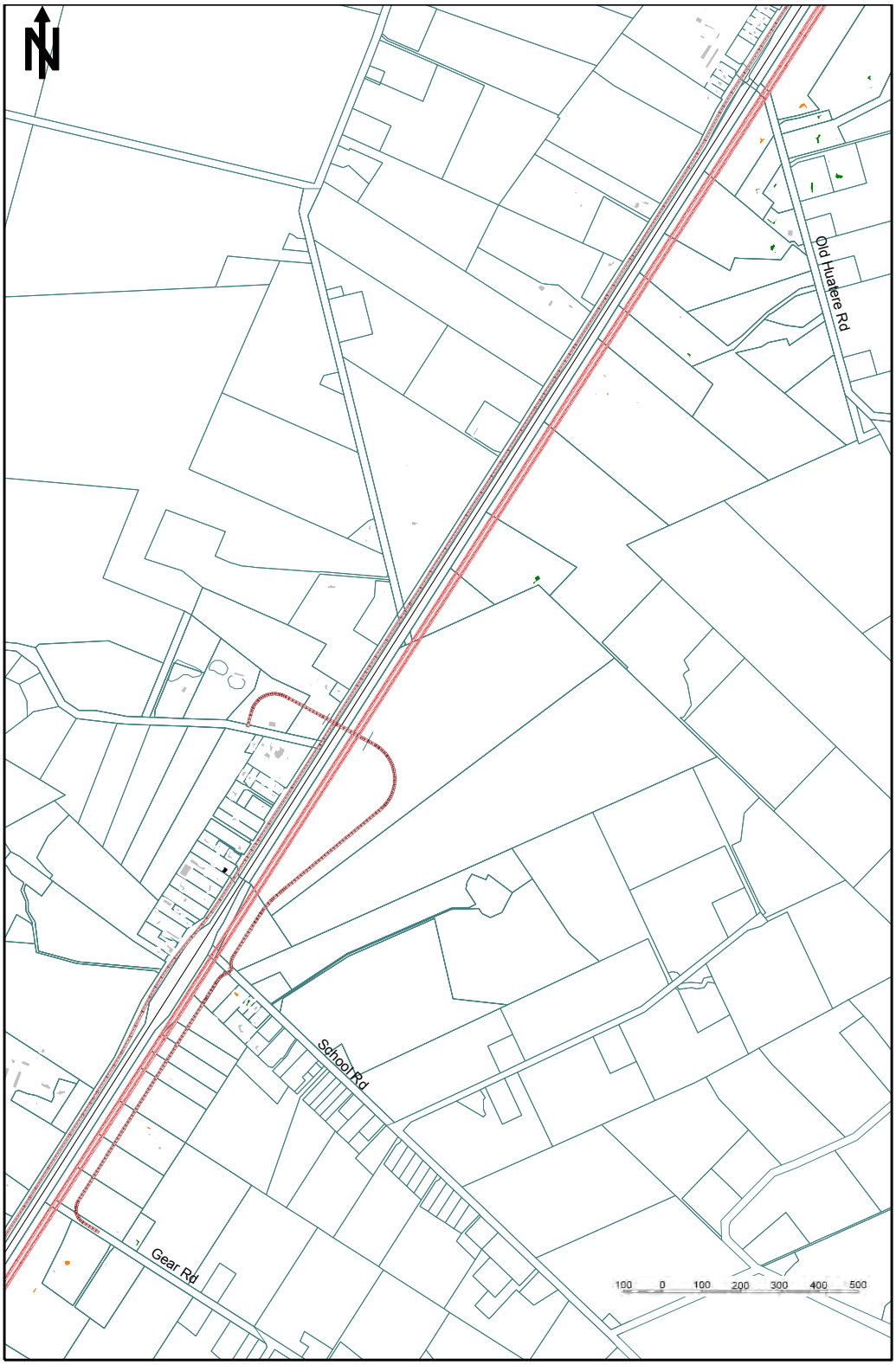


Figure A-25 Area F – Option 3 – PA-10 to expressway

Appendix A - Mitigation options

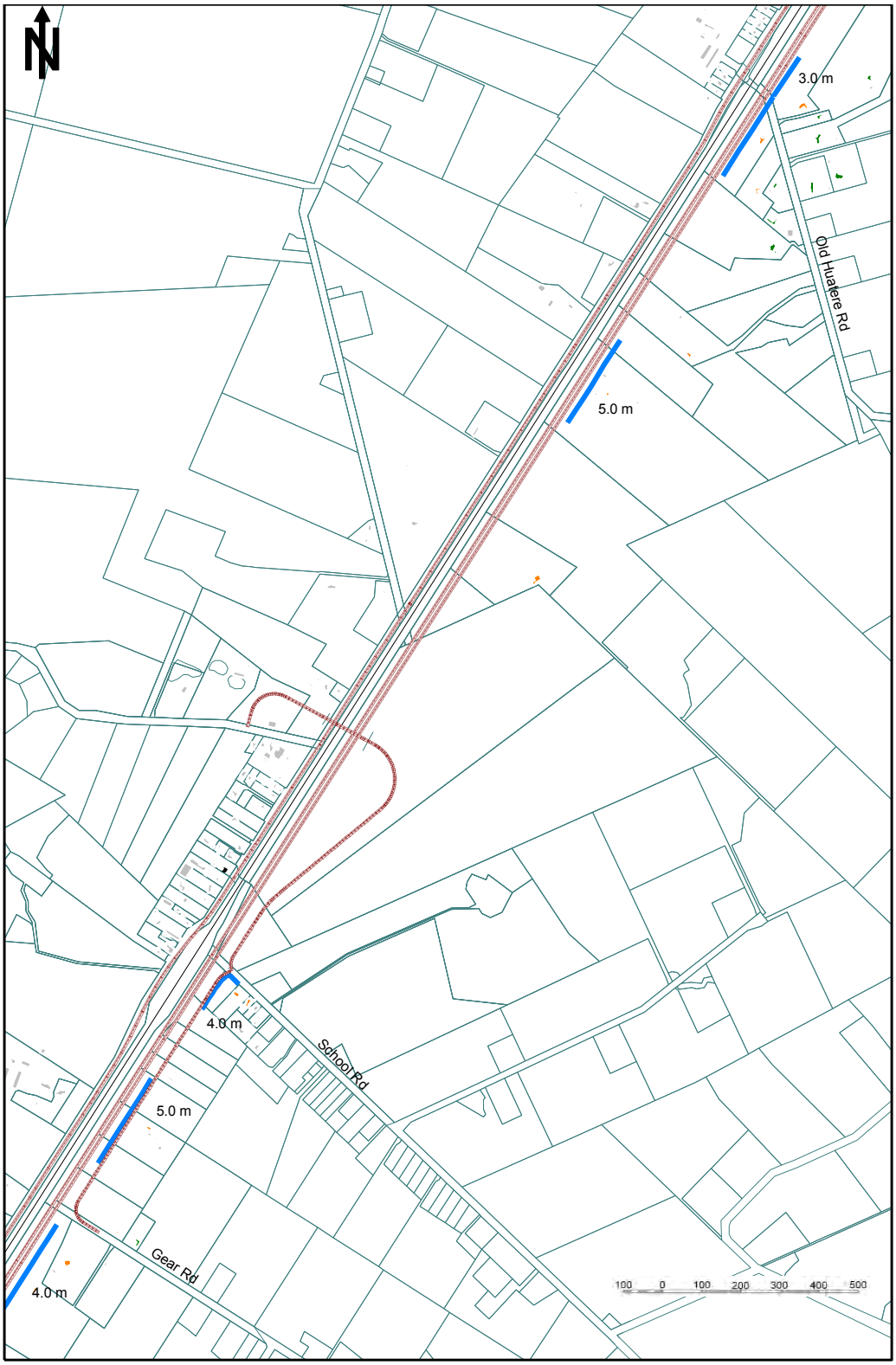


Figure A-26 Area F – Option 4 – 3–5 m high barriers

Appendix A - Mitigation options

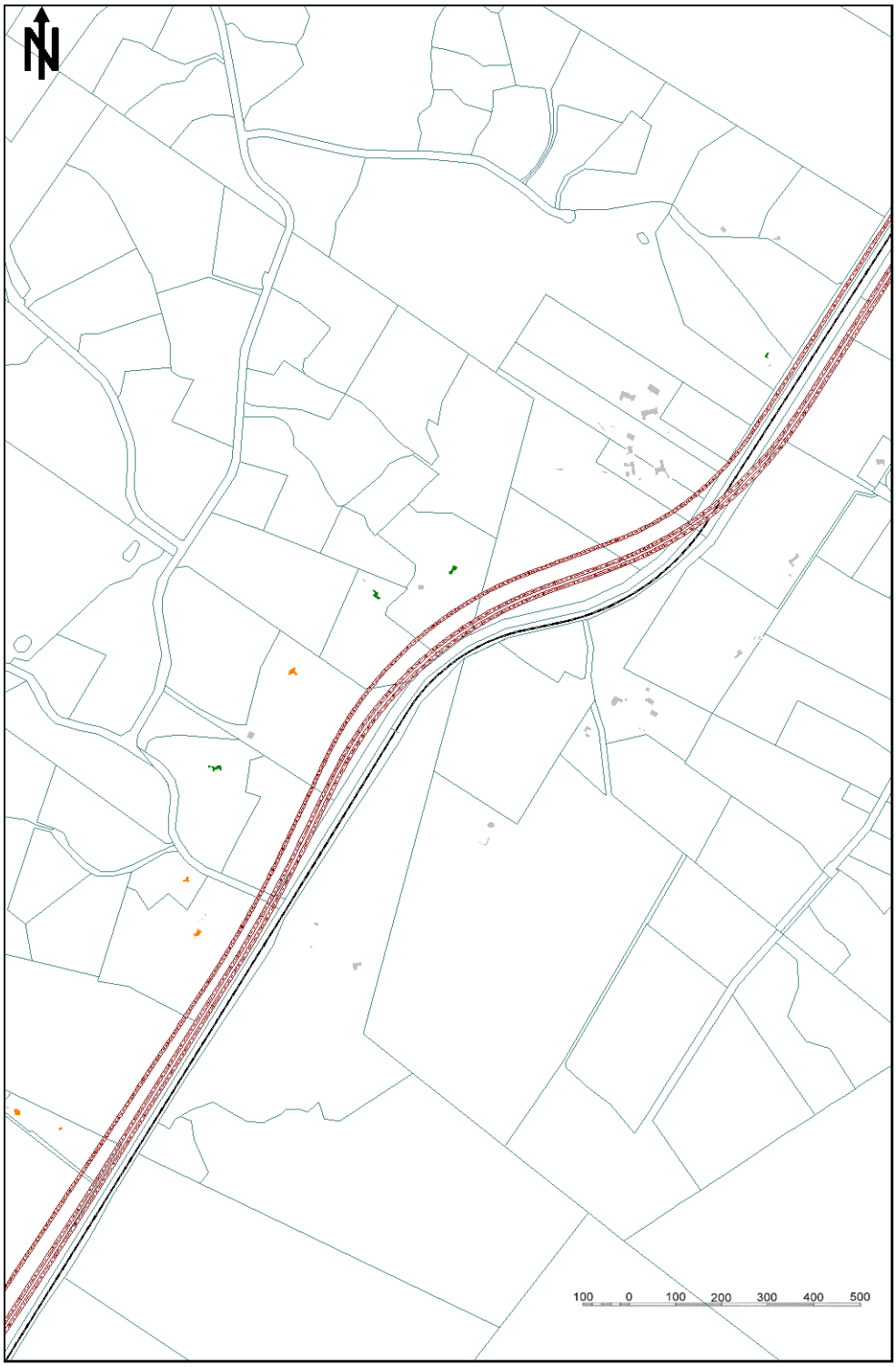


Figure A-27 Area G – Do minimum

Appendix A - Mitigation options

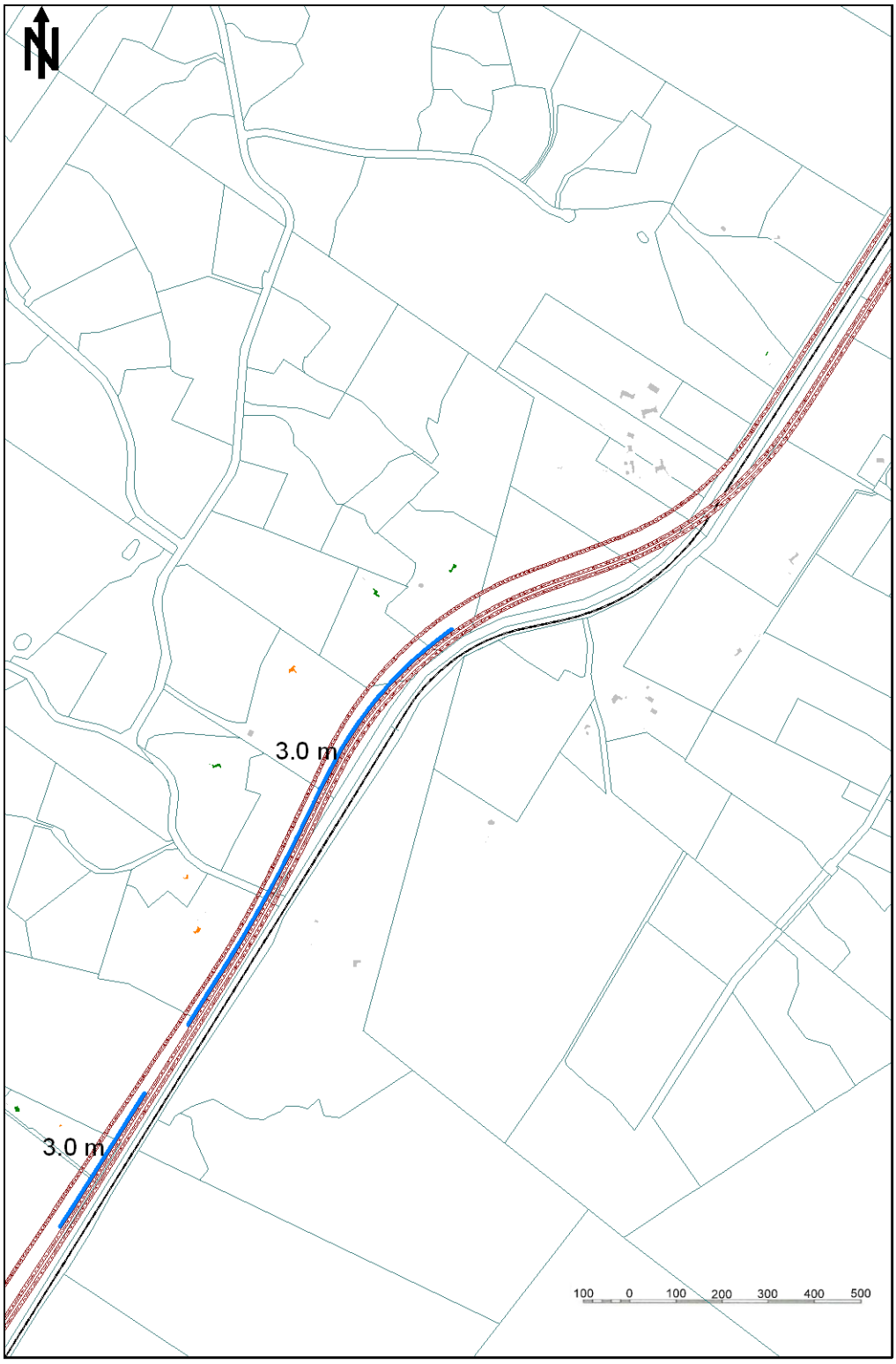


Figure A-28 Area G – Option 1 – 3m high barrier

Appendix A - Mitigation options

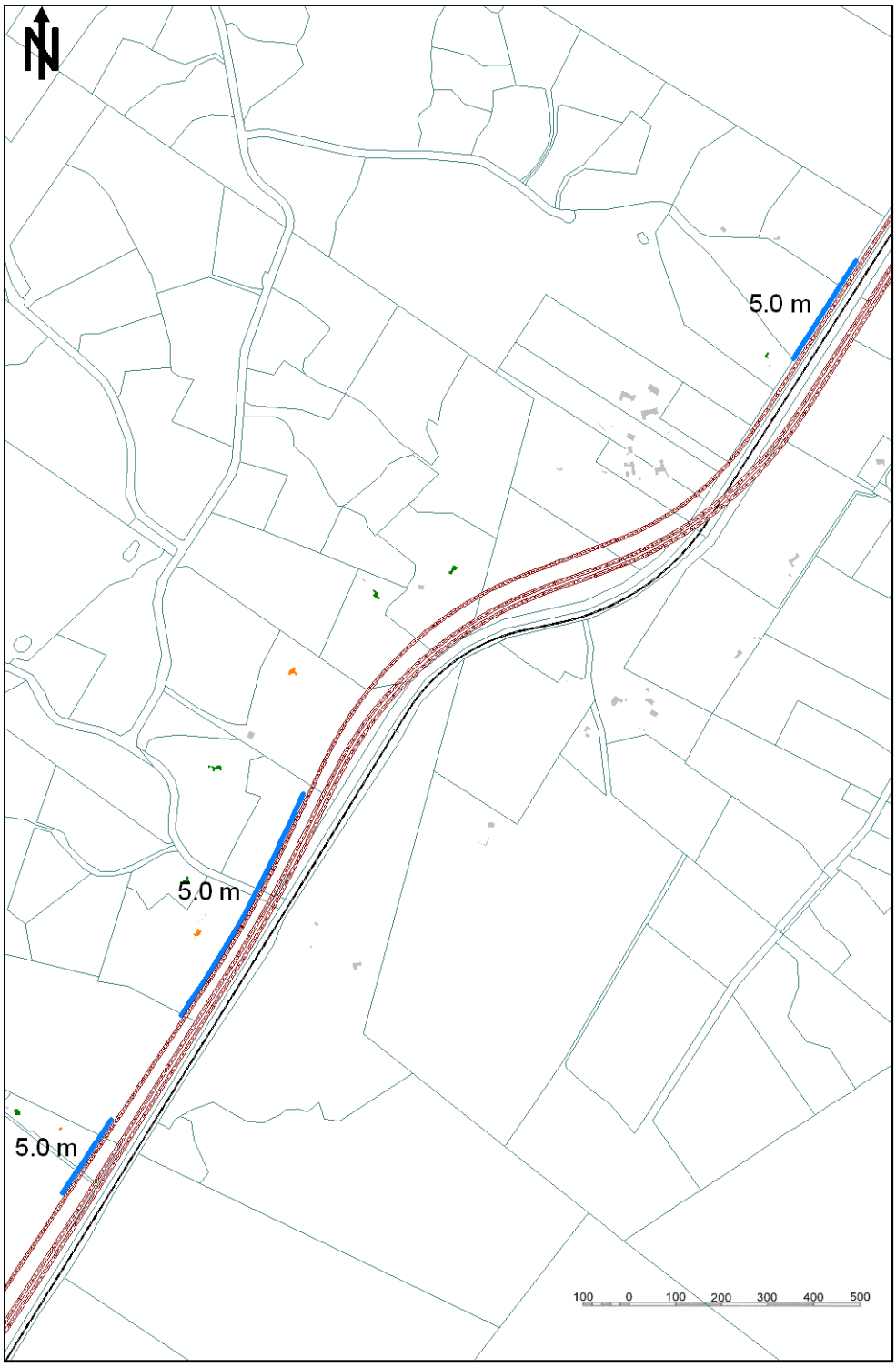


Figure A-29 Area G – Option 2 – 5m high barriers

Appendix A - Mitigation options

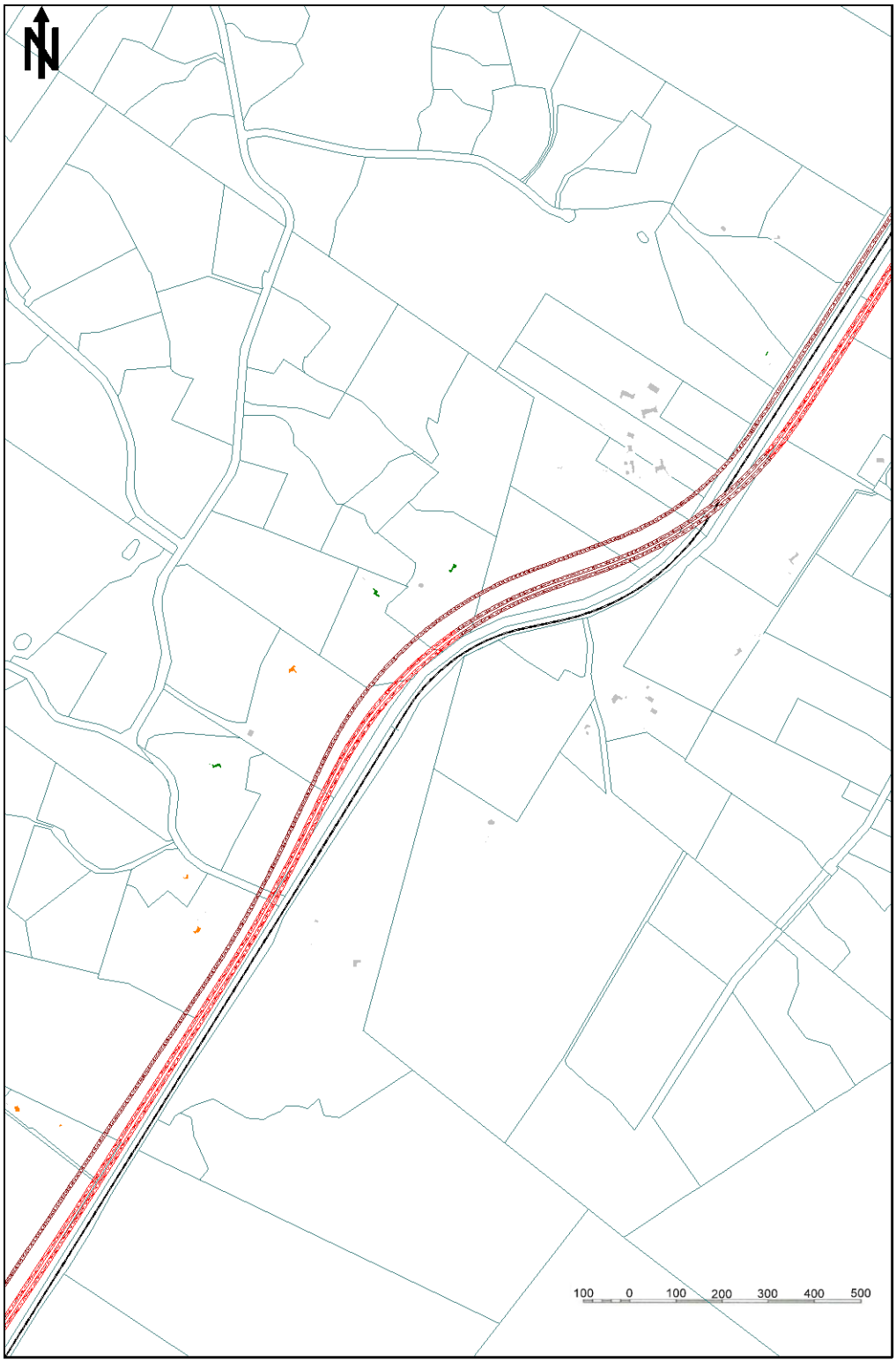


Figure A-30 Area G – Option 3 – PA-10 to expressway

Appendix A - Mitigation options

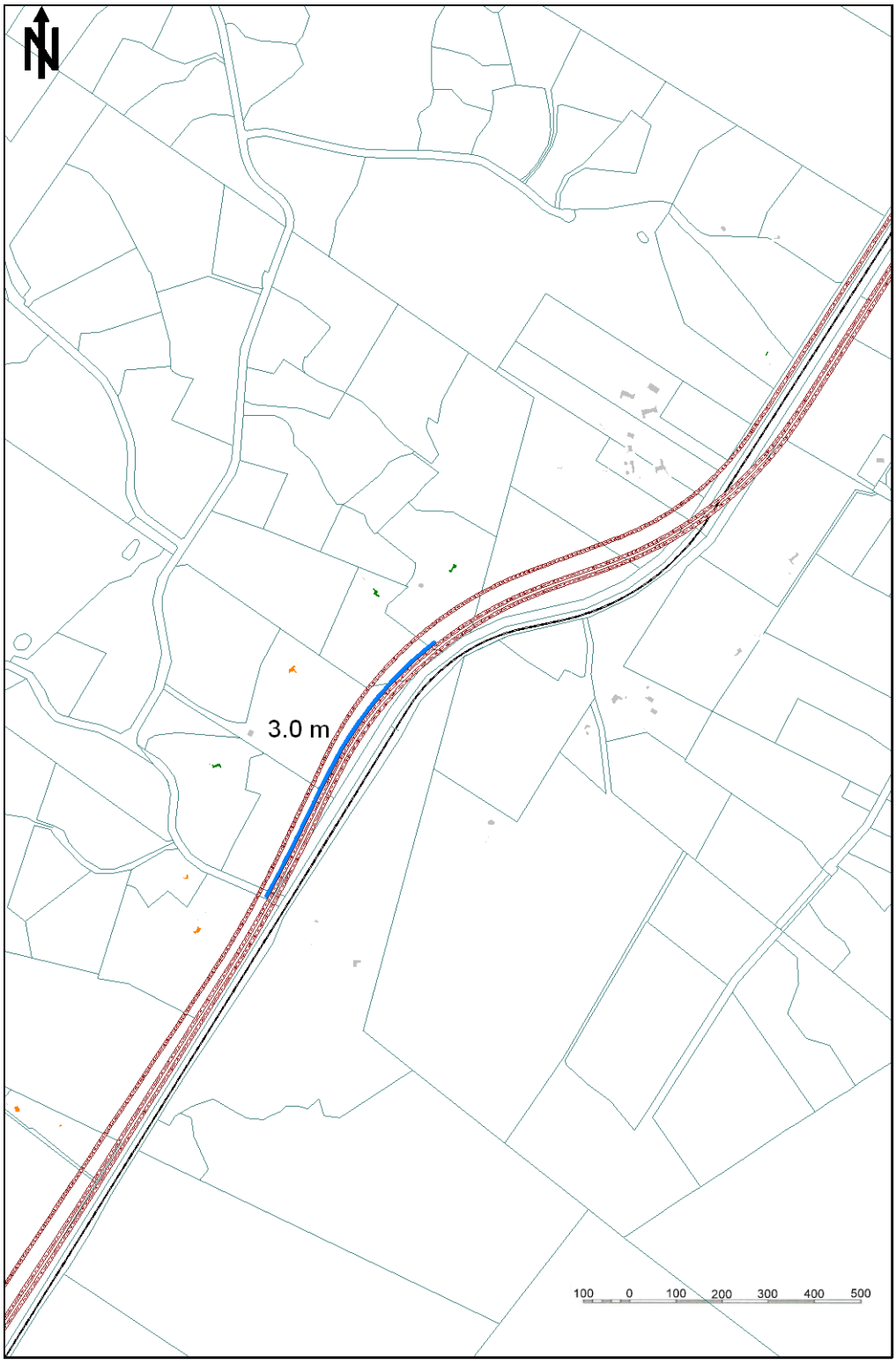


Figure A-31 Area G – Option 4 – single 3m high barrier

B

Appendix B PSF/13

Appendix B - PSF/13

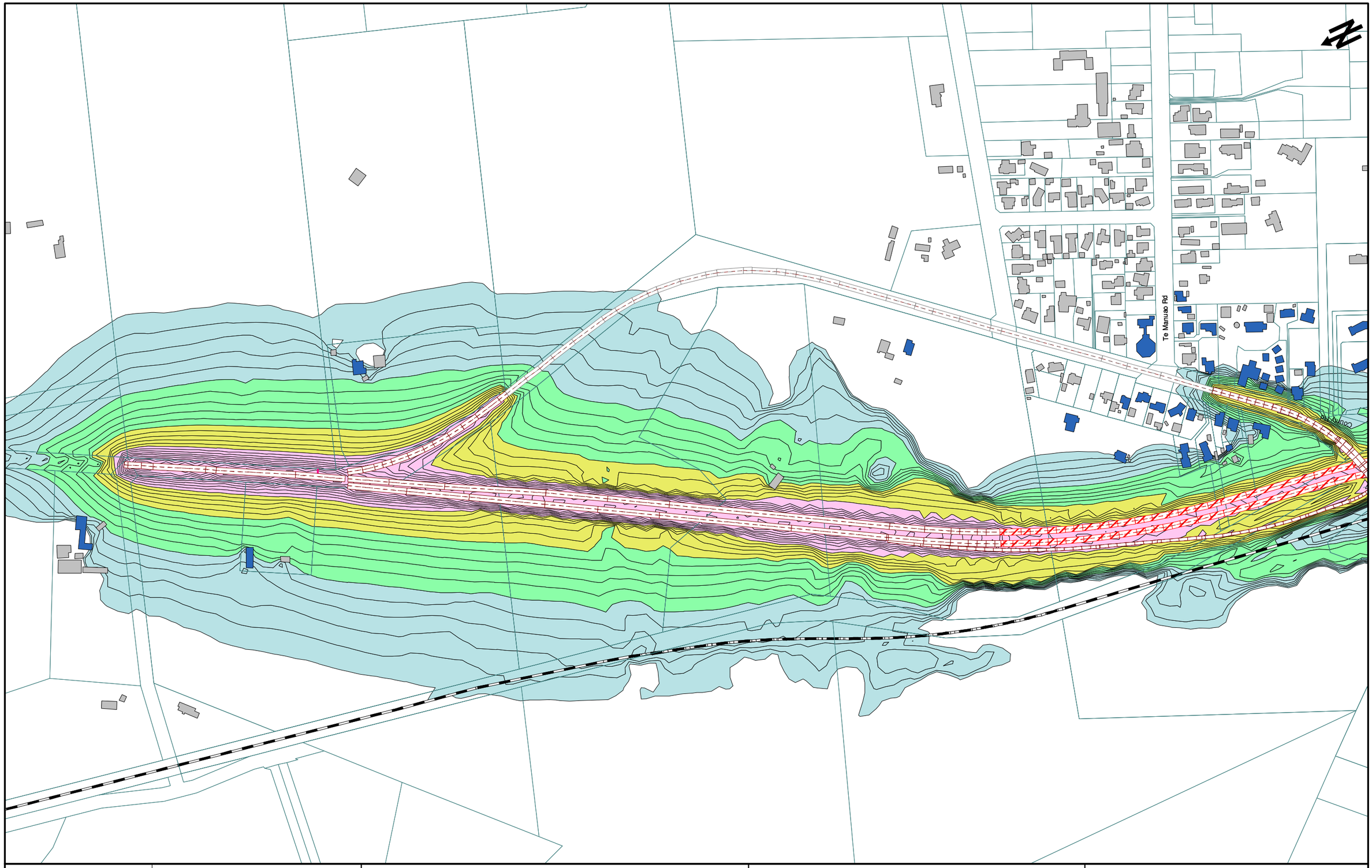
Social and Environmental Screen			Social and Environmental Assessment		
Issue *Social and environmental issues*	**Effects** *Describe the potential social and environmental effects of the option, including where the option may improve social and environmental outcomes*	**Degree of effect** *H / M / L / NA***	**Requirements** *List all legal requirements and relevant NZTA social and environmental objectives*	**Addressing effects and meeting requirements** *List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.*	
				Specific Actions	**Estimated Cost ($)**
Road-traffic noise	Opening year AADT – 21,137 vpd PPFs within 200m – 164 houses The project closely follows an existing state highway in both urban and rural areas. However, in some locations there will be an appreciable increase in road-traffic noise.	**Medium**	**Specific NZTA objectives:** Environmental Plan N2 - Determine reasonable noise requirements when seeking new or altering existing designations including when designating existing local roads by using RMA procedures. **Other:** NZS 6806 KCDC district plan (Transit Guidelines)	Determine the BPO in accordance with NZS 6806, based on the findings of the SARA but with input from the project team and NZTA national and regional staff. Based on the SARA, the indicative BPO is: - 6.3 km PA-10 - 114 m long, 2 m high noise wall (timber fence) Consult with all property owners adjacent to any proposed barriers.	$2,173,000
Construction noise and vibration	The project will involve substantial earthworks and construction of several major structures. There are houses near to many parts of the works and will be affected by construction noise. Several areas such as on the north bank of the Otaki River are remote from houses, so provide options for a site compound/staging areas/batching plant, which would not cause noise disturbance. As most works are for a new alignment night works should be limited.	**Medium**	**Specific NZTA objectives:** Environmental Plan N3 – Manage construction and maintenance noise to acceptable levels. Environmental Plan V3 - Avoid or reduce, as far as is practicable, the disturbance to communities from vibration during construction and maintenance. **Other:** NZS 6803 KCDC district plan (NZS 6803P:1984)	Conduct a construction noise and vibration assessment to: identify activities, predict typical noise and vibration levels, propose indicative mitigation measures and prepare a draft construction noise and vibration management plan.	TBC

Appendix B - PSF/13

Social and Environmental Screen			**Social and Environmental Assessment**		
Issue *Social and environmental issues*	**Effects** *Describe the potential social and environmental effects of the option, including where the option may improve social and environmental outcomes*	**Degree of effect** *H / M / L / NA***	**Requirements** *List all legal requirements and relevant NZTA social and environmental objectives*	**Addressing effects and meeting requirements** *List actions to be taken to meet specific social and environmental requirements and objectives and address all effects identified. Include an estimated cost.*	
				Specific Actions	**Estimated Cost ($)**
Rail noise	The project results in the rail line moving closer to properties to the west. The move results in 3 properties falling within 80 metres of the rail noise effects corridor.	**Medium**	TBC with KiwiRail	Using the KiwiRail reverse sensitivity guidelines as a reference, it is likely that noise barriers on the property boundary of 3 houses will be required (2.5 m high barrier, total length 70 m). Confirm the criteria and mitigation with KiwiRail. Consult with all property owners adjacent to any proposed barriers.	$28,000
Road-traffic vibration	There are no PPFs immediately adjacent to the new road and vibration would be expected to be within reasonable limits. There are PPFs near altered road sections which might currently experience road-traffic vibration.	**N/A**	**Specific NZTA objectives:** Environmental Plan V1 - Plan and design new state highways to avoid or reduce adverse vibration effects. **Other:** NS 8176	Conduct vibration measurements by existing road to confirm levels and indirectly ground conditions.	TBC
Rail vibration	No properties are within 40 metres of the moved rail corridor.	**N/A**	TBC with KiwiRail	Confirm the criteria with KiwiRail, and conduct further investigations if necessary.	TBC

C

Appendix C Noise contour plots



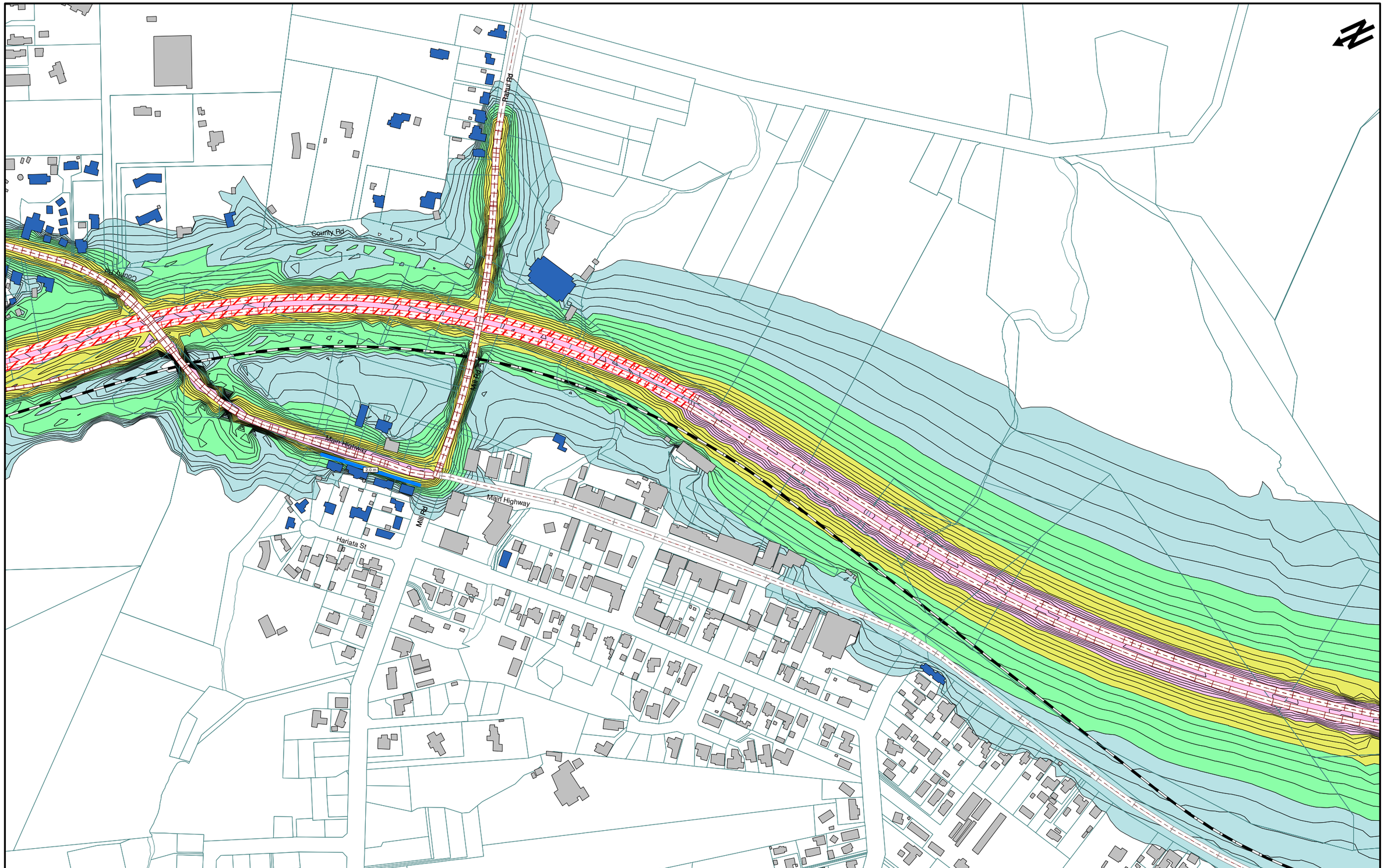
55.0 ... 60.0 dB
60.0 ... 65.0 dB
65.0 ... 70.0 dB
70.0 ... dB

Road
Road, low-noise surface
Road, not assessed
Railway
Barrier
Building, PPF
Building, not assessed

URS

Client	NZ Transport Agency
Project	Peka Peka to North Otaki Expressway
Title	Predicted sound levels (Indicative solution)

Section	Reference
Sheet 01	42176987 C004
Scale	Date
1:4000 @ A3	14.09.11



55.0 ... 60.0 dB
60.0 ... 65.0 dB
65.0 ... 70.0 dB
70.0 ... dB

Road
Road, low-noise surface
Road, not assessed
Railway
Barrier
Building, PPF
Building, not assessed

URS

Client	NZ Transport Agency
Project	Peka Peka to North Otaki Expressway
Title	Predicted sound levels (Indicative solution)

Section	Reference
Sheet 02	42176987 C004
Scale	Date
1:4000 @ A3	14.09.11

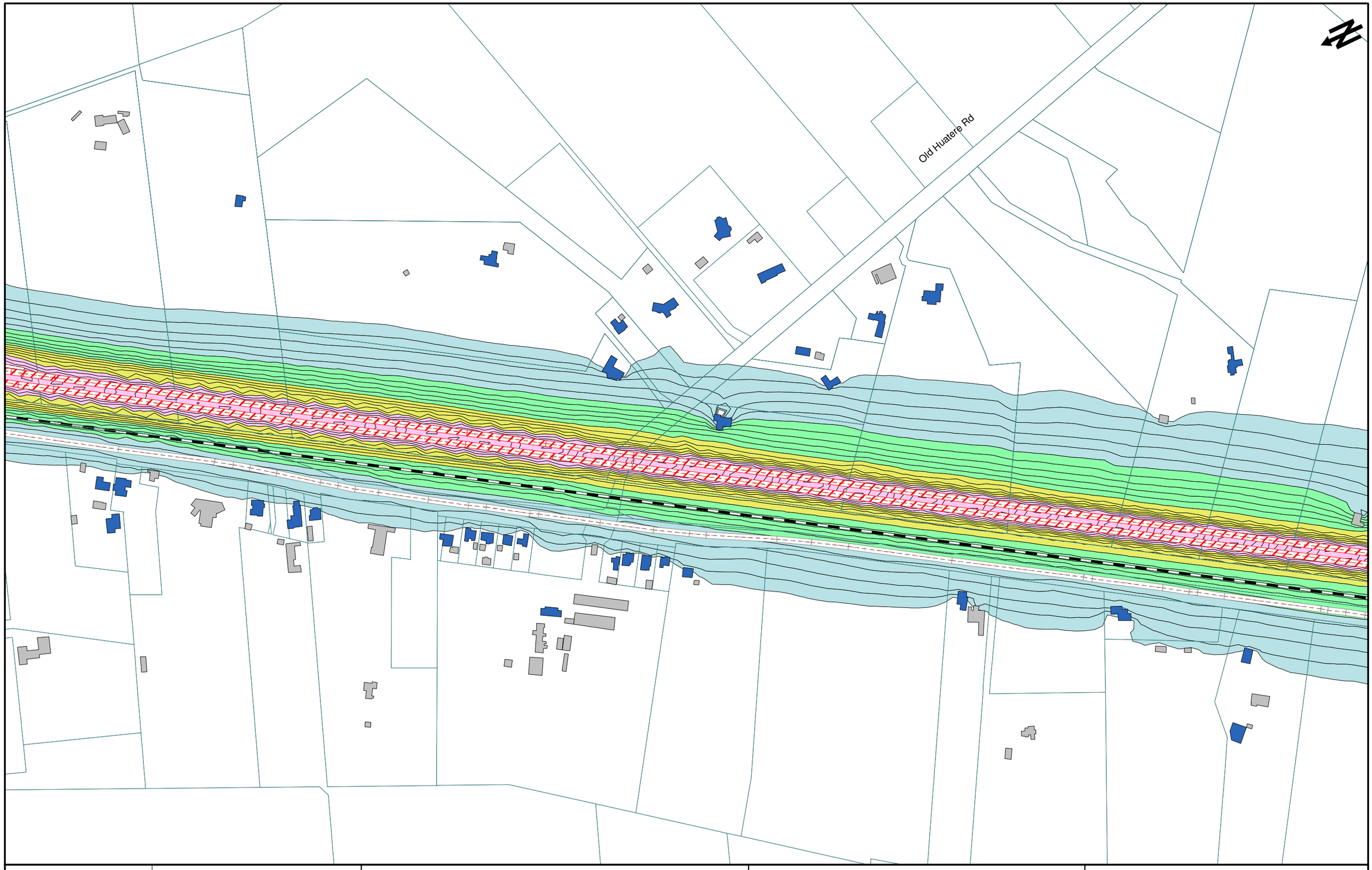
55.0 ... 60.0 dB
60.0 ... 65.0 dB
65.0 ... 70.0 dB
70.0 ... dB

Road
Road, low-noise surface
Road, not assessed
Railway
Barrier
Building, PPF
Building, not assessed

URS

Client	NZ Transport Agency
Project	Peka Peka to North Otaki Expressway
Title	Predicted sound levels (Indicative solution)

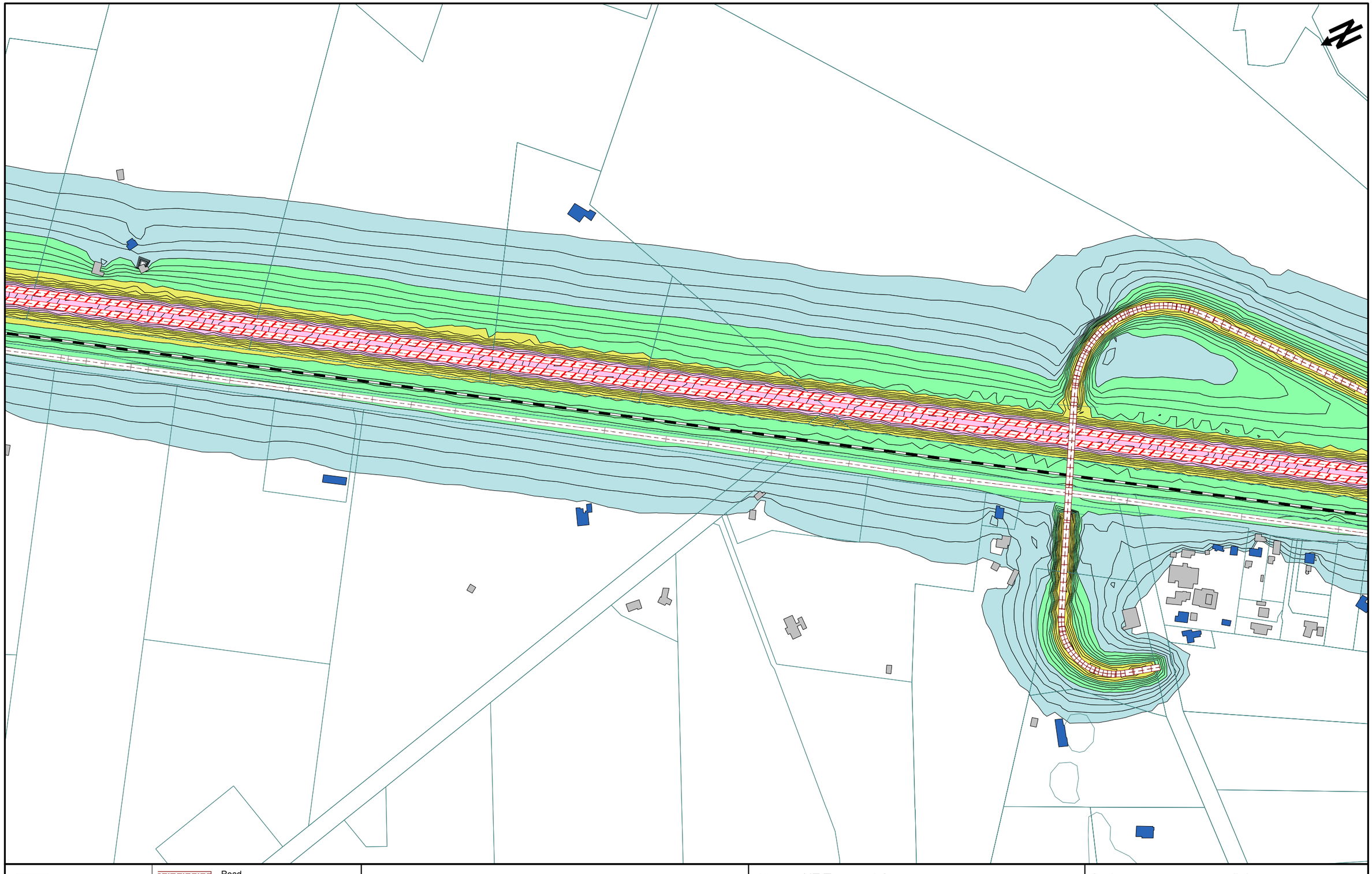
Section	Reference
Sheet 03	42176987 C004
Scale	Date
1:4000 @ A3	14.09.11



URS

Client	NZ Transport Agency
Project	Peka Peka to North Otaki Expressway
Title	Predicted sound levels (Indicative solution)

Section Sheet 04	Reference 42176987 C004
Scale 1:4000 @ A3	Date 14.09.11



55.0 ... 60.0 dB
60.0 ... 65.0 dB
65.0 ... 70.0 dB
70.0 ... dB

Road
Road, low-noise surface
Road, not assessed
Railway
Barrier
Building, PPF
Building, not assessed

URS

Client	NZ Transport Agency
Project	Peka Peka to North Otaki Expressway
Title	Predicted sound levels (Indicative solution)

Section	Reference
Sheet 05	42176987 C004
Scale	Date
1:4000 @ A3	14.09.11

School Rd

Gear Rd

55.0 ... 60.0 dB
60.0 ... 65.0 dB
65.0 ... 70.0 dB
70.0 ... dB

Road
Road, low-noise surface
Road, not assessed
Railway
Barrier
Building, PPF
Building, not assessed

URS

Client	NZ Transport Agency
Project	Peka Peka to North Otaki Expressway
Title	Predicted sound levels (Indicative solution)

Section	Reference
Sheet 06	42176987 C004
Scale	Date
1:4000 @ A3	14.09.11

55.0 ... 60.0 dB
60.0 ... 65.0 dB
65.0 ... 70.0 dB
70.0 ... dB

Road
Road, low-noise surface
Road, not assessed
Railway
Barrier
Building, PPF
Building, not assessed

URS

Client NZ Transport Agency

Project Peka Peka to North Otaki Expressway

Title Predicted sound levels (Indicative solution)

Section Sheet 07

Reference 42176987 C004

Scale 1:4000 @ A3

Date 14.09.11

55.0 ... 60.0 dB
60.0 ... 65.0 dB
65.0 ... 70.0 dB
70.0 ... dB

Road
Road, low-noise surface
Road, not assessed
Railway
Barrier
Building, PPF
Building, not assessed

URS

Client	NZ Transport Agency
Project	Peka Peka to North Otaki Expressway
Title	Predicted sound levels (Indicative solution)

Section	Sheet 08
Reference	42176987 C004
Scale	1:4000 @ A3
Date	14.09.11

URS New Zealand Limited
Level 1, 31 Orchard Road
Christchurch Airport 8053
PO Box 4479, Christchurch 8140 New Zealand

T: 64 3 374 8500
F: 64 3 377 0655

www.urscorp.co.nz