Report

Assessment of Air Quality Effects - Peka Peka to North Otaki Expressway

FEBRUARY 2013

Prepared for

Opus Consultants Limited

Level 5 Majestic Centre,
100 Willis Street,
Wellington,
New Zealand

42034404

NZ TRANSPORT AGENCY
WAKA KOTAHI

URS

Project Manager: PP ....
Peter Stacey
Air Quality Consultant

Principal-In-Charge: ....
Andrew Curtis
Principal Air Quality Engineer

Author: PP ....
Peter Stacey
Air Quality Consultant

Reviewer: ....
Doug Boddy
Associate Air Quality Consultant

URS New Zealand Limited

URS Centre, 13-15 College Hill
Auckland 1011
PO Box 821, Auckland 1140
New Zealand

T: 64 9 355 1300
F: 64 9 355 1333

Date:	**February 2013**
Reference:	42034404/R001/f
Status:	Final

Document delivery

URS New Zealand provides this document in either printed format, electronic format or both. URS considers the printed version to be binding. The electronic format is provided for the client's convenience and URS requests that the client ensures the integrity of this electronic information is maintained. Storage of this electronic information should at a minimum comply with the requirements of the Electronic Transactions Act 2002.

Where an electronic only version is provided to the client, a signed hard copy of this document is held on file by URS and a copy will be provided if requested.

URS

Table of Contents

Table of Contents

Table of Contents

Table of Contents

Tables

Table of Contents

Figures

Table of Contents

Appendices

Abbreviations

Abbreviation	Description
AADT	Annual Average Daily Traffic
AC	Auckland Council
BECA	BECA Infrastructure
CAQMP	Construction Air Quality Management Plan
CEMP	Construction Environmental Plan
CO	Carbon monoxide
CO_2	Carbon dioxide
DMRB	Design Manual for Roads and Bridges
EPA	New Zealand's Environmental Protection Agency
GPG	Good Practice Guide
GWRC	Greater Wellington Regional Council
HCV	Heavy Commercial Vehicles
LCV	Light Commercial Vehicles
LTMA	Land Transport Management Act (2003)
M2PP	MacKays to Peka Peka
MfE	Ministry for the Environment
MoT	Ministry of Transport
NES	National Environmental Standards
NIMT	North Island Main Trunk Line
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Mono-nitrogen oxides
NoR	Notice of Requirement
NZAAQG	New Zealand Ambient Air Quality Guidelines
NZ	New Zealand
NZTA	New Zealand Transport Agency
NZTS	New Zealand Transport Strategy
O_3	Ozone
Opus	Opus Consultants Limited
PM_{10}	Particulate matter with an aerodynamic diameter <10 µm
The Project	Peka Peka to North Otaki
RAQMP	Greater Wellington Regional Council Air Quality Management Plan
RMA	Resource Management Act
RoNS	Road of National Significance
SARA	Scheme Assessment Report Addendum
SH	State Highway
SO_2	Sulphur dioxide
TAPM	The Air Pollution Model
URS	URS New Zealand Limited
USA	United States of America
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VEPM	Vehicle Emissions Prediction Model
VOC	Volatile Organic Compounds

Abbreviations

Abbreviation	Description
WHO	World Health Organisation
µm	Unit of length (micron)
m	Unit of length (metre)
km	Unit of length (kilometre)
km/hr	Unit of speed (kilometres per hour)
m/s	Unit of speed (metres per second)
$\mu g/m^3$	Concentration (microgram per cubic metre)
mg/m^3	Concentration (milligram per cubic metre)
g/km	Emission Rate (grams per kilometre)
kW	Unit of Energy (kilowatt)
%	Percentage

Executive Summary

This report assesses the potential effects of discharges to air associated with the construction of an expressway between Peka Peka and North Otaki (the Expressway and Project) as part of the Wellington Northern Corridor Road of National Significance (RoNS).

Assessment of Effects from the Construction of the Expressway

The primary potential air discharge from the construction of the Expressway will be dust. Generally, properties located within 100 m of construction activities could be affected and mitigation will be required.

A number of mitigation measures have been recommended to reduce the potential for dust emissions. These measures will be contained in the Construction Air Quality Management Plan (CAQMP) and include:

- speed restrictions on construction vehicles operating near sensitive receptors;
- where practical, defining an area around construction activities where there is the potential to create dust effects and putting in place appropriate mitigation to minimise dust effects within that area;
- use of water tankers to dampen surfaces that have the potential to create dust; and
- finished cut batters will be vegetated or covered with hydroseed or mulch as soon as practicable.

There will also be minor emissions (exhaust fumes) from construction vehicles. These are not considered significant due to the relatively small number of vehicles that will be operating during the construction period.

Assessment of Effects from Vehicle Emissions

The assessment has predicted ambient concentrations of nitrogen dioxide (NO_2), carbon monoxide (CO) and PM_{10} from vehicle emissions within the project area for the opening year (2021) and the design year (2031). The results of the assessment indicate that a reduction in concentration can be expected between 2021 and 2031 for the pollutants assessed. This reduction in concentrations is primarily due to a decrease in vehicle emissions as a result of improvements in vehicle emission technologies.

The results of road traffic pollution dispersion modelling indicate that small reductions in the concentration of vehicle air pollutants can be expected in the township of Otaki along the existing SH 1 and especially around the SH 1 / Mill Road intersection. For both of the years assessed, concentrations are generally predicted to increase in areas located within 200 m of the Expressway. However, this increase is minor and likely to only be experienced in a small area due to the location of the proposed Expressway alignment, which takes vehicle traffic to the east and away from the majority of the township of Otaki. Regardless of the scale of any increase, predicted concentrations will remain well below relevant air quality assessment criteria.

An assessment was undertaken to determine whether there was the potential for elevated concentrations of pollutants due to reduced dispersion effects associated with the below grade section and the close proximity of a number of sensitive receptors. The results of road traffic pollution

dispersion modelling showed that the Project is unlikely to cause significant increases in NO_2 concentrations or exceedances of air quality assessment criteria in this area.

The results of dispersion modelling for the settlement of Te Horo predict improvements in air quality, especially at locations on the western side of the main arterial road. A small increase in concentrations is expected in areas adjacent to the eastern side of the Expressway, however this increase is expected to be minor when compared to the overall improvements associated with the construction of the Project, and will not result in exceedances in air quality assessment criteria.

NO_2 concentrations within 200 m of the Expressway between Te Horo and Peka Peka were found to be below relevant air quality assessment criteria.

Overall, the Expressway will improve air quality in the project area as a result of improved traffic flows which corresponds to reduced traffic emissions.

1

Introduction

The NZ Transport Agency (NZTA) is lodging a Notice of Requirement (NoR) and applications for resource consents for the construction of the Expressway. The NoR for the re-alignment of about 1.2 km of the North Island Main Trunk (NIMT) through Otaki is also being sought, and is being undertaken on behalf of KiwiRail. In this document, “the Project” refers to:

- construction of the main road alignment;
- realignment of part of the NIMT; and
- associated local road connections.

This report assesses the air quality effects associated with the operation and construction of the Expressway and has been prepared in accordance with the Tier 3 detailed assessment methodology contained in the Draft NZTA Standard for Producing Air Quality Assessments for State Highway Projects[1] (Draft NZTA Standard) along with guidance found in the Ministry for the Environment (MfE) Good Practice Guide (GPG) for Assessing Discharges to Air from Land Transport (MfE GPG LT)[2].

The report structure is as follows:

Section 2	Methodology
Section 3	Description of Project
Section 4	Assessment Matters
Section 5	Existing Environment
Section 6	Traffic and Emissions Modelling
Section 7	Dispersion Modelling
Section 8	Assessment of Effects from the Construction of the Project
Section 9	Mitigation of Construction Effects
Section 10	Assessment of Effects from the Operation of the Project
Section 11	Mitigation of Operational Effects
Section 12	Summary and Conclusions

[1] Draft NZTA Standard for Producing Air Quality Assessments for State Highway Projects, Version 5, 16 July 2010
[2] Ministry for the Environment, Good Practice Guide for Assessing Discharges to Air from Land Transport, May 2008

2

Project Description

2.1 Expressway Alignment

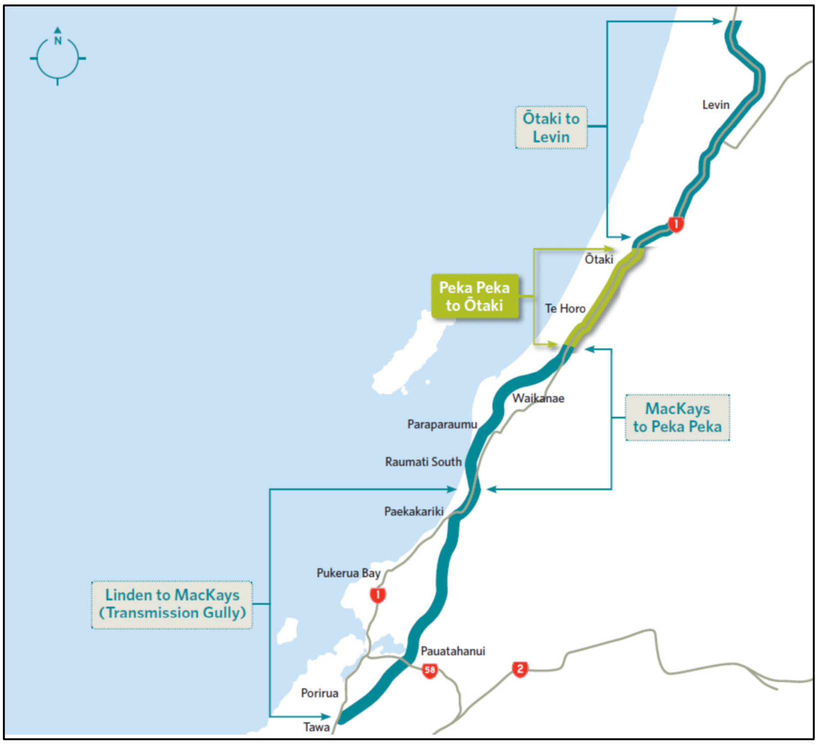
The Wellington Northern Corridor RoNS runs from Wellington Airport to Levin. The Project is one of eight sections of the Wellington Northern Corridor RoNS. The location of the Project in the overall scheme of this corridor is illustrated in Figure 2-1 below.

The NZTA proposes to designate land and obtain the resource consents to construct, operate and maintain the Expressway. This project extends from Te Kowhai Road in the south to Taylors Road just north of Otaki; an approximate distance of 13 km.

The Expressway will provide two lanes of traffic in each direction. Connections to existing local roads, new local roads and access points over the Expressway to maintain safe connectivity between the western and eastern sides of the Expressway are also proposed as part of the Project. There is an additional crossing of the Otaki River proposed as part of the Project, along with crossings of other watercourses throughout the Project corridor.

On completion, it is proposed that the Expressway becomes State Highway 1 (SH 1) and that the existing SH 1 between Peka Peka and North Otaki becomes a local arterial road, allowing for the separation of local traffic. The power to declare roads to be State highways or to revoke status resides with the Chief Executive of the Ministry of Transport, not with the NZTA.

Figure 2-1 Location of Peka Peka to North Otaki Expressway within the Wellington Northern Corridor



2.2 North Island Main Trunk (NIMT)

KiwiRail proposes to designate land in the Operative Kāpiti Coast District Plan for the construction, operation and maintenance of a re-aligned section of the North Island Main Trunk (NIMT) through Otaki. This realignment is necessary to facilitate the construction of the Project.

Methodology

3.1 Overview

This assessment is based on the Draft NZTA Standard and the MfE GPG LT, both of which set out a tiered approach to determine the appropriate level of assessment required when assessing the environmental effects from road traffic emissions. The three-tiered approach is intended to ensure that the level of assessment reflects the potential magnitude of effects from the Project.

The three assessment tiers set out in the Draft NZTA Standard are as follows:

- Tier 1 Preliminary – This level of assessment is designed to identify whether there are likely to be significant air quality effects. This assessment is based on predicted traffic flows, proximity of sensitive receptors to the Project and existing air quality.

- Tier 2 Screening Assessment – This level of assessment is based on simplified techniques, involving dispersion curve methodologies.

- Tier 3 Detailed Assessment – This level of assessment is based on detailed atmospheric dispersion modelling techniques and reliance on site-specific input data. The Tier 3 assessment is designed to evaluate in detail the likely effects of air quality risks or opportunities arising from the Project and feed this information back into the detailed design process. The Tier 3 assessment also aims to provide information on how any effects can be mitigated.

A Tier 1 assessment of the Expressway was undertaken by URS and the results of this air quality assessment were presented in a letter to Allan Planning & Research Ltd on 27 July 2011[3]. In summary, the Tier 1 assessment found that the Expressway corridor has a 'Medium' air quality risk and therefore required a more detailed evaluation in the form of a Tier 3 assessment. In addition there has been some public comment regarding potential air quality effects from the Project.

The methodology adopted for this Tier 3 assessment is presented in the following section.

This report also assesses air quality effects associated with the construction of the Expressway in accordance with MfE guidance for assessing and managing the environmental effects of dust emissions[4] (MfE GPG Dust).

[3] URS New Zealand Limited, Peka Peka to North Otaki, Assessment of alternative corridors Acoustics and Air Quality, July 2011
[4] MfE Good Practice Guide for Assessing and Managing the Environmental Effects of Dust emissions, September 2001

3.2 Approach to Assessment of Effects

3.2.1 Construction Emissions

As is common practice in New Zealand, a qualitative assessment of the potential effects associated with the construction of the Project has been undertaken. This assessment has involved reviewing the activities that are being undertaken at a particular location, and determining the potential for these activities to generate nuisance dust that might affect the local community. In determining whether there is the potential for nuisance to occur, consideration has been made of:

- The nature of the activity being undertaken;
- How long the activities are likely to occur;
- The nature of the soils or other material being cut or placed;
- Whether mitigation measures can be implemented to control the potential for effects (e.g. use of water carts, covering stockpiles etc);
- How close receptors are to the works;
- The nature of the receptors and their sensitivity to dust; and
- The prevailing meteorological conditions.

3.2.2 Operational Emissions

The following vehicle-related air pollutants have been identified as having the potential to cause adverse health effects:

- carbon monoxide (CO);
- oxides of nitrogen (NO_x, including NO_2);
- volatile organic compounds (VOC);
- and particulate matter with a mean aerodynamic diameter less than 10 μm (or PM_{10}).

There are also other gases such as ozone and secondary particulate, as sulphates and nitrates, that can form in the atmosphere from chemical reactions involving these primary pollutants, that also have the potential to cause adverse effects.

Oxides of nitrogen (NO_x) play a number of important roles in atmospheric chemistry, and have the potential to contribute to photochemical smog formation and acid deposition, the operational phase road traffic emissions of NO_x (as determined in this assessment) were not deemed to be significant enough to warrant a detailed assessment of their potential to cause photochemical smog, and/or health risk or ecosystems impacts. This is based on URS's experience of a number of road traffic air quality assessments of a similar nature and scale to the Project.

In addition to effects on human health there is also the potential for air pollutants to have effects on ecosystems. However these effects are generally only noticed when concentrations reach high levels, higher than those used as assessment criteria for determining adverse health effects. Levels of air pollution in New Zealand rarely reach these ecosystem effect levels and therefore it is reasonably assumed that providing pollutants are below the health based effects assessment criteria then there are unlikely to be effects on the environment or ecosystems.

3 Methodology

From the large range of pollutants associated with vehicle emissions the MfE GPG LT has identified five pollutants that have the greatest potential to cause adverse effects and require the greatest level of attention. These pollutants are as follows:

- CO;
- NO_x;
- photochemical oxidants, including ozone (O_3);
- particulate matter (PM_{10} and $PM_{2.5}$); and,
- VOCs, including benzene and 1,3-butadiene.

Of the pollutants mentioned, concentrations of CO, NO_2 and PM_{10} have been predicted at the selected locations surrounding the Expressway and local roads using a road traffic pollution model (as described in Section 7.1) and compared concentrations against the assessment criteria presented in Section 3.3. The road traffic pollution dispersion model relies on a number of key inputs such as traffic volumes, emission rates and local meteorology, as described in Section 6 and 7.

VOC, O_3 and $PM_{2.5}$ were not assessed as the ambient concentrations are reasonably expected to be below guidelines given the moderate traffic volumes predicted. If NO_2, CO and PM_{10} concentrations are found to exceed air quality assessment criteria, then a more detailed assessment of VOC, O_3 and $PM_{2.5}$ concentrations may be required. This assumption is based on guidance found in the GPG LT *"For most assessments it is valid to assume that CO, PM_{10} and NO_x are good indicators of the likely effects".*

A number of locations near to the Expressway have been identified as being sensitive to ambient air pollutants arising from vehicle emissions and required specific analysis to determine the level of effect. These locations are defined in Section 5.2.

In addition to the contribution from vehicle emissions, specifically CO, NO_2 and PM_{10}, the pollutants are present in the environment as 'background' concentrations. These predominantly arise from activities such as domestic home heating and industrial processes. This report has attempted to determine background concentrations, within the assessment area, by undertaking a short-term ambient air quality monitoring study, measuring concentrations at a number of locations within the region. This data has then been used in this assessment to assess cumulative concentrations i.e. road contribution + background.

Five scenarios have been assessed to determine potential effects associated with the Project. These scenarios reflect the effect the Expressway will have on air quality, taking into consideration improvements in vehicle emissions and changes to the composition of the vehicle fleet, when compared with the option of not implementing the Project.

URS has predicted the potential effects of the Expressway on the surrounding environment for the current situation (base year 2010), the opening year (2021) and 10 years after opening (2031). Future scenarios are referred to as either 'Without Project' or 'With Project'.

These scenarios are set out in accordance with the Draft NZTA Standard and are defined as:

- Base Year (2010) – Current Situation.
- Opening Year (2021) With Project – The Project is implemented.
- Opening Year (2021) Without Project – Assumes the Project does not proceed and the current SH section is maintained.

- Opening Year + 10 Years (2031) With Project – The project is implemented.
- Opening Year + 10 Years (2031) Without Project – Assumes the Project does not proceed and the current SH 1 section is maintained.

3.3 Air Quality Assessment Criteria

The following assessment criteria have been identified as being relevant to the Project:

- National Environmental Standards for Air Quality;
- New Zealand Ambient Air Quality Guidelines;
- World Health Organisation Standards; and,
- Regional Ambient Air Quality Targets.

3.3.1 National Environmental Standards

The MfE promulgated National Environmental Standards for Air Quality (NES)[5] as regulations under the Resource Management Act 1991 (RMA) on 6 September 2004 which are based on the potential for health effects. These health effects are described in the MfE New Zealand Ambient Air Quality Guidelines (NZAAQG)[6]. The NES applies standards to five air pollutants: PM_{10}, CO, NO_2, SO_2 and O_3. The NES also places restrictions on home heating appliances, hazardous waste combustion etc, but these are not relevant to this assessment.

While these standards were not intended to become air quality assessment criteria they have become de facto assessment criteria because regional authorities are required to ensure air quality within their jurisdiction is maintained at or below these levels.

Table 3-1 presents the ambient air quality assessment criteria relevant to this assessment.

Table 3-1 National Environmental Standards for Ambient Air Quality

Pollutant	Air Quality Criteria	Averaging Period
PM_{10}	50 µg/m³	24-hr
CO	10 mg/m³	8-hr
NO_2	200 µg/m³	1-hr
SO_2	350 µg/m³	1-hr
O_3	150 µg/m³	1-hr

3.3.2 New Zealand Ambient Air Quality Guidelines

The NZAAQG were published by the MfE in 2002 following a comprehensive review of international and national research, and are widely accepted among New Zealand air quality practitioners. The NZAAQG criteria provide the minimum requirements that ambient air quality should meet in order to protect human health and the environment.

NZAAQG levels for pollutants and averaging periods not superseded by the NES are still relevant and should be considered as part of any assessment. The NZAAQG criteria set for the protection of human-health are presented in Table 3–2.

[5] Ministry for the Environment, Resource Management (National Environmental Standards for Air Quality), Regulations 2004
[6] Ministry for the Environment, Ambient Air Quality Guidelines (2002 update)

Table 3-2 New Zealand Ambient Air Quality Guidelines Relevant to Assessment

Pollutant	Threshold Concentration	Averaging Period
PM_{10}	20 µg/m³	Annual
CO	30 mg/m³	1-hr
NO_2	100 µg/m³	24-hr
Benzene	3.6 µg/m³	Annual

3.3.3 World Health Organisation

The NES and NZAAQG are essentially the same as those promulgated by the World Health Organisation (WHO), WHO Air Quality Guidelines (WHO AQG)[7]. In addition WHO has promulgated 24-hr and annual guidelines for $PM_{2.5}$ and an annual guideline for NO_2, both of which are relevant to this assessment. These guidelines are presented in Table 3-3.

Table 3-3 WHO Air Quality Guidelines Relevant to this Assessment

Pollutant	Maximum	Averaging Period
$PM_{2.5}$	25 µg/m³	24-hr
	10 µg/m³	Annual
NO_2	40 µg/m³	Annual

3.3.4 Greater Wellington Regional Quality Targets

The Greater Wellington Regional Council's (GWRC) Air Quality Management Plan (RAQMP)[8] became operative on 8 May 2000 and sets out regional ambient air quality guidelines for a number of pollutants relevant to this Project. These are presented in Table 3-4. These targets are the same as those found in the NES and NZAAQG, except for 1-hr NO_2 which is less stringent.

Table 3-4 Regional Ambient Air Quality Guidelines Regional Ambient Air Quality Guidelines

Pollutant	Maximum	Averaging Period
PM_{10}	50 µg/m³	24-hr
	20 µg/m³	Annual
CO	10 mg/m³	8-hr
NO_2	300 µg/m³	1-hr
	100 µg/m³	24-hr

3.4 Significance Criteria for Incremental Analysis

The MfE has recommended a set of criteria to determine whether the predicted concentrations of road traffic pollutants are likely to be 'significant' (MfE GPG LT). These are absolute criteria and are not

[7] WHO (2006), Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulphur dioxide, Global updated 2005
[8] Greater Wellington Regional Council, Regional Air Quality Management Plan for the Wellington Region, 8 May 2000

3 Methodology

related to the existing air quality and are for incremental analysis only. The significance criteria relevant to this assessment are presented in Table 3-5.

The significance of changes in air quality has been presented in Section 10 using the results of road traffic pollution dispersion modelling. A significant change in pollutant concentrations has been indicated with either a '–ve', indicating an improvement by more than the significant criteria concentration or a '+ve', indicating degradation in air quality by more than the significant criteria concentration. Minor changes less than the significant criteria concentration have been indicated with a 'NC'.

Table 3-5 MfE Ambient Air Quality Significance Criteria

Pollutant	Significant Criteria Concentration	Averaging Period
PM_{10}	2.5 µg/m³ 1.0 µg/m³	24-hr Annual
NO_2	20 µg/m³ 5 µg/m³	1-hr 24-hr
CO	1 mg/m³	8-hr

Relevant Matters for Consideration

In addition to the assessment criteria set out in Section 3, there are various other matters that require consideration when undertaking an assessment of this type. These matters can be influenced by the environment described in Section 5. Those that are appropriate to this assessmentare set out below.

4.1 RMA Matters

The purpose of the RMA is to promote the sustainable management of natural and physical resources, including air, as defined in section 5 of the Act:

"5. Purpose

1. *The purpose of this Act is to promote the sustainable management of natural and physical resources.*

2. *In this Act, "sustainable" means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while –*

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
(b) Safeguarding the life-supporting capacity of air, water, soil and ecosystems; and
(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment."

4.2 Resource Management (Energy and Climate Change) Amendment Act 2004

Under the Resource Management (Energy and Climate Change) Amendment Act 2004 the RMA was amended to:

"(a) to make explicit provision for all persons exercising functions and powers under the principal Act to have particular regard to—

(i) the efficiency of the end use of energy; and

(ii) the effects of climate change; and

(iii) the benefits to be derived from the use and development of renewable energy; and

(b) to require local authorities—

(i) to plan for the effects of climate change; but

(ii) not to consider the effects on climate change of discharges into air of greenhouse gases."

This amendment removed the power of local government to consider the effect of greenhouse gas emissions on climate change when making rules in regional plans, or when assessing air discharge consent applications, except where it is necessary to implement a National Standard.

Although there is expected to be an increase in the number of vehicles travelling along the Peka Peka to Otaki section of the State highway, as part of the implementation of the Expressway, and therefore an increase in greenhouse gas emissions, the Expressway will allow vehicles to travel at a higher average speed. This increase in the average speed along with improved combustion and fuel efficiencies, associated with the replacement and renewal of the vehicle fleet, is expected to result in an overall reduction in greenhouse emissions, when compared to the 'Without Project' scenarios.

Greenhouse gas emissions are therefore not considered any further in this report.

4.3 Land Transport Management Act

"The purpose of the Land Transport Management Act 2003 (LTMA)[9] is to:

1. *Contribute to the aim of achieving an affordable, integrated, safe, responsive, and sustainable land transport system.*
2. *To contribute to the purpose, the LTMA*
    - *provides an integrated approach to land transport funding and management; and*
    - *improves social and environmental responsibility in land transport funding, planning, and management; and*
    - *ensures that the land transport funding is allocated in an efficient and effective manner."*

4.4 NZTA Environmental Plan

The NZTA Environmental Plan[10] specifies how NZTA staff and suppliers are expected to address key social and environmental impacts and sets out the objectives, performance indicators and implementation plans. Included in the objectives are:

"A1 Understand the contribution of vehicle traffic to air quality.

A2 Ensure new State highway projects do not directly cause national environmental standards for ambient air quality to be exceeded.

A3 Contribute to reducing emissions where the State highway network is a significant source of exceedances of national ambient air quality standards."

The air quality performance indicator in the Environmental Plan is *annual assessment of vehicle emissions from the State highway network gathered from selected sites using diffusion tubes to measure nitrogen dioxide (NO_2) as a surrogate measure. The objective is to monitor a decreasing trend in emissions of NO_2."*

Initiatives of the implementation plan for air quality management guidance include:

- *"undertaking air quality assessments for new and upgraded State highways;*
- *determining best practicable option to avoid, remedy or mitigate exposure to elevated levels of air pollution associated with the State highway network;*
- *seeking designation air quality management and monitoring conditions for new or upgraded State highways;*
- *dealing with reverse-sensitivity air quality issues near the State highway network;*
- *managing air pollution emissions, including dust, associated with construction and maintenance activities on the State highway network; and handling and managing air pollution complaints."*

[9] Land Transport Management Act, 2003 No 118, Public Act, as at 10 May 2011
[10] Transit 2008. Environmental Plan, Version 2 June 2008

4.5 New Zealand Transport Strategy

"The New Zealand Transport Strategy (NZTS)[11] set out key transport targets. Those that relate to air quality include:

1. *"ensuring environmental sustainability*
    - *Halve per capita greenhouse gas emissions from domestic transport by 2040*
    - Become one of the first countries in the world to widely use electric vehicles.
    - *Reduce the rated carbon dioxide (CO_2) emissions per kilometre of combined average new and used vehicles entering the light vehicle fleet to 170 grams CO_2 per kilometre by 2015, with a corresponding reduction in average fuel used per kilometre.*
2. *protecting and promoting public health*
    - *Reduce the number of people exposed to health endangering concentrations of air pollution in locations where the impact of transport emissions is significant."*

4.6 Greater Wellington Regional Council Air Quality Management Plan

The RAQMP identifies air emissions from mobile transport as significant sources of air pollution within the region, particularly in the Wellington urban area. The RAQMP contains objectives and policies that address the air quality impacts from these sources of air pollution. In addition, Objectives 4.1.1 and 4.1.2 also cover emissions associated with the construction of roads. The RAQMP contains no specific rules relating to discharges from mobile transport sources.

Objective 4.1.1

High quality air in the Region is maintained and protected, degraded air is enhanced, and there is no significant deterioration in ambient air quality in any part of the Region.

Objective 4.1.2

Discharges to air in the Region are managed in a way, or at a rate which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while ensuring that adverse effects, including any adverse effects on:

- *local ambient air quality;*
- *human health;*
- *amenity values;*
- *resources or values of significance to tangata whenua;*
- *the quality of ecosystems, water, and soil; and*
- *the global atmosphere;*

are avoided, remedied or mitigated.

Policy 4.2.22

To avoid, remedy, or mitigate the adverse effects of discharges to air from mobile transport sources and to promote:

[11] Ministry of Transport 2008, New Zealand Transport Strategy, August 2008

(1) the use of transport fuels which are low or non-polluting;
(2) the use of fuel-efficient and well maintained vehicles; and
(3) driving habits which minimise the production of harmful emissions.

Policy 4.2.23

To promote improved air quality in the Region through regional and district transport planning practices which:

(1) encourage the development of an efficient and effective public transport system;
(2) promote the use of non-motorised forms of transport such as walking and cycling; and
(3) aim to reduce the growth in motor vehicle numbers and motor vehicle congestion in urban centres.

4.7 Wellington Regional Land Transport Strategy

The Wellington Regional Land Transport Strategy[12] contains the following policies that relate to air quality within the region.

- *Support continuous improvement in air quality through reduction in harmful vehicle emissions.*
- *Support the reduction of greenhouse gas emissions arising from the operation of the regional transport network.*

4.8 Operative Kāpiti Coast District Plan

The Operative Kāpiti Coast District Plan does not have any specific rules relating to air quality that are applicable to the Project. The plan instead refers to the RAQMP for the Wellington Region.

4.9 Airshed

In 2005 the regional councils and unitary authorities identified a number of areas throughout New Zealand where ambient concentrations of air pollutants could reach levels higher than the NES for air quality. These areas have been called airsheds. Airsheds serve as a management tool for regional councils to assist with controlling levels of pollutants within that area. Regional councils have the responsibility to monitor concentrations of air pollutants within theses airshed, and may implement rules and regulations to ensure that air quality is maintained at levels below the NES.

The project area is located within the gazetted Kāpiti Coast airshed. Figure 4-1 shows the boundary of the airshed. The Kāpiti Coast airshed has been gazetted under the NES as concentrations of PM_{10} measured at Paraparaumu are considered to have the potential to exceed the 24-hr average PM_{10} standard. This is supported by monitoring undertaken by the GWRC during the winter months of 2010.

Although there is the potential for exceedances to occur within the Kāpiti Coast airshed, particularly at locations with significant populations, such as Paraparaumu, it is considered unlikely that existing concentrations within the project area (within 200 m of the Expressway) will exceed the standard. This assumption is based on the six months of PM_{10} monitoring undertaken by URS during the period 20 July 2011 to 06 February 2012, as discussed in Section 5.4.2, where maximum measured

[12] Wellington Regional Land Transport Strategy 2010-2040, Approved September 2010

4 Relevant Matters for Consideration

concentrations were found to be well below the NES. This monitoring study is considered to have provided worst-case PM_{10} concentrations within the project area, as the monitoring location was close to the most prominent sources of PM_{10} (vehicle traffic on SH 1 and residential home heaters within Otaki) and included monitoring during the winter months both of which have the greatest potential to contribute towards elevated background PM_{10} concentrations.

Figure 4-1 Gazetted Kāpiti Coast Airshed

Source: MapToasterTopo New Zealand Topographical Maps and Aerial Photography, V5.0.246

Site Description/Existing Environment

This section of the report provides an overview of the air quality environment between Peka Peka and North Otaki, the area in which the Project will be constructed.

5.1 Land Use and Topography

The Expressway alignment primarily runs alongside the existing SH 1 through land which is zoned rural and residential. The main township of Otaki and the settlement of Te Horo are located between the coast, approximately 4 km to the west, and the Tararua Ranges which are 3 km to the east. The rural land is mainly used for beef and sheep farming as well as market gardening activities.

The NIMT follows the alignment of SH 1 from Peka Peka to North Otaki. The railway line is mainly used to transport freight, with a passenger service currently using the railway line twice a day.

Figures showing the land use and topography of the area along the Expressway alignment are presented in the Assessment of Environmental Effects Report - Peka Peka to Otaki Expressway, Volume 5 (Scheme Drawings – Site Layout Plans).

5.2 Sensitive Receptors

A ‘sensitive receptor’ is defined as a location where people or surroundings may be particularly sensitive to the effects of air pollution. This type of receptor includes residential houses, hospitals, schools, early childhood education centres, childcare facilities, rest homes, residential properties, premises used primarily as temporary accommodation (such as hotels, motels, and camping grounds), open space used for recreation, the conservation estate, marae and other similar cultural facilities[13].

In addition, orchards and market gardens can be considered sensitive to construction dust as it has the potential to reduce produce quality[14].

There are a number of residential properties, churches and schools located near to the Expressway at Otaki, Otaki South and Te Horo that have the potential to be sensitive to the effects of the Project. During the preliminary stages of the assessment areas were identified where there was the potential for air quality impacts, and a number of representative sensitive receptors selected in each of those areas. These receptors are presented in Table 5-1.

Effects on the other sensitive receptors are likely to be less than at the selected locations. This is common practice for such projects.

The modelling results discussed later in the report also considered all other residential properties within 200 m of the proposed alignment.

The location of these selected sensitive (discrete) receptors is also shown in Figure 5-1, (the township of Otaki,) Figure 5-2 (Otaki South) and Figure 5-3, (the settlement of Te Horo). The Expressway alignment and the extent of the designations are also annotated onto each of the figures. The designation boundaries are shown as the outer line.

[13] NZTA, Guide to assessing air quality effects for the State highway asset improvement projects, Version 0.6, 2012, Draft
[14] P McCrea, An Assessment of the Effects of Road Dust on Agricultural Production Systems , Agricultural Economics Unit, Lincoln University 1984

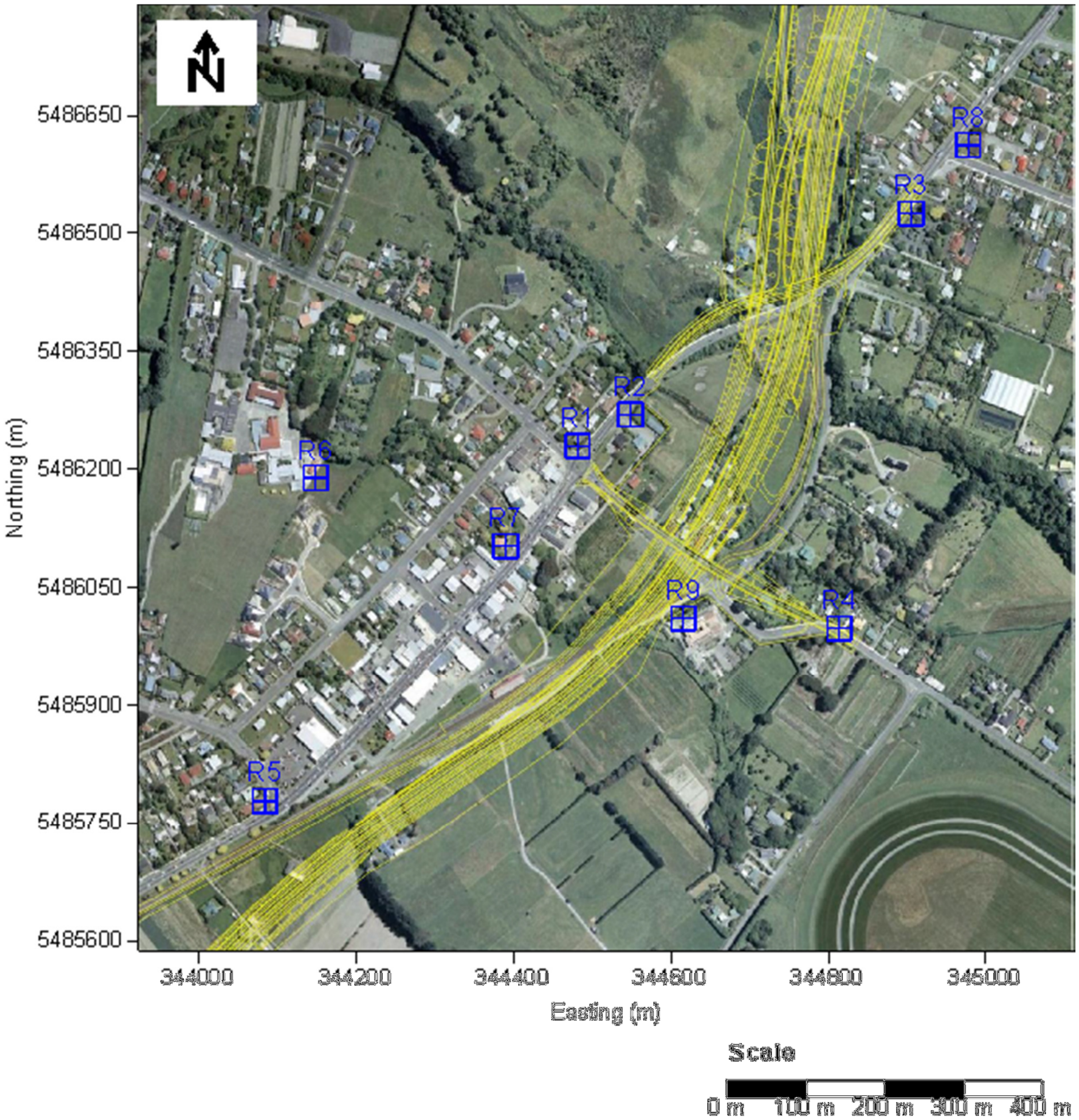
5 Site Description/Existing Environment

Table 5-1 Sensitive (Discrete) Receptors

Sensitive Receptors	Receptor No.	Receptor Location (Universal Transverse Mercator (UTM,) Zone 60)	Type
Otaki			
286 Main Hwy	R1	344482 m E, 5486230 m S	Residential Property
Otaki Motel	R2	344549 m E, 5486270 m S	Accommodation
270A Main Hwy	R3	344905 m E, 5486526 m S	Residential Property
56A Rahui Road	R4	344814 m E, 5485998 m S	Residential Property
153 Main Hwy	R5	344084 m E, 5485778 m S	Residential Property
Otaki College	R6	344149 m E, 5486189 m S	School
239 Main Hwy	R7	344390 m E, 5486102 m S	Residential Property
Highway Baptist Church	R8	344978 m E, 5486613 m S	Church
Former Rahui Milk Treatment Station	R9	344616 m E, 5486010 m S	Convention Centre
Otaki South			
53 Otaki Gorge Road	R1	343558 m E, 5484334 m S	Residential Property
44 Otaki Gorge Road	R2	343484 m E, 5484096 m S	Residential Property
34 Otaki Gorge Road	R3	343350 m E, 5484256 m S	Residential Property
69 Otaki Gorge Road	R4	343690 m E, 5484460 m S	Residential Property
1277 Addington Road	R5	343229 m E, 5484602 m S	Residential Property
10 Addington Road	R6	343033 m E, 5484323 m S	Commercial Property
1229 Addington Road	R7	343091 m E, 5484245 m S	Residential Property
1209 Addington Road	R8	342998 m E, 5484084 m S	Residential Property
1199 Addington Road	R9	342960 m E, 5484021 m S	Orchard
36 Otaki Gorge Road	R10	343335 m E, 5483975 m S	Orchard
Te Horo			
Te Horo School	R1	342215 m E, 5480630 m S	School
26 School Road	R2	341501 m E, 5481253 m S	Residential Property
Red House Café	R3	341361 m E, 5481285 m S	Cafe
97 Gear Road	R4	341262 m E, 5480587 m S	Residential Property
845 SH 1	R5	341170 m E, 5480929 m S	Residential Property
961 SH 1	R6	341766 m E, 5481955 m S	Residential Property
937 SH 1	R7	341612 m E, 5481690 m S	Residential Property

5 Site Description/Existing Environment

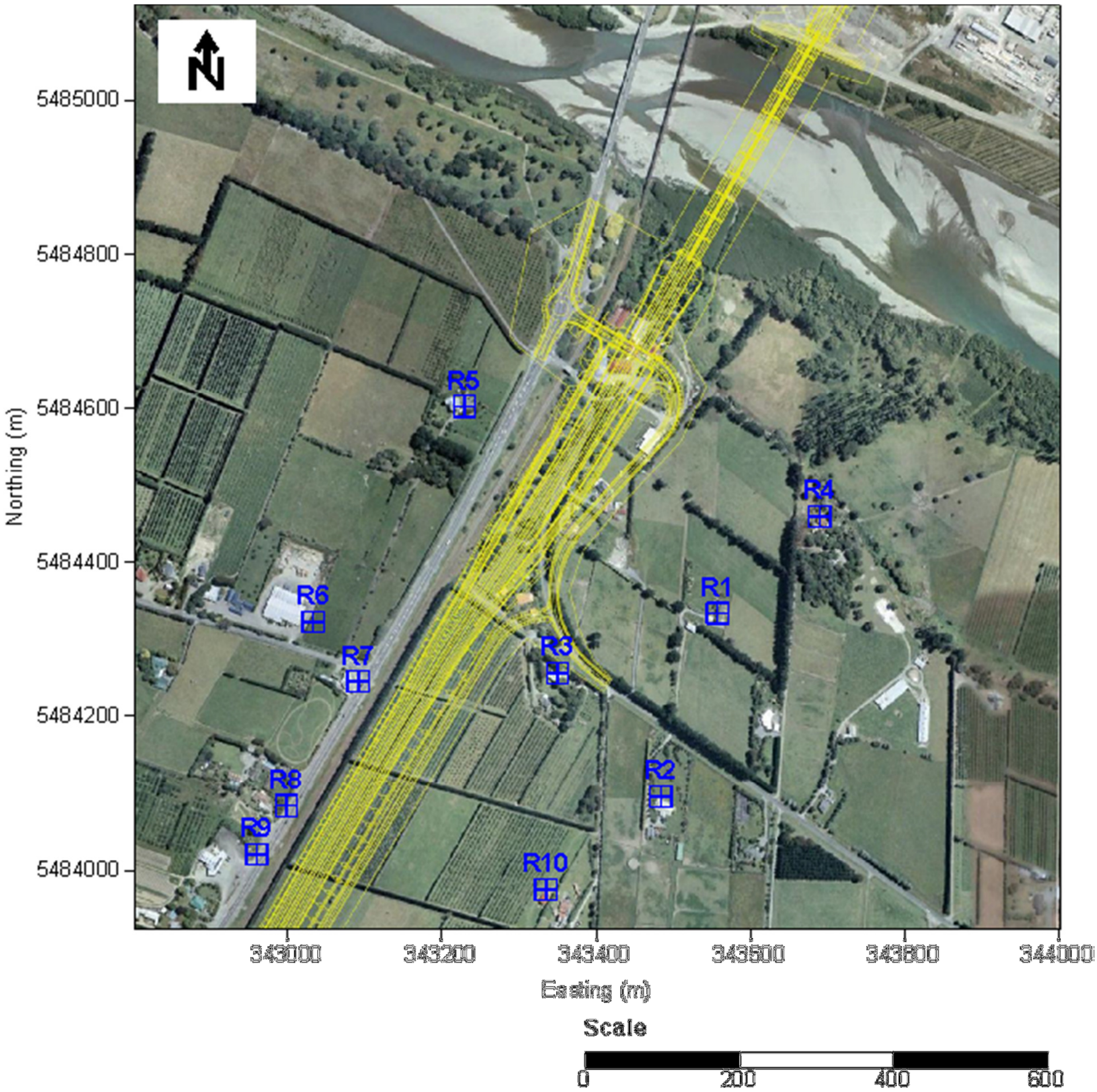
Figure 5-1 Sensitive Receptors Located Near to the Expressway at Otaki



Aerial Source: Google Earth™, Image Kāpiti Coast District Council

5 Site Description/Existing Environment

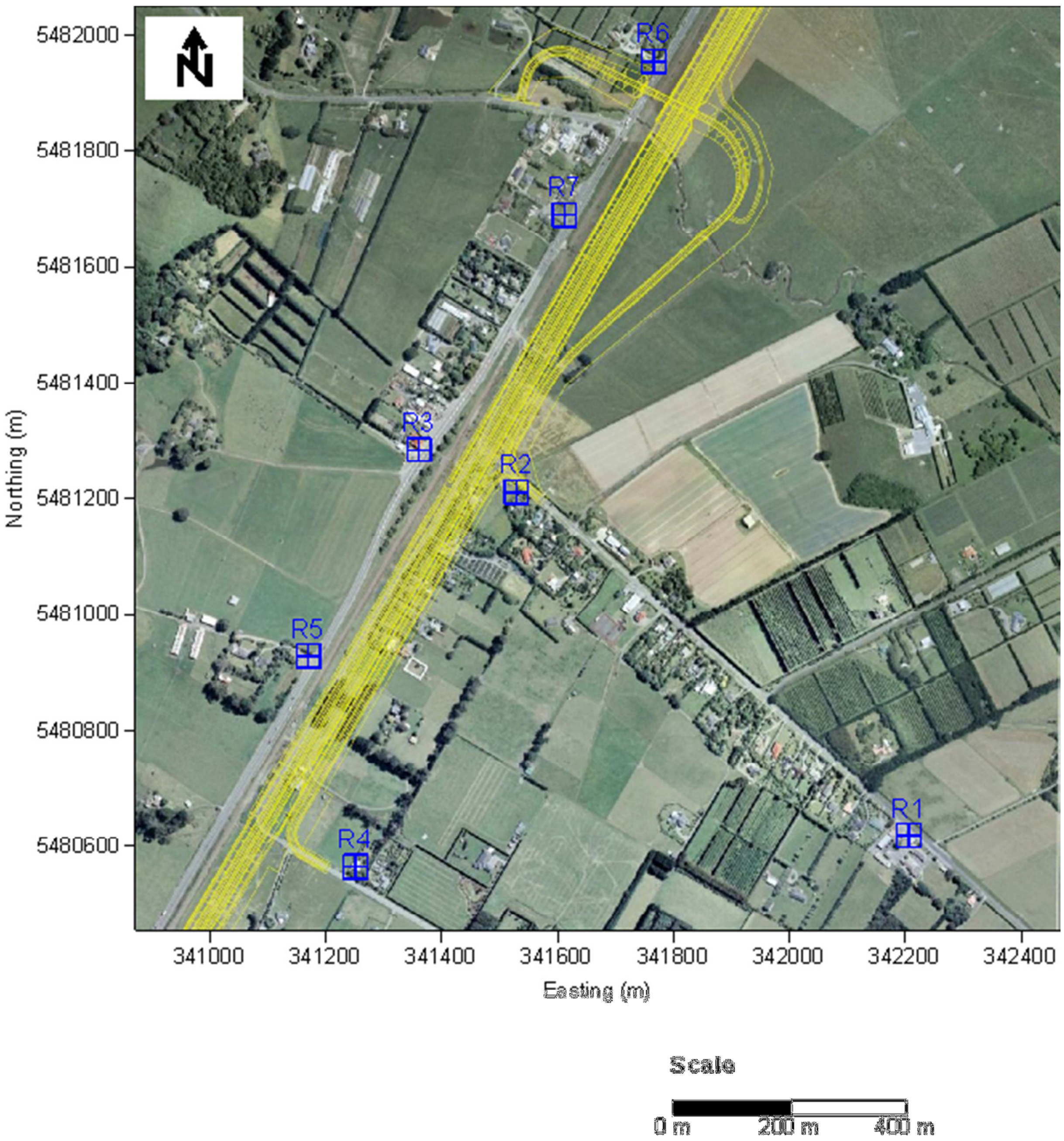
Figure 5-2 Sensitive Receptors Located Near to the Expressway at South Otaki



Aerial Source: Google Earth™, Image Kāpiti Coast District Council

5 Site Description/Existing Environment

Figure 5-3 Sensitive Receptors Located Near to the Expressway at Te Horo



Aerial Source: Google Earth™, Image © 2012 Digital Globe, Image Kāpiti Coast District Council

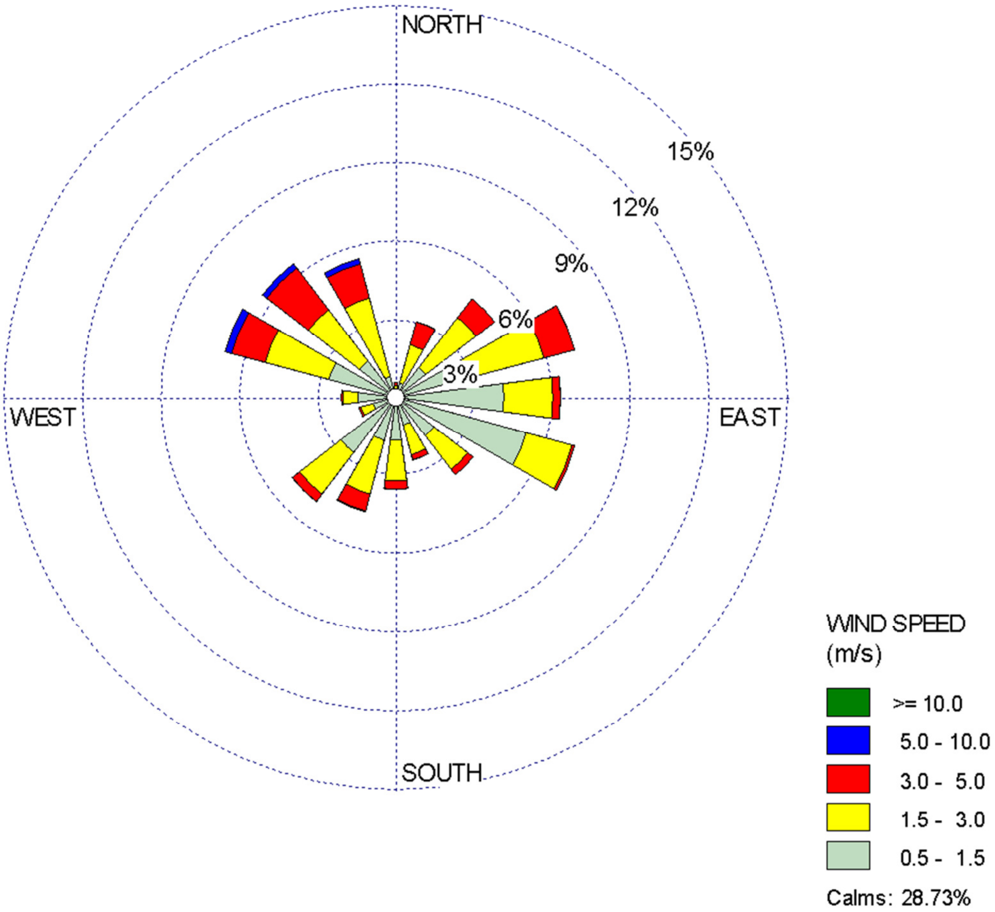
5.3 Meteorology

URS reviewed historic data from the Te Horo meteorological station operated by the MetService during the period 1972-1976. This data is presented in Appendix A.

Given the age of this data a meteorological station was installed at Te Horo, approximately halfway between Peka Peka and Otaki. The meteorological station was commissioned in March 2011 at 7 Gear Road and measures wind speed and direction, temperature, humidity and rainfall. A wind rose of the 1-hr mean wind data for the period 04 March 2011 to 31 December 2012 at the Te Horo site is presented in Figure 5-4.

In addition to the data collected from the Te Horo weather station, meteorological data collected at Levin and Paraparaumu has also been reviewed and used. The Levin monitoring site is located approximately 21 km to the north of Otaki and Paraparaumu is 23 km to the south. Wind roses for the Levin and Paraparaumu monitoring sites for the period 01 January 2005 to 31 December 2012 are presented in Figures 5-5 and 5-6 respectively.

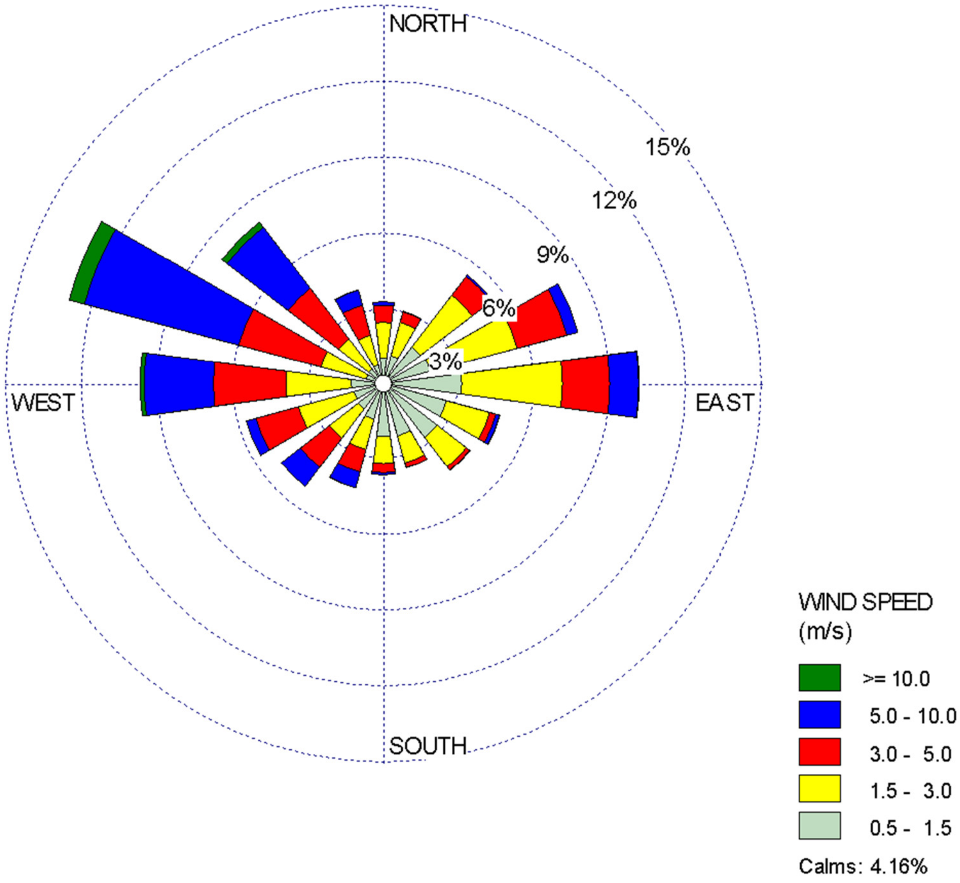
Figure 5-4 Te Horo Meteorological Data for the Period 04 March 2011 to 31 December 2012



5 Site Description/Existing Environment

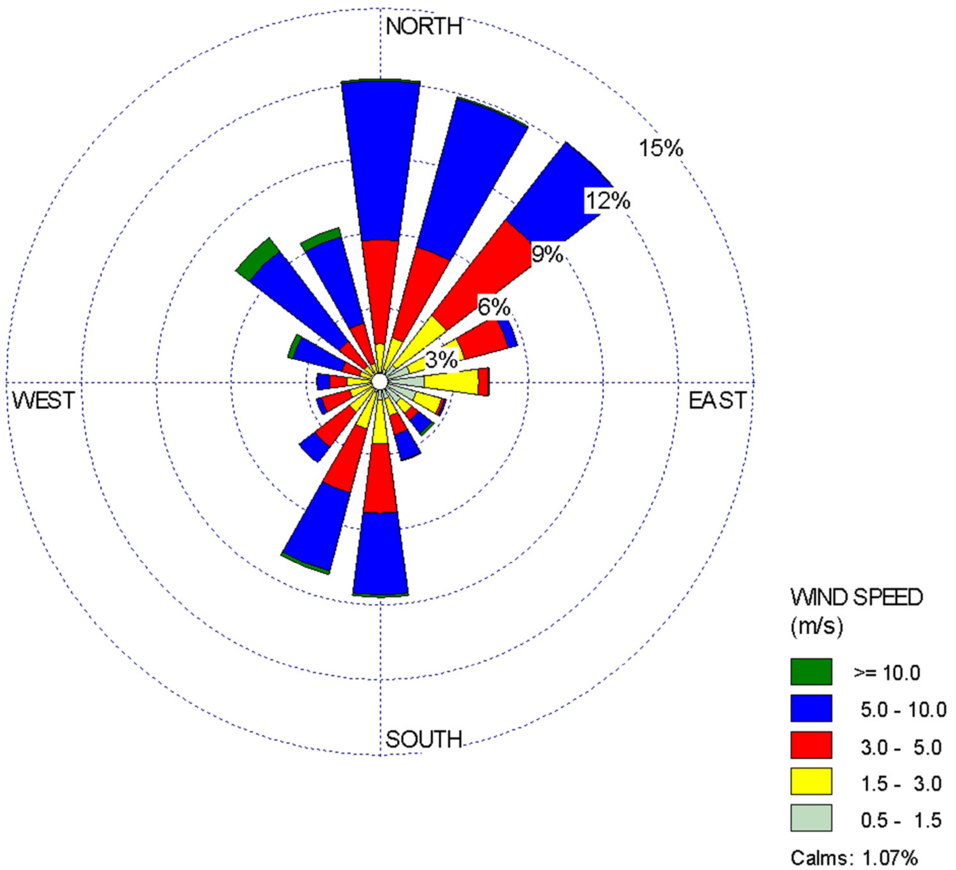
Figure 5-4 shows that the predominant wind direction measured at Te Horo for the monitoring period was from the easterly quadrant, with the strongest winds being from the northwest. As presented in Figure 5-4, there were a large number of calm periods and low wind speeds measured, when compared to the monitoring data from Levin and Paraparaumu. This is most likely due to the different heights at which the anemometer (wind speed sensor) was located, as wind speed increases with height above ground. The Te Horo station anemometer was located at 6 m compared to the other stations which have a height of 10 m.

Figure 5-5 Levin Meteorological Data for the Period 01 January 2005 to 31 December 2012



5 Site Description/Existing Environment

Figure 5-6 Paraparaumu Meteorological Data for the Period 01 January 2005 to 31 December 2012



5.4 Background Ambient Air Quality

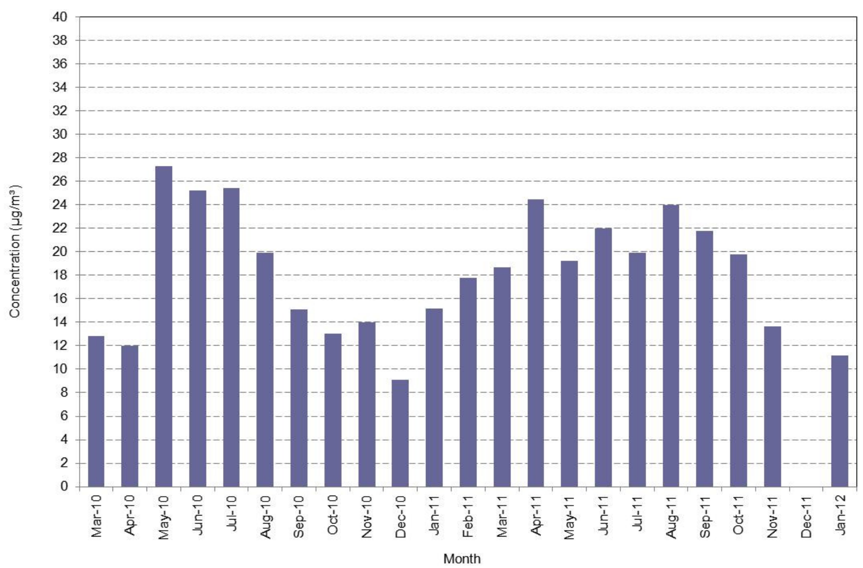
This section of the report presents the air quality monitoring data available for the assessment area.

5.4.1 NZTA Passive NO_2 Monitoring Programme

No known long-term background NO_2 monitoring has been undertaken within the assessment area. However, the NZTA has set up a comprehensive network of monitoring sites throughout New Zealand[15,16] measuring short-term average NO_2 concentrations. As part of this network, monitoring has been undertaken in Otaki at the corner of SH 1 and Mill Road. Monitoring at this location commenced in March 2010 and will continue for the foreseeable future. NO_2 measurements are collected as monthly averages using passive diffusion tubes which are supplied and analysed by Staffordshire County Council Scientific Services in the United Kingdom.

To date the monitoring location has measured moderate levels of NO_2. This is primarily due to its close location to the busy intersection, where worst-case emissions occur as vehicles have to slow and queue. Figure 5-7 presents the monthly NO_2 concentrations measured at this site. The data shows that NO_2 concentrations are lowest during summer months and highest during the winter. This is most likely due to meteorological conditions and the contribution of combustion emissions from fuel burning heaters in the township of Otaki. The average concentration for the period March 2010 to January 2012 was 18 µg/m³ and the annual average concentration for the period January 2011 to December 2011 was 20 µg/m³. Based on the results of the monitoring data, no adverse effects are expected from NO_2 concentrations at this location as the annual average is well below the WHO[17] annual average guideline of 40 µg/m³.

Figure 5-7 Summary of NO_2 Monitoring Undertaken at Otaki (Corner SH1 and Mill Road) (March 2010 – January 2012)



[15] NZTA Ambient Air Quality (nitrogen dioxide) monitoring network report) 2007 - 2009
[16] NZTA Ambient Air Quality (nitrogen dioxide) monitoring network site meta data report 2007-2010
[17] World Health Organisation Air Quality Guidelines Global Update, 2005

5.4.2 URS Monitoring Study

During the scoping phase of the Project, it was identified that there was generally a lack of air quality monitoring at locations within the assessment area. A short-term monitoring study was completed between July 2011 and January 2012 to assist with determining background concentrations of the main vehicle related pollutants. The monitoring undertaken as part of this monitoring programme is presented below.

On 3 August 2011, URS began monitoring NO_2, using the same method mentioned in Section 5.4.1, at three locations, Rahui Road in Otaki, 7 Gear Road in Te Horo and at the MacKays to Peka Peka project monitoring station on Raumati Road in Paraparaumu. This monitoring was undertaken in accordance with the National Standards Authority of Ireland (NSAI) Standard for the determination of concentrations of gases and vapours[18].

The Te Horo monitoring site is located in a semi-rural area approximately 85 m from SH 1 and 40 m from the NIMT, and provides a good approximation of NO_2 concentrations within Te Horo.

The Paraparaumu monitoring location was selected in order to compare measured passive badge concentrations of NO_2 with the co-located continuous NO_X monitor located at the site.

Continuous PM_{10} and CO monitors were also installed at Rahui Road on 19 July 2011 to provide additional information on the other air pollutants of concern. These air quality monitors were sited in accordance with the specifications outlined in Australia/New Zealand Standard AS/NZS 3580.1.1:2007[19]. The Rahui Road monitoring site is located approximately 135 m to the south east of the SH 1/Mill Road intersection and at a sufficient distance that it is unlikely to be significantly influenced by traffic emissions. This site is likely to provide a good approximation of background concentrations within the township of Otaki, and is considered to be an urban background monitoring location.

All of the ambient air quality monitoring was undertaken in accordance with the recommendations outlined in the MfE GPG for Air Quality Monitoring and Data Management[20].

Meta data for each monitoring location is presented in Appendix B.

[18] National Standards Authority of Ireland (NSAI) Ambient Air Quality - Diffusive Samples for the Determination of Concentrations of gases and vapours – Part 1-3, 2002

[19] Australian/New Zealand Standard AS/NZS 3580.1.1:2007 Methods for Sampling and analysis of ambient air

[20] Ministry for the Environment (MfE) Good Practice Guide for Air Quality Monitoring and Data Management, 2009

5.4.2.1 NO_2 Monitoring Results

The results of NO_2 monitoring along with concentrations measured at the SH 1/Mill Road location are presented in Table 5-2 and Figure 5-8. The results show that NO_2 concentrations at the SH 1/Mill Road intersection are significantly higher than those measured at Rahui Road and Te Horo. This is due to the location's close proximity to the State highway roadside (<5 m) when compared with the other locations at 135 m and 85 m respectively from the roadside. The results from this location have therefore been used to verify the road traffic pollution model and the concentrations measured at Rahui Road and Te Horo have been used to estimate typical background concentrations within the assessment area.

The Rahui Road and Te Horo monitoring locations produced very similar results. The results are interesting in that concentrations are similar in spite of the different distances to the highway and contributing sources of pollution: the Rahui Road location's contribution is primarily from local domestic fired burners in Otaki and emissions from vehicles travelling at low speed through Otaki. The only significant contribution at the Te Horo location is from emissions from vehicles travelling at highway speeds (free flow speeds typical for highways (e.g. 100 km/hr)). Both sites are located close to the NIMT and are likely to experience some contribution from locomotive emissions. Given the correlation in concentrations between the locations, the value of 8 µg/m³ has conservatively been used as the annual background concentration of NO_2 for both Otaki and Te Horo. The monitoring results also showed that the passive tubes located at Paraparaumu measured higher concentrations than those measured by the co-located reference NO_x analyser with the passive tubes over-predicting concentrations by between 44% and 100%. As the road traffic pollution dispersion model has been verified for the Project using the SH 1/Mill Road monitoring results, with a correction factor being applied, the predicted concentrations are likely to provide a robust outcome. The methodology used to develop the correction factor is described in Section 7.1.1.

Based on the monitoring results average background NO_2 concentrations are well below the WHO annual average guideline.

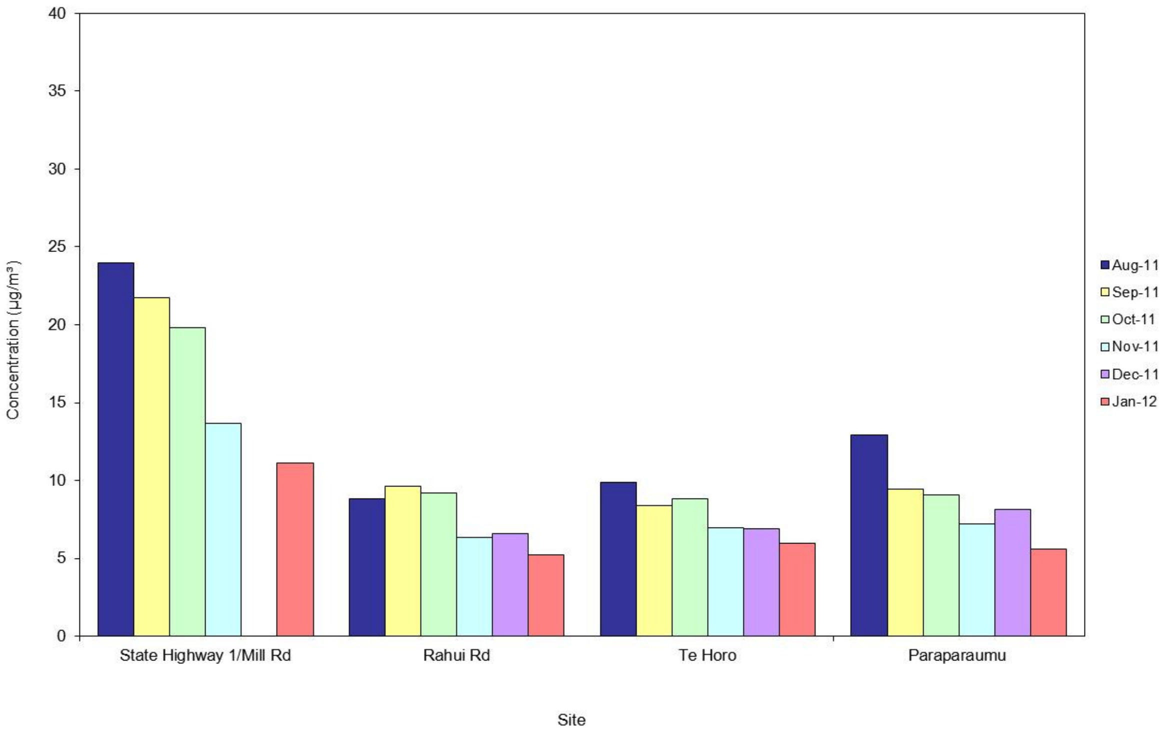
Table 5-2 Summary of NO_2 Monthly Average Concentrations August 2011 to January 2012

Site Name	Concentration µg/m³								
	Aug	Sep	Oct	Nov	Dec	Jan	Min	Average	Max
SH 1/Mill Road	24	22	20	14	No Result[21]	11	11	18	24
Rahui Road	9	10	9	6	7	5	5	8	10
Te Horo	10	8	9	7	7	6	6	8	10
Paraparaumu	13	9	9	7	8	6	6	9	13
Paraparaumu Reference Analyser[22]	9	7	5	4	6	3	3	6	9

[21] No result, monitor was vandalised.
[22] M2PP Alliance monitoring, data provided by BECA on 17 July 2012

5 Site Description/Existing Environment

Figure 5-8 Summary of NO_2 Monthly Average Concentrations August 2011 to January 2012



5.4.2.2 CO Monitoring Results

The results of CO monitoring at Rahui Road are summarised in Table 5-3 and presented graphically in Figure 5-9 as 1-hr average concentrations and Figure 5-10 as 8-hr rolling average concentrations. The average CO concentration for the period was 0.4 mg/m³ (monitoring period average) which compares with the average concentration measured at the Paraparaumu monitoring station for the same period of 0.2 mg/m³.

Based on the monitoring results background CO concentrations are below air quality assessment criteria.

Table 5-3 Summary of CO Results 20 July 2011 to 06 February 2012

	1-hr Average Concentration (mg/m³)	8-hr Rolling Average Concentration (mg/m³)
Maximum	4.9	1.6
Median	0.3	0.4
Minimum	0.0	0.0
Average	0.4	0.4

Figure 5-9 CO (1-hr Average) Concentrations 20 July 2011 to 06 February 2012

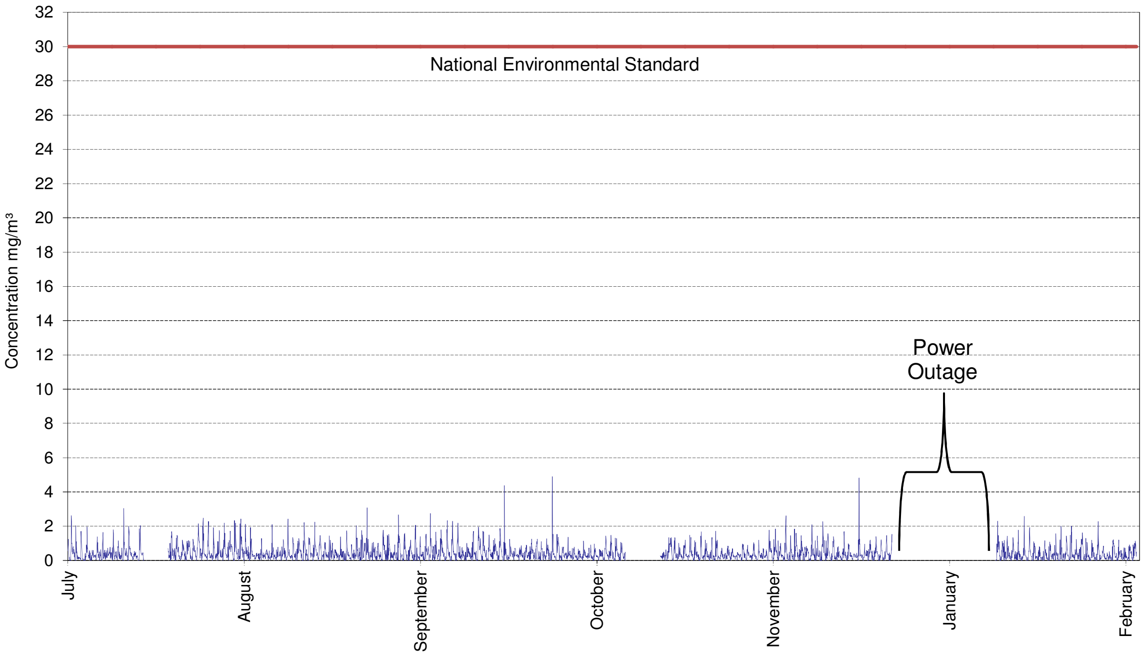
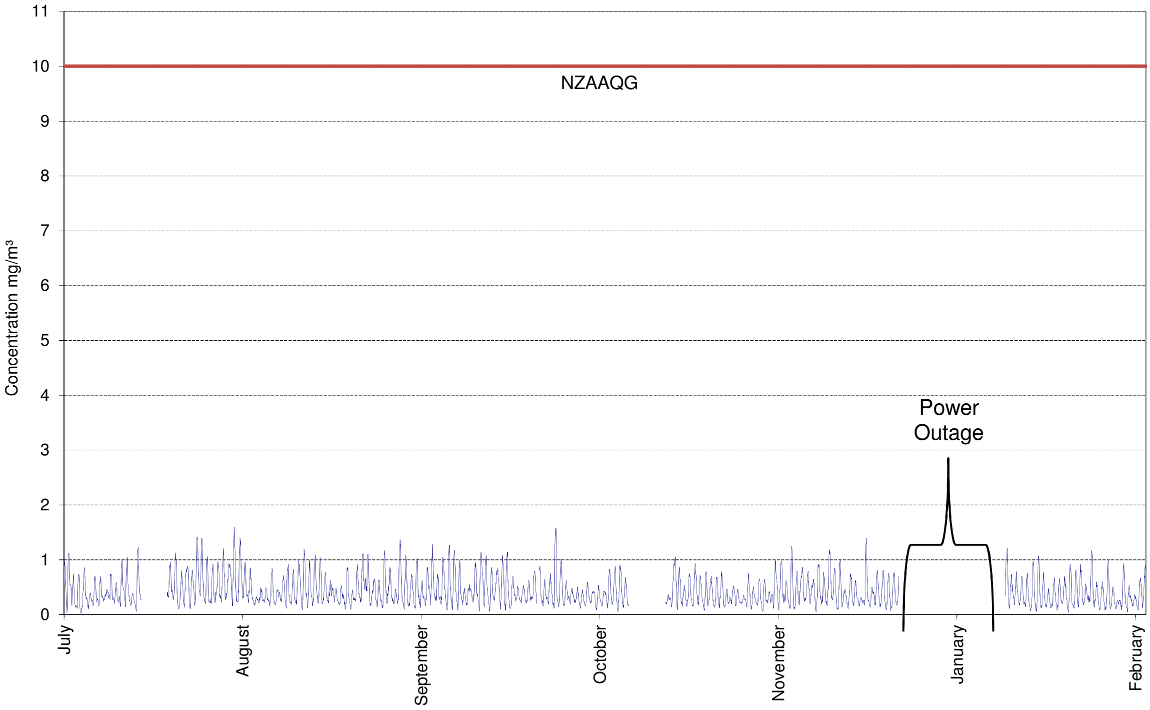


Figure 5-10 CO (8-hr rolling average) Concentrations 20 July 2011 to 06 February 2012



5.4.2.3 PM_{10} Monitoring Results

The results of PM_{10} monitoring at Rahui Road are summarised in Table 5-4 and presented graphically in Figure 5-11 as 24-hr average concentrations and in Figure 5-12 as a pollution rose using the Te Horo wind data and 1-hr average PM_{10} concentrations measured at Rahui Road. The average 24-hr PM_{10} concentration for the period was 14 µg/m³ which compares with the average concentration measured at the Paraparaumu monitoring station for the same period of 12 µg/m³. The pollution rose indicates the contribution of PM_{10} at the monitoring location is from a variety of sources and that vehicle emissions from SH 1 are not likely to be the dominant source. This is based on the high frequency of elevated PM_{10} concentrations from directions other than west, the wind direction that would blow pollution towards the monitor from SH 1.

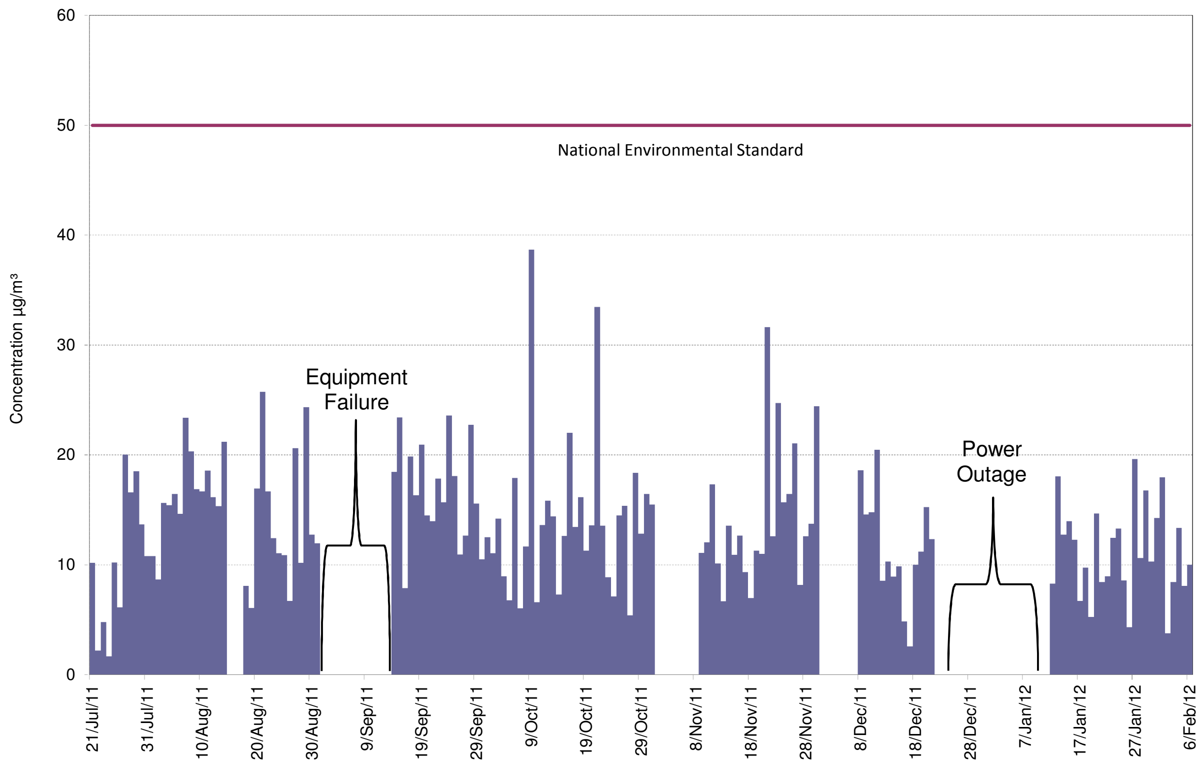
Based on the monitoring results background PM_{10} concentrations are below relevant air quality assessment criteria.

Table 5-4 Summary of PM_{10} Results 20 July 2011 to 06 February 2012

	24-hr Average Concentration (µg/m³)
Maximum	39
Median	13
Minimum	2
Average	14

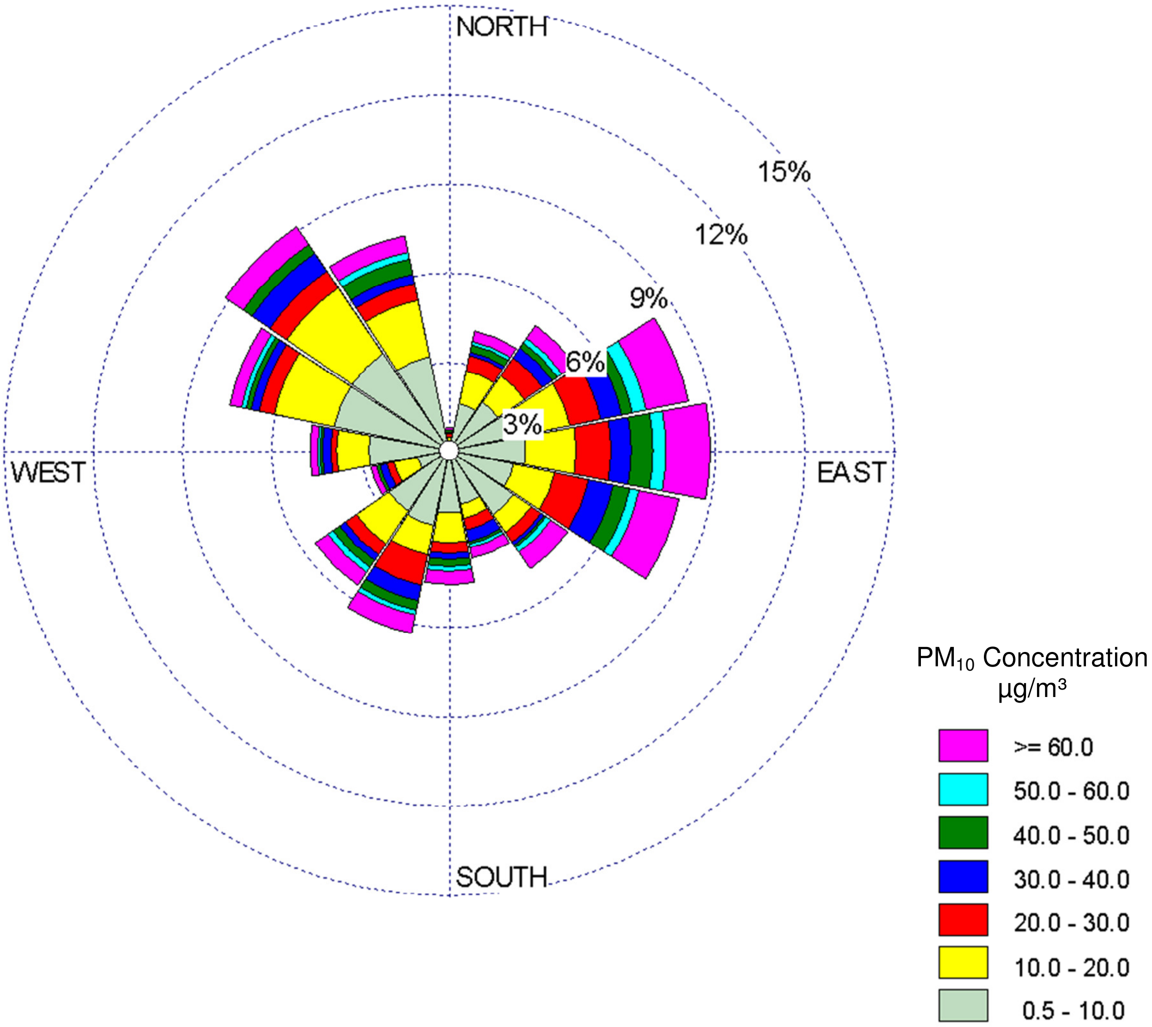
5 Site Description/Existing Environment

Figure 5-11 PM_{10} (24-hr Averages) Concentrations 20 July 2011 to 06 February 2012



5 Site Description/Existing Environment

Figure 5-12 PM_{10} Pollution Rose for Rahui Road 20 July 2011 to 06 February 2012 (1-hr averaging period)



5.4.3 Background Concentrations

The results of monitoring at Otaki, Te Horo and Paraparaumu have been used to estimate typical background concentrations within the assessment area. These background concentrations are presented in Table 5-5. In the absence of 1-hr and 24-hr average NO_2 concentrations measured within the assessment area, the results of monitoring at Paraparaumu for the period February 2011 to January 2012 have been used. In addition to these results, 1-hr and 24-hr concentrations from the highest monthly average concentration obtained from the passive survey at the background locations of Rahui Road and Te Horo have been derived using methodology contained in the MfE GPG for Atmospheric Dispersion Modelling[23], Page 72. The formula used to calculate these values is as follows:

$$Concentration\,(1\ or\ 24hr\ avg) = Monthly\ Concentration\left[\frac{720}{Averaging\ Time\ (either\ 1\ or\ 24hr)}\right]^{0.2}$$

The calculated 1-hr and 24-hr values are contained within parentheses in the Table below. The higher values have conservatively been used in the assessment.

The CO and PM_{10} concentrations measured at Rahui Road have been used to estimate background concentrations. The background concentrations presented have conservatively been used for all locations within the assessment area.

This assessment has made no allowance for changes in background concentrations over time as there is no certainty as to what changes may occur. Therefore for the purposes of this assessment, the background concentrations have been used to assist in determining air quality effects for all of the future scenarios.

Table 5-5 Peka Peka to North Otaki Airshed Background Concentrations

Contaminant	Averaging Period	Air Quality Assessment Criteria	Average Concentration (µg/m³)	Maximum Concentration
NO_2	1-hr 24-hr	200 µg/m³ 100 µg/m³	6 (10) µg/m³ 6 (10) µg/m³	53 (37) µg/m³ 27 (20) µg/m³
CO	1-hr 8-hr	30 mg/m³ 10 mg/m³	0.4 mg/m³ 0.4 mg/m³	4.9 mg/m³ 1.6 mg/m³
PM_{10}	24-hr Annual	50 µg/m³ 20 µg/m³	14 µg/m³ 14 µg/m³	39 µg/m³ -

[23] MfE Good Practice Guide for Atmospheric Dispersion Modelling, June 2004

Traffic and Emissions Modelling

6.1 Sections of Expressway Assessed

For the purposes of this assessment, the Expressway has been split into four sections:

- Section 1: North Otaki to South Otaki (Otaki) - Chainage 0 m to 4,000 m
- Section 2: South Otaki to Te Horo (South Otaki) - Chainage 4,000 m to 7,000 m
- Section 3: Te Horo - Chainage 7,000 m to 9,000 m
- Section 4: Te Horo to Peka Peka - Chainage 9,000 m to 12,243 m

Specific road traffic pollution dispersion modelling has only been undertaken on Sections 1 to 3, as Section 4 is located in an area where there are a low number of sensitive receptors in close proximity to the alignment, vehicles travel at highway speed for its entire length and emissions are constant.

A significant section of Expressway between South Otaki and Te Horo (Section 2) is located within a cut (extends to a depth of 7 m below grade) to provide clearance for the South Otaki interchange (Bridge 6). There was the potential that this might result in poor dispersive conditions which could give rise to elevated concentrations of air pollutants at sensitive receptor locations close to the Expressway. The model has therefore been used to assess the effects from this section of the Expressway.

For Section 4, the model has been used to assess emissions from a small section of the Expressway, which are considered to be representative of those found over the entire length of the section. These results have then been used to predict potential effects.

6.1.1 Road Links Incorporated into the Modelling Domain

All of the road links within the modelling domain for Sections 1 and 3 have been incorporated into the model to assess the potential for cumulative effects. For Sections 2 and 4 only the arterial Road and Expressway links were included in the model as the contribution from the minor link roads was considered to be insignificant. Appendix C contains figures showing the links incorporated into the model for the 'with project' scenarios. In selecting which road links were included, URS reviewed the traffic flow data provided by Opus and included those links where changes were of a magnitude that measureable changes in emissions might result. In general this meant that links where the change in traffic flow was less than 20 vehicles per hour were ignored.

6.2 Traffic Flow and Speed Predictions

6.2.1 Road Traffic

Annual average daily traffic flows (AADT), for the base year 2010 were obtained from NZTA traffic counts[24]. Projected AADT, Morning and Afternoon peak traffic flows for the opening year '2021' and opening year plus ten '2031' were provided by Opus[25], for two scenarios; 'Without Project' and 'With Project'.

A summary of the traffic data used in this assessment is presented in Appendix D.

Measured vehicle speed data was not available, therefore cars and light commercial vehicles (LCV) were assumed to be free flowing at the designated speed limit and Heavy Commercial Vehicles (HCV) between 10 km/hr and 20 km/hr below the speed limit (10 km/hr on local roads/arterial roads and 20

[24] http://www.nzta.govt.nz/resources/state-highway-traffic-volumes/index.html
[25] Opus International Consultants Limited, Integrated Transport Assessment, Technical Report no. 6 Volume 3 of the AEE

km/hr on the Expressway). The SH 1 roundabout intersection with Mill Road was an exception to this assumption, with speed reduced to 10 km/hr (for all vehicles) within 30 m of the roundabout to represent vehicles slowing down and queuing at the roundabout.

To predict 1-hr and 24-hr average NO_2 concentrations it was assumed that peak traffic periods were between 7 am and 9 am and 5 pm and 7 pm. During this time the traffic flow was assumed to be 10% of the AADT[26] for the base year scenario and for the 2021 and 2031 scenarios AM/PM peak values from traffic modelling were used. For other times the traffic flow was assumed to be the average hourly traffic flow (AADT/24). CO and PM_{10} concentrations were predicted based on the use of the average hourly traffic data for all scenarios.

6.2.1.1 Holiday Traffic

It is understood that there is the potential for queuing to occur during public holidays on the north-bound lane of the Expressway as traffic approaches the end of the Expressway and is required to merge from two lanes to one lane. Opus has advised URS that there is the potential for this scenario to occur from the year 2031 onwards as forecasted traffic volumes reach a critical point that congestion may occur. This scenario has been modelled assuming a peak traffic flow of 1,510 vehicle/hour[27] in the northern direction, and has conservatively assumed that that this would occur for all hours of the year to cover all worst-case meteorological conditions. In the absence of idle emission factors, for the predicted fleet of vehicles. It was assumed that the traffic moves in the queue at a speed of 10 km/hr, the lowest speed for which emission factors are available in the Vehicle Emissions Prediction Model (VEPM).

Based on data provided by Opus peak flows in the south-bound direction are expected to be approximately 622 vehicles/hour.

6.2.2 Locomotive Traffic

The number of diesel powered locomotives operating on the NIMT used in this assessment is based on information provided by Kiwirail staff[28], who estimated that, on average, a total of 15 locomotives operate per day on this section of railway line. This total includes two passenger locomotives and 13 freight locomotives. The fleet current comprises of approximately an equal split of DFT[29] and DX[30] locomotives. Kiwirail has indicated that it will introduce two of the new DL[31] type locomotives onto the NIMT within the next year to replace some of the current fleet, with the number rising to between six and eight within the next 10 to 15 years. No information was available on the exact schedule that locomotives operate to on the line over a 24-hr period. To simplify the model inputs and to provide a conservative approach, this assessment has applied the future average fleet profile of 7.5 locomotives of the DX and DFT specification and 7.5 locomotives of the newer DL locomotive. This scenario is considered to be conservative as the DL locomotive has been calculated to produce the greatest emissions of the various types of locomotives operating on the NIMT, as discussed in Section 6.6.

[26] Ministry for the Environment, Good Practice Guide for Assessing Discharges to Air from Land Transport, May 2008
[27] Opus Consultants, Memo
[28] Pers comms , Adam Nicholls, Opus Consultants, email dated 16 August 2012
[29] General Motors Diesel (GMD), DFT Class, Diesel Locomotive, UIC: Co-Co
[30] General Electric, DX Class, Diesel, Locomotive UIC: Co-Co
[31] Dalian Locomotive and Tolling Stock (CNR Group), Model CKD-9B, Diesel Locomotive, UIC: Co-Co

6.3 Vehicle Fleet Profile

HCV data for the base year 2010 was obtained from NZTA traffic monitoring, and projected HCV data for 2021 and 2031 was provided by Opus. Detailed fleet composition data was not available for this assessment and therefore the default vehicle fleet profile, ratioed to the predicted HCV composition, within the emissions model (discussed in Section 6.5) was used to obtain the proportion of vehicles within each category including cars, LCV, HCV and buses.

6.4 Road Gradients

The majority of the Expressway is at-grade with zero gradient. There are some sections where the road grade approaches 1%, however, this change in gradient is not significant with respect to the potential for increased vehicle emissions. Therefore no vehicle emission factors have been adjusted to compensate for the changes in gradient.

6.5 Emission Modelling Methodology

The Auckland Council (AC) and NZTA Vehicle Emission Prediction Model (VEPM) version 5.0 was used in conjunction with the traffic data provided to determine emission factors for NO_x, CO and PM_{10} for the future scenarios modelled. NO_2 emission factors were conservatively estimated as 20% of the NO_x value. This is in accordance with guidance found in the MfE GPG LT, which is based on data from Khyber Pass, Auckland and is considered to be conservative.

VEPM was selected in accordance with current industry best practice. VEPM provides emission factors for various pollutants for a range of vehicle fleet categories including passenger cars, light duty and heavy duty vehicles[32]. VEPM uses these emission factors in combination with a fleet profile to obtain an average fleet emission factor. The emission factors consider a number of variables including:

- Vehicle speed;
- Impact of cold engine operation;
- Impact of catalytic converter removal;
- Impact of fuel properties;
- Impact of emission degradation due to vehicles accumulated distance; and
- Fleet profile.

The following VEPM default values have been used as inputs into the model:

- Average trip Length = 9.1 km;
- Ambient temperature =13.1 °C;
- Cold Start = Yes;
- Degradation = Yes;
- Percentage of catalytic converters not working on old cars = 15%;
- Percentage of catalytic converters not working on new cars = 0%; and
- Heavy Vehicle Load = 50%.

An example of the VEPM input data is presented in Appendix E.

[32] Emissions Impossible Ltd, Instructions For Using The Vehicle Emissions Prediction Model (VEPM) Version 5.0

6.6 Vehicle Emission Rates

6.6.1 Road Transport Emissions

The emission rates used in this assessment for road transport emissions are presented in Appendix F for all of the scenarios assessed.

6.6.2 Locomotive Emissions

The majority of New Zealand's fleet of locomotives are powered using large diesel engines, with the mainstays of the current fleet being used on the NIMT being the DX and DFT locomotives, equipped with GM EMD 645 and GE 7FDL series engines. More recently Kiwirail has purchased and introduced the new DL class locomotive into its fleet. The locomotive is equipped with the MTU 20V400R43 engine.

A report written by the Ministry of Transport (MoT) in 1999[33] estimated the emissions from GM EMD 645 and GE 7FDL series engines, using emission factors provided by the United States Environmental Protection Agency (USEPA). The report determined that the USEPA emission factors are representative of the New Zealand locomotive fleet as variants of the engines mentioned above were used in the tests performed by the USEPA to determine the emission factors. No data was found on emissions from the MTU 20V400R43 engine used by the new DL class locomotive and the same emission factors as the GM EMD 645 and GE 7FDL series engines has been used. This is considered to be a conservative approach, given the expected improvements in emission technology.

The emission factors used in the modelling assessment have been calculated using the power output for each type of locomotive with these factors then been ratioed depending on the composition of the fleet operating on the NIMT. This assessment has conservatively applied the same emission factors for each of the various modelling scenarios. Calculated emission factors have been based on the predicted 2021-2031 fleet profile which comprises of a large number of DL locomotives which have been calculated to produce the greatest emission of the locomotives operating on the line.

It has been assumed that the average speed of each locomotive operating on the section of track between Peka Peka and North Otaki is 30 km/hr. Table 6-1 presents the fleet averaged emission factors for locomotives used in this assessment.

Table 6-1 MoT/USEPA Emission Factors for Locomotive in Current Service

Locomotive Type	Number of Trains operating on the line per day	NO_x		*NO_2		CO		**PM	
		g/KW.hr	g/km	g/KW.hr	g/km	g/KW.hr	g/km	g/KW.hr	g/km
DX	3.75	17.3	1220	3.5	244	1.7	120	0.43	30
DFT	3.75	17.3	1064	3.5	213	1.7	105	0.43	26
DL	7.5	17.3	1557	3.5	311	1.7	153	0.43	39
Fleet Ratioed Values		17.3	1350	3.5	270	1.7	133	0.43	34

*The NO_2 emission factors are based on 20% of the NO_x value.

** Particulate emissions have been assumed to be PM_{10}.

33 Ministry of Transport, Impacts of Rail Transport on Local Air Quality, July 1999

6.6.3 Sensitivity Analysis

A sensitivity analysis of vehicle emission rates, relative to changes in fleet profile and vehicle speed, has been undertaken to determine the effect on predicted ambient concentrations of air pollutants as a result of changes in the assumed values used in the modelling assessment. Detailed results of this analysis are presented in Appendix G.

Overall the effect of an increase in the proportion of HCV, along with variability in the speed of vehicles travelling on the Expressway is not considered to be significant with respect to both the concentrations predicted and compliance with air quality assessment criteria.

Dispersion Modelling

A road traffic pollution dispersion model was used to predict the concentration of various pollutants at specific locations along the existing SH 1 and at locations near to the Expressway. The results of modelling were then used to assist in the assessment of air quality effects from the operation of the Project.

7.1 Dispersion Modelling

The traffic dispersion model CAL3QHCR version 2.0 has been used in this assessment. CAL3QHCR is accepted by the USEPA as a guideline model to be used in all regulatory applications involving the prediction of pollutant concentrations downwind of highways in relatively uncomplicated terrain.

The CAL3QHCR steady-state Gaussian-plume dispersion model was selected in this assessment for the following reasons:

1. CAL3QHCR is a USEPA Regulatory model for assessing road traffic pollution impacts.
2. CAL3QHCR is a refined version of the California Line Source Dispersion Model (e.g. CALINE4). The model can process a full year of hourly meteorological data (actual local data as opposed to worst-case wind directions) and can incorporate hourly varying emissions, traffic, and signalisation data (where available).
3. It is a near-field model and is therefore appropriate for assessing impacts from road traffic (e.g. within 200 m of a road) – see DMRB (2007)[34].
4. Terrain effects were not considered to be significant as the surrounding terrain is generally less than 1 in 10.
5. CAL3QHCR, and a number of other Gaussian-plume dispersion models, have been widely used in numerous national and international air quality impact assessments of a similar scale and nature to this study, and the use of CAL3QHCR is therefore considered to be appropriate, particularly as the model was verified against monitoring data.

Like all dispersion models, CAL3QHCR has requirements for a number of inputs in order to make it function.

Examples of the model output data files are presented in Appendix H.

7.1.1 Verification of Dispersion Modelling Results

Model verification is seen as the process by which any differences between model outputs and field-based observations (monitoring data) are investigated and where possible minimised. In some cases, LAQM.TG(09)[35] requires that appropriate adjustment factors are applied to ensure that model predictions are representative of the monitoring data for the assessment area. For example, linear regression may be used to generate a functional relationship of the form: $y = mx$ (where the intercept is set to zero), which allows the tuning of the model predictions, y, to fit the observations, x. The slope parameter, m, may (among other things) represent the influence of:

- Local meteorology on atmospheric dispersion;

[34] Design Manual for Roads and Bridges (DMRB), Volume 11 – Environmental Assessment, Section 3 – Environmental Assessment Techniques, Part 1 – Air Quality (known as the “HA 208/07”), UK Department for Transport/Highways Agency, May 2007

[35] Local Air Quality Management Technical Guidance: LAQM.TG(09), UK Department for Environment, Food and Rural Affairs (Defra), February 2009

- Local buildings/structures and/or complex terrain on atmospheric dispersion; and
- Local vehicle emissions which differ from Auckland vehicle emissions. There is a potential limitation of using the Vehicle Emissions Prediction Model (VEPM) emission factors as these are based on Auckland vehicle emissions.

Once the urban air quality model is tuned in this way, as per the requirements of LAQM.TG(09)[36], the air quality modeller, NZTA and the EPA will have a greater degree of confidence in the model results and overall assessment conclusions.

The model was verified in accordance with the above procedure by comparing the model predictions with the actual observations (measured concentrations of NO_2). The resulting adjustment factor was then applied to the model results.

It is considered better to have multiple sites at which to verify results rather than just one continuous monitor. The use of one continuous monitor alone to derive the adjustment factor for a model is not typically recommended, as the monitoring site may not be representative of other locations modelled, and the adjustment factor derived will be heavily dependent on the source-to-receptor relationship as represented by the meteorological data file used in the dispersion model. This generally means using NO_2 diffusion tube data (as opposed to more expensive monitoring techniques) to determine the spatial variations in concentrations in the verification procedure. Due to the high capital and operational costs involved, it is not always possible to obtain the same level of details for other pollutants (e.g. carbon monoxide, or particulate matter as PM_{10}), and therefore, in lieu of actual data, it is considered appropriate to apply the NO_2-based adjustment factor to these pollutants, particularly when (as in this case) the model was found to be under-estimating for NO_2. This is based on URS's experience of a number of road traffic air quality assessments of a similar nature and scale to this study.

7.1.2 Verification Correction Factor Methodology

The air quality at the SH 1/Mill Road intersection was modelled for the current situation (Base Year 2010) and predicted annual NO_2 concentrations at the location of the NZTA passive NO_2 monitor where compared with actual monitoring data. When comparing the results it was found that the model under-predicted concentrations by a factor of 3.5. Therefore to adjust the modelled data to correlate with measured values a correction factor of 3.5 was applied to all of the modelling scenarios. This correction factor was calculated by subtracting the background concentration for the assessment area from the annual average NO_2 concentration measured at the SH 1/Mill Road Intersection. This value was then divided by the concentration, predicted by the model, at the location of the SH 1/Mill Road intersection monitor to determine the correction factor.

7.2 Modelling Input Data

The following sections describe the inputs used in this assessment. Appendix I contains tables showing the input data used in the model for the future scenarios.

[36] Local Air Quality Management Technical Guidance LAQM.TG(09), February 2009

7.2.1 Meteorology

The CAL3QHCR model uses meteorological data for any length of time from one hour to one year. The Air Pollution Model (TAPM)[37] has been used to predict the meteorological conditions at the Project site. This model takes the synoptic weather patterns for New Zealand and applies them over the terrain of the area to be modelled and applies corrections to the wind flows based on real meteorological data for locations within the area. The meteorological data is then used in the dispersion model for all of the scenarios assessed.

A meteorological data file was developed for 2010 and was used in earlier stages of the project. The 2010 meteorological data was used to verify the model and predict concentrations for the base year 2010 and was based on observations from monitoring stations at Levin and Paraparaumu.

For this assessment an additional meteorological data file for the year 2011 utilising the Te Horo monitoring data, in addition to the data from Levin and Paraparaumu. This data is considered to be a better approximation of the local meteorological conditions and has therefore been used in this assessment. The following section compares the two meteorological data sets and provides justification for the use of the 2011 data for the modelled ‘future’ scenarios as opposed to the 2010 data.

7.2.1.1 Meteorological Model Set-up and Configuration

The TAPM modelling domain was centred on the Te Horo weather station location at UTM Zone 60, 1778888 mE, 5480778 mS. The wind speed and direction observations for 2011 taken from the URS operated Te Horo AWS, Paraparaumu AWS and Levin AWS were used in TAPM to nudge the predicted solution towards the observations.

The parameters used in the TAPM are summarised in Table 7-1. The model input and output data files are available upon request.

Table 7-1 Meteorological Parameters used in this Assessment

TAPM (v 4.0)	
Number of grids (spacing)	5 (30 km, 10 km, 3 km, 1 km, 0.3 km)
Number of grid points (x,y,z)	25 x 25 x 20
Year of analysis	2011
Centre of analysis	Te Horo AWS (UTM Zone 60 1778888 mE, 5480778 mS.
Data assimilation	Meteorological data assimilation using data from Te Horo, Paraparaumu and Levin AWS. Area of Influence = Te Horo= 8 km, Paraparaumu = 5 km, Levin = 9 km.

7.2.2 TAPM Generated Meteorological Data

A wind rose of the TAPM generated wind data for 2010 and 2011 is presented in Figures 7-1 and 7-2, respectively. URS has compared the TAPM generated data for 2010 and 2011 and considers the 2011 data to better represent local meteorological conditions for the Project site. This is based on the similarity between the TAPM generated data and the Te Horo meteorological station data. The 2011 TAPM data has benefited from the adjustment of the meteorological model by the inclusion of the local

[37] Commonwealth Scientific and Industrial Research Organisation (CSIRO), The Air Pollution Model, Version 4.04

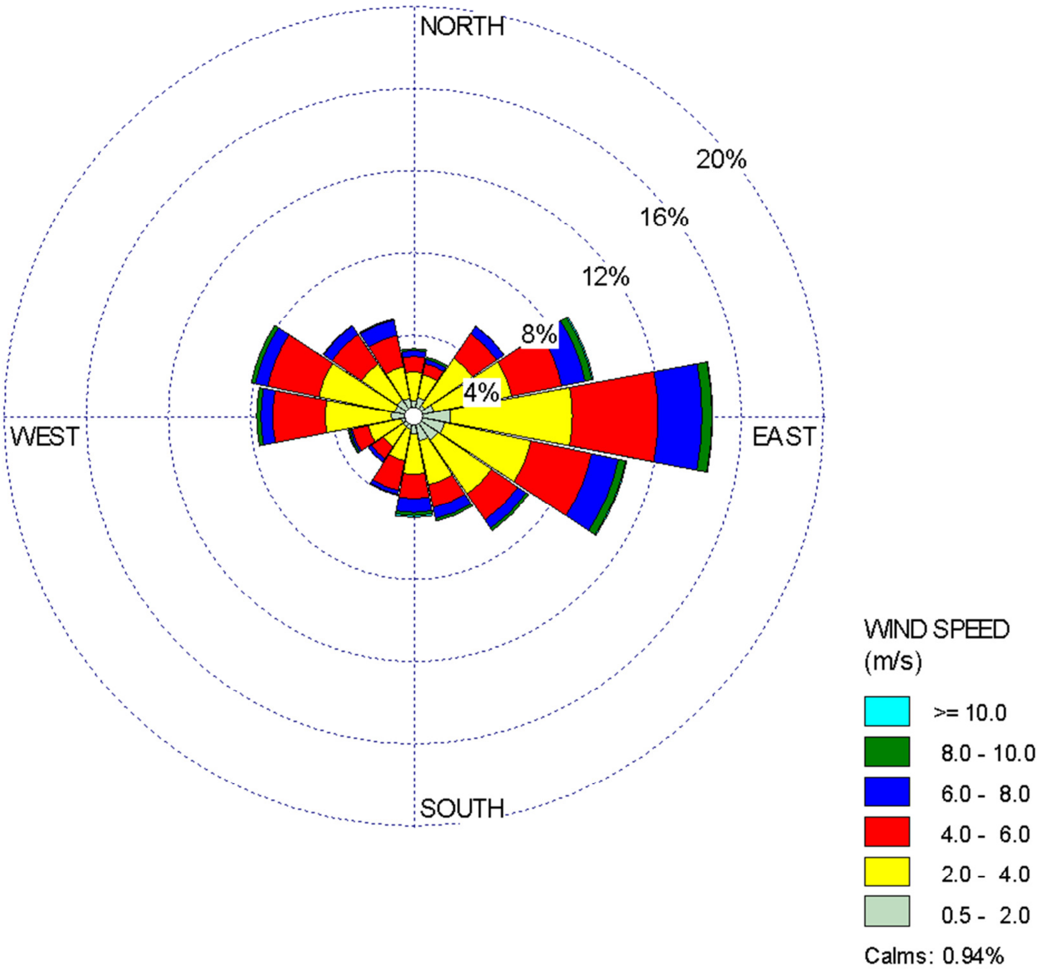
7 Dispersion Modelling

Te Horo meteorological data. URS has evaluated the two data sets and presents this analysis in Figures: Figure 7-3 (Frequency of stability classes for 2010 and 2011), Figure 7-4 (Frequency of wind speeds for 2010 and 2011) and Figure 7-5 (frequency of stability classes for 2010 and 2011). The 2011 data provides the greatest frequency of poor dispersive conditions, with a greater number of calm to low wind speeds. Wind speeds below 1 m/s occur 4% and 39% of the time for 2010 and 2011 respectively. The frequency of stability classes for each year is fairly similar, however 2011 has a greater percentage of stable conditions which can result in poor dispersion conditions. The frequency of mixing heights below 100 m, for which there is the greatest potential for inversion conditions, are similar with these conditions occurring 16% and 12% of the time for 2010 and 2011 respectively.

Based on the above analysis, URS considers that the 2011 dataset provides a more conservative and representative set of meteorological conditions and has therefore determined to use this data in the atmospheric dispersion modelling assessment for the 2021 and 2031 scenarios. In addition, URS has compared the results of modelling using both sets of meteorological data and found that the 2011 data provided the greatest level of conservatism (i.e. higher predicted concentrations.)

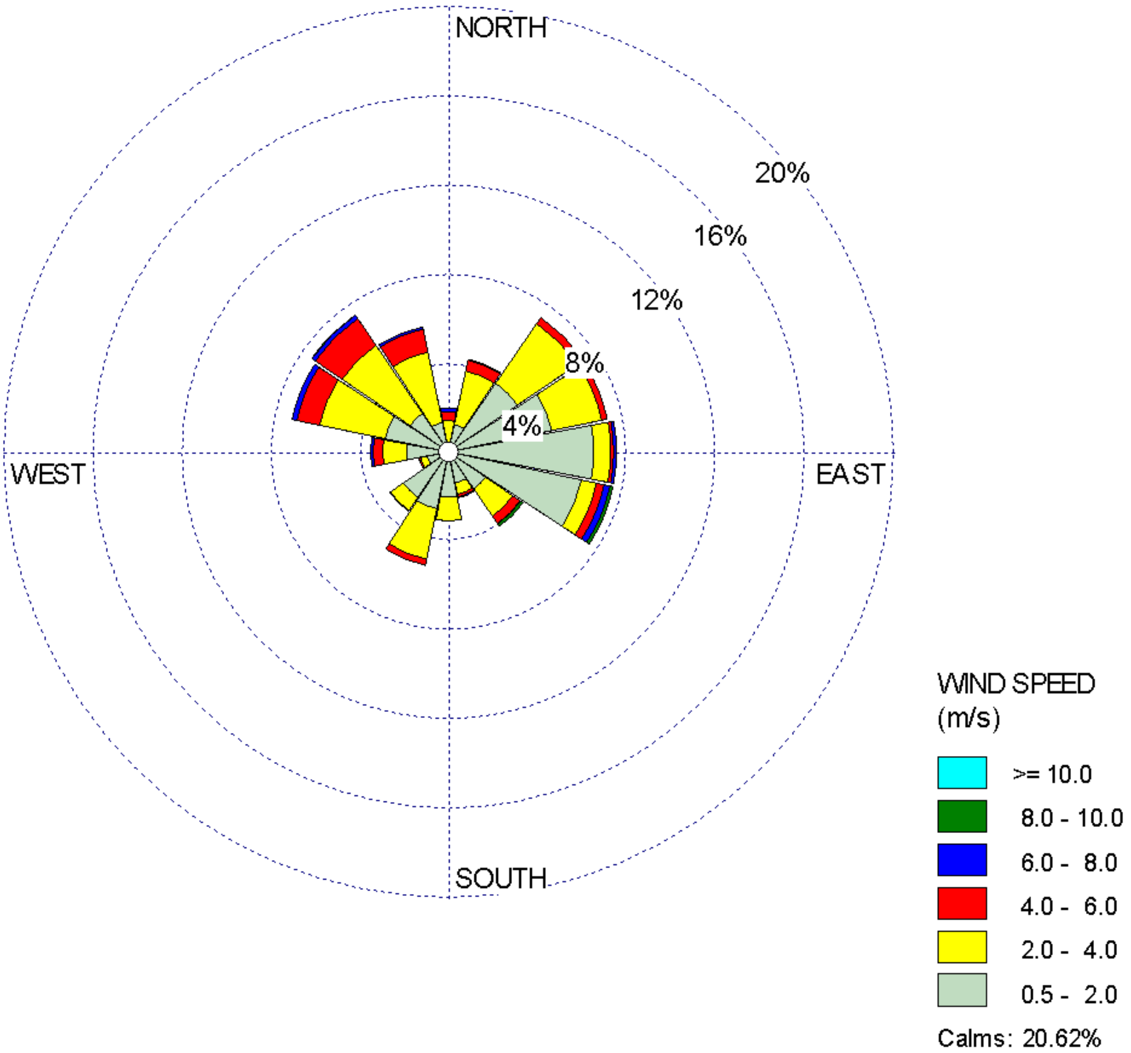
7 Dispersion Modelling

Figure 7-1 TAPM Generated Meteorological Data Otaki for 2010



7 Dispersion Modelling

Figure 7-2 TAPM Generated Meteorological data Otaki for 2011



7 Dispersion Modelling

Figure 7-3 Frequency of Stability Classes for 2010 and 2011

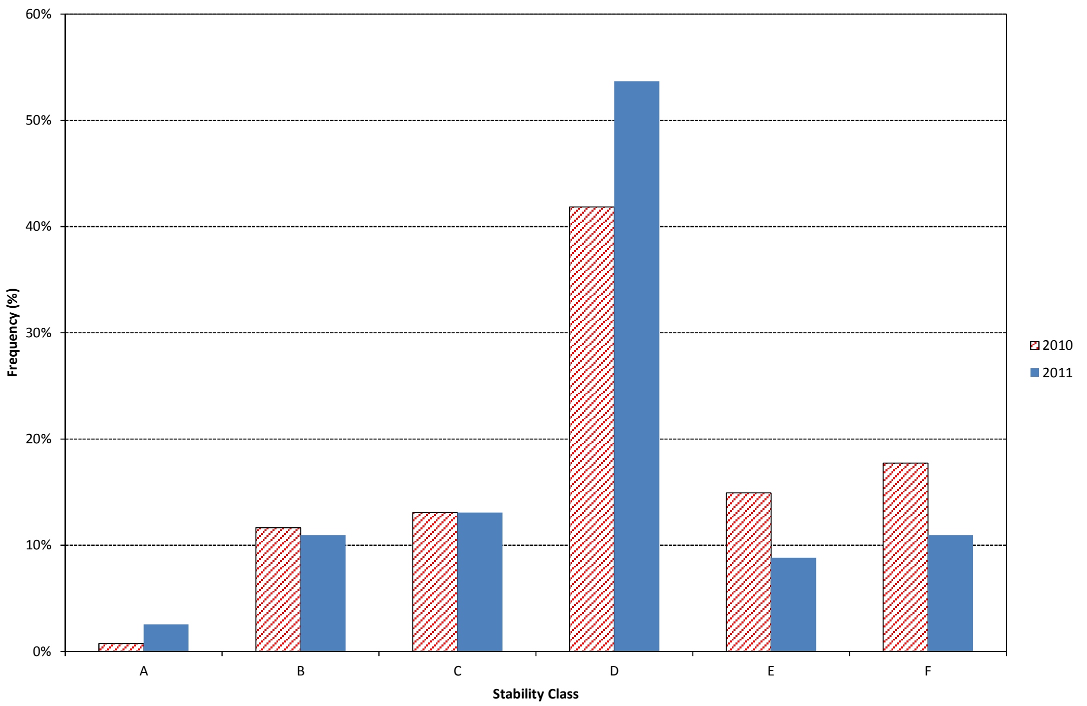
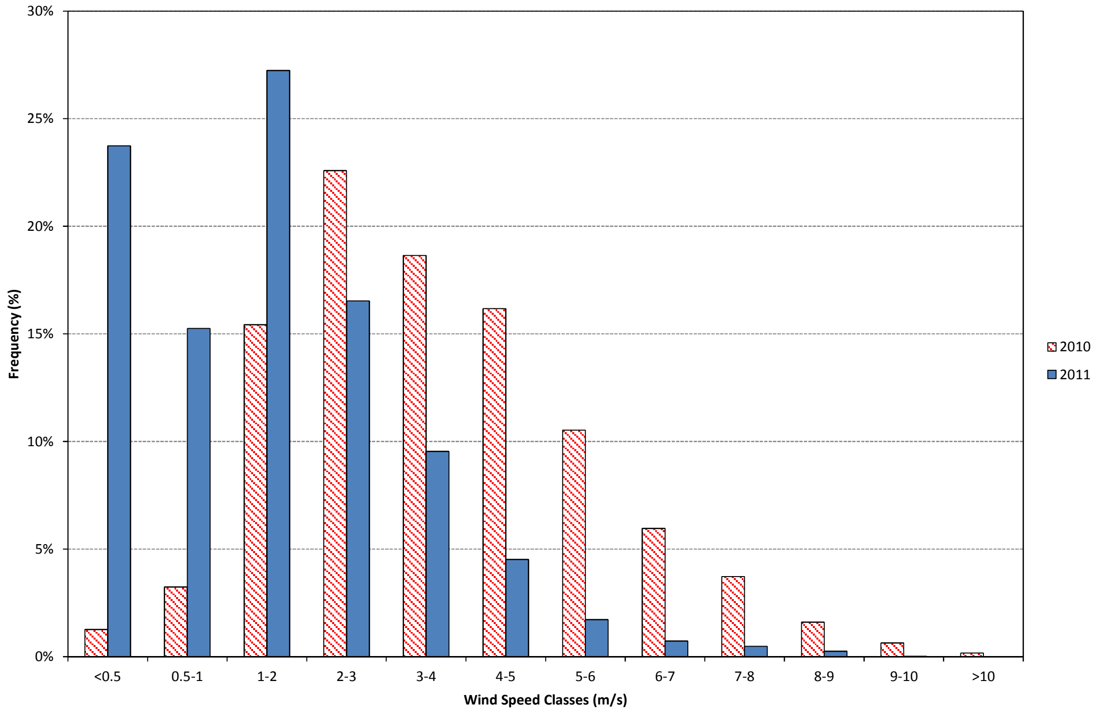
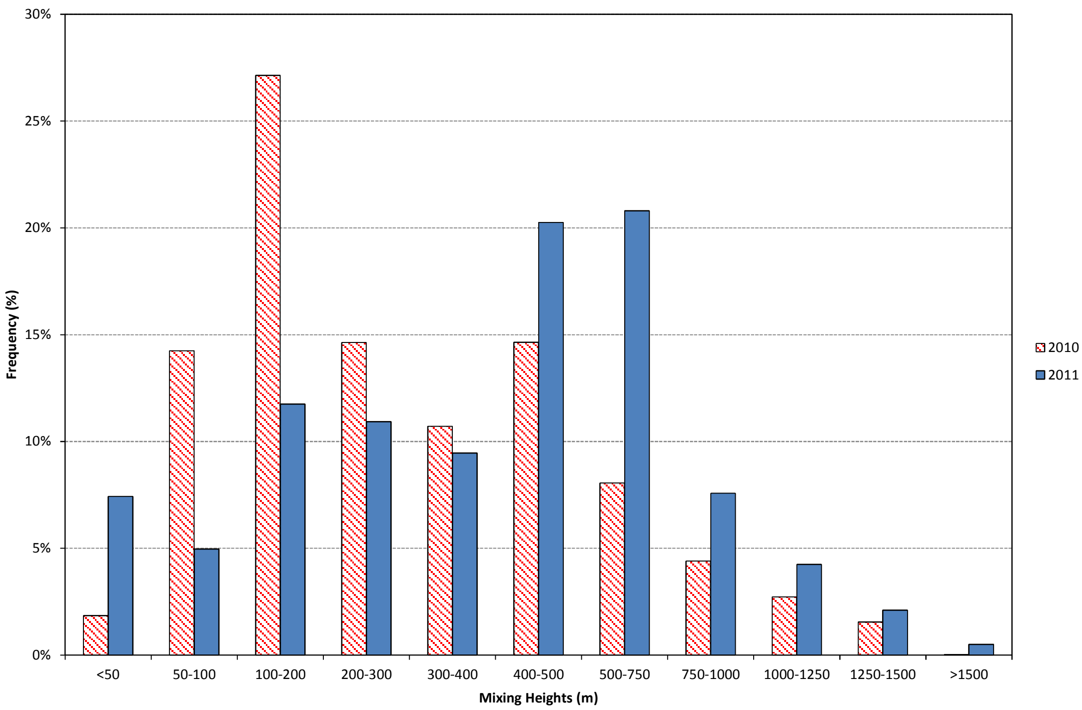


Figure 7-4 Frequency of Wind Speeds for 2010 and 2011



7 Dispersion Modelling

Figure 7-5 Frequency of Mixing Heights for 2010 and 2011



7.2.3 Terrain

As described in Section 5.1, the surrounding area is relatively flat with the nearest hills approximately 3 km to the east. Therefore no terrain data has been included in the model.

7.2.4 Other Modelling Options

There are also a number of additional options that need to be defined in the model. Table 7-2 shows the settings selected for the specific locations assessed.

Table 7-2 Modelling Options

Location	Surface Roughness Length	Urban or Rural Settings	Road at Grade Level	Grid Receptor Height (m)
Otaki	Suburban	Urban	At Grade	0
South Otaki	Suburban	Urban	Below Grade	0
Te Horo and Te Horo to Peka Peka	Rural	Rural	At Grade	0

URS

7.3 Summary of Model Assumptions

The following assumptions have been made as part of the modelling assessment:

- Hourly inter-peak traffic flows used to assess 1 and 24-hr average NO_2 concentrations have been estimated as AADT divided by 24 hours;
- Peak hourly traffic flows have not been included in the model to assess CO and PM_{10} concentrations;
- Terrain has been assumed to be flat;
- The fleet profile has been calculated as a ratio of the default VEPM compositions based on the % HCV data provided by Opus' traffic forecasting model;
- VEPM emission factors were used;
- Vehicle speeds were assumed to be constant and do not account for variability encountered during peak traffic flow periods;
- For the purposes of the modelling assessment it was assumed that 1 locomotive operated on the NIMT per hour which is greater than the estimated rate of 15 per day; and
- NO_2 emissions were assumed to be 20% of NO_x emissions.

7.4 Accuracy of the Model

Road traffic pollution dispersion models, as with other atmospheric dispersion models, can only approximate atmospheric dispersion processes. Many assumptions and simplifications are required to describe real phenomena in mathematical equations. Model uncertainties may cause discrepancies between measured and modelled data (in both space and time) and can result from:

- Simplifications and accuracy limitations related to input data, including uncertainties in emissions data (e.g. VEPM emission factors and their suitability for the Project site; continuous versus hourly varying emissions);
- Simplifications in building topography and the potential under-representation of the reduced ventilation effects around buildings (e.g. street canyons);
- Uncertainties and suitability in meteorological data used in modelling study, including model input parameters such as roughness length; and
- General limitations and assumptions contained within the dispersion model algorithms.

Given the number of assumptions that have been made as part of this assessment URS considers that it is likely that the model will conservatively predict ground level concentrations, and as such the results should not be considered as definitive. Instead, the results of modelling should primarily be used to demonstrate the magnitude of changes in concentration at receptors. However URS has also used the model results to indicate whether compliance with NES and NZAAQG would be achieved.

The results presented in this report consist of concentrations from road contributions as well as the cumulative effect of both the road and background values. Further conservatism is applied in that it is assumed assumes that maximum road concentrations and maximum background concentrations occur at the same time.

8

Assessment of Effects from the Construction of the Project

During the construction phase of the Project there is potential for nuisance dust from construction activities and combustion emissions from construction vehicles to affect properties.

8.1 Construction Dust

The various construction activities required as part of the Project have the potential to result in the generation of dust if not appropriately controlled. The following are some of the activities that have potential to result in dust generation if not appropriate controlled or mitigated:

- Stripping of topsoil;
- Excavation of cut material;
- Placement of fill;
- Stockpiling of soil / cut material;
- Traffic movements on the haul road; and
- Rehabilitation of completed areas.

As discussed earlier the potential effects of dust from these activities will depend on a range of factors including the location of any receptors in the vicinity of the works. Generally receptors more than 300 m from construction activities are unlikely to experience any construction dust related nuisance, and therefore have only been considered where there is some special factor (such as any cut material containing high quantities of material less than 100 µm in size with little or no clay), that it might generate dust that can travel further than normal.

Receptors within 100 m of construction activities have a greater potential to experience nuisance effects and mitigation measures will be required to ensure that any effects on these receptors are minimised.

A number of procedures have been presented in the following section designed to mitigate against these effects.

The following sub sections review the potential dust effects for the four sections described in the draft Construction Methodology Report[38] that the construction has been divided up into. It is noted that as certain details of the construction methodology have not been developed it is not possible to be more specific about dust generating activities. However as the effects of dust are relatively independent of the activity generating it, this lack of specificity is not considered important. What is important is that sensitive receptors are identified and appropriate mitigation developed to minimise effects on those locations.

8.1.1 Section 1 North Otaki to Otaki River Bridge

The main construction activity that has the potential to generate dust in this section is the large cut through the sand dunes. This material will be utilised as fill in other locations within the Project. There is also potential for nuisance from the haul road as the alignment is used to transport material within the Project.

The majority of residential receptors in this area are more than 100 m to the southeast of these works (See Figure 8-1), which is likely to be downwind for a significant period of time. While the majority of

[38] Opus, Peka Peka to North Otaki Expressway Project, Construction Methodology Report, August 2012

8 Assessment of Effects from the Construction of the Project

the sand is unlikely to reach the residences, there is the potential for finer material to do so in the absence of the mitigation measures described in the following section.

Based on the geotechnical report[39] it appears that the majority of the cut materials through Otaki are likely to have a high water content and are therefore unlikely to give rise to dust nuisance. The main potential for dust nuisance will come from the placement of fill materials that form the approaches to the Rahui Road overbridge.

It is unlikely that there will be nuisance dust carried by the wind towards the Otaki Railway Retail area due to the distance and the relatively low percentage of moderately strong winds that would be required to carry any dust.

That said, the construction activities will occur extremely close (within 20 m) to the former Rahui Milk Treatment Station and Social Hall, and specific measures will be contained in the Construction Air Quality Management Plan (CAQMP) to ensure that these properties are not adversely affected by dust during the construction process.

[39] Opus, Peka Peka to Otaki Expressway Assessment of Environmental Effects, Technical Report Geotechnical Engineering and Geology, October 2012

8 Assessment of Effects from the Construction of the Project

Figure 8-1 Sensitive Locations in Section 1

Sensitive Residential Areas

8.1.2 Section 2 Otaki River Bridge to Old Hautere Road

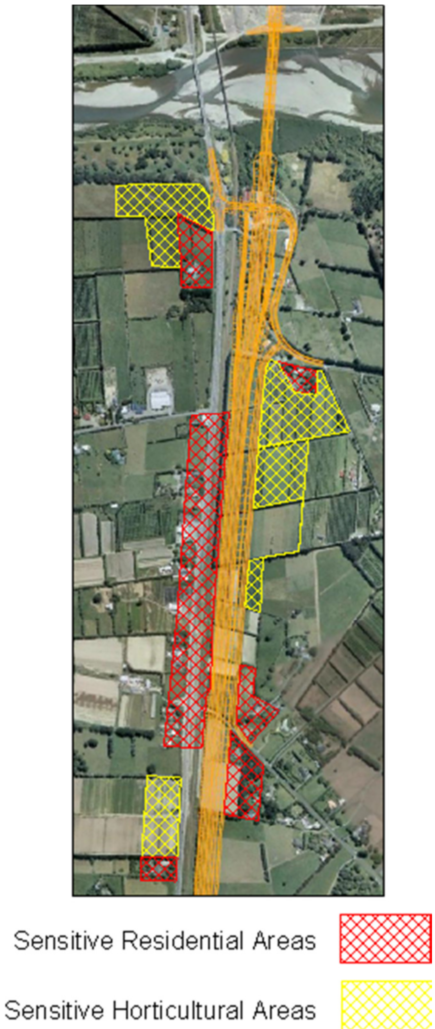
The main potential for dust nuisance in this section comes from the large cut at the southern approach to the Otaki River Bridge as well as the general movement of traffic on the haul road.

There are relatively few residences close to the alignment, but some areas of crops particularly close to Old Gorge Road and in the general area between Old Gorge Road and Old Hautere Road, to the east of the existing SH, may be more sensitive to dust at some times of the year. Generally, activities to the west of the existing SH are unlikely to be affected by construction dust due to the distance as shown in Figure 8-2. The nature of any mitigation that may be required for these areas or crops will depend on the timing of the works with respect to growing cycle, and the nature of the crops.

8 Assessment of Effects from the Construction of the Project

It is unlikely, with the mitigation measures being employed, that dust will result in significant or noticeable reductions in crop yields, but it is possible that some crops, or portions thereof may be downgraded if they are seen to be "dirty", where they are grown extremely close (less than 20 m) to construction activities. Additional mitigation measures to deal with these localised effects will be developed in consultation with affected landowners and incorporated in the CAQMP.

Figure 8-2 Sensitive Locations in Section 2



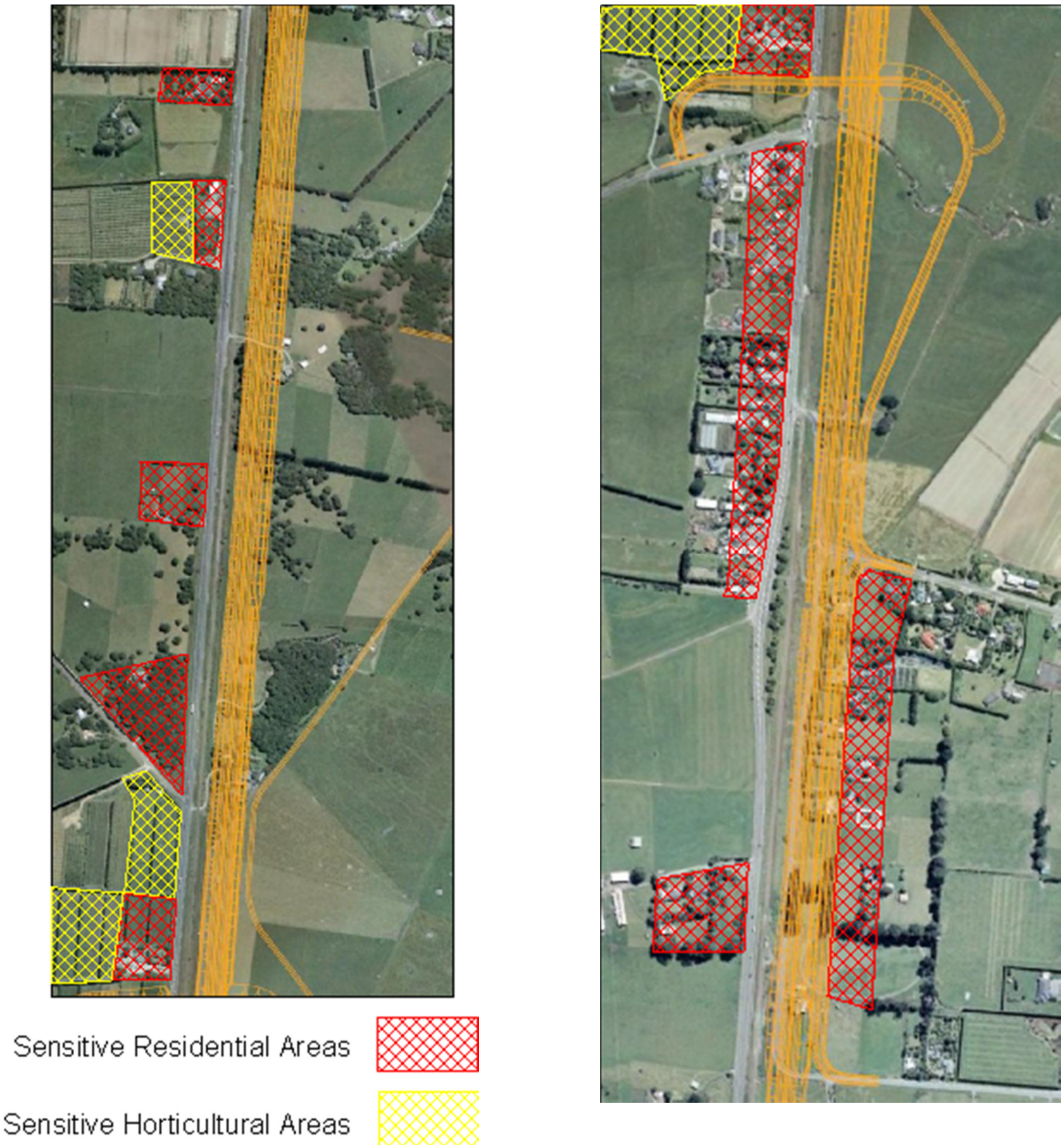
8 Assessment of Effects from the Construction of the Project

8.1.3 Section 3 Old Hautere Road to Te Horo

There is relatively little cut or fill in this section of the construction and therefore the main dust will come from the construction process and traffic using the designation to access other sections of the Project.

As shown in Figure 8-3 there are no receptors that are considered especially sensitive to dust close to the alignment in this section, therefore there are not considered to be any specific construction dust related issues in this section of the scheme, which cannot be controlled with the standard mitigation measures described in Section 9.

Figure 8-3 Sensitive Locations in Section 3



8 Assessment of Effects from the Construction of the Project

8.1.4 Section 4 Te Horo to Peka Peka Interchange

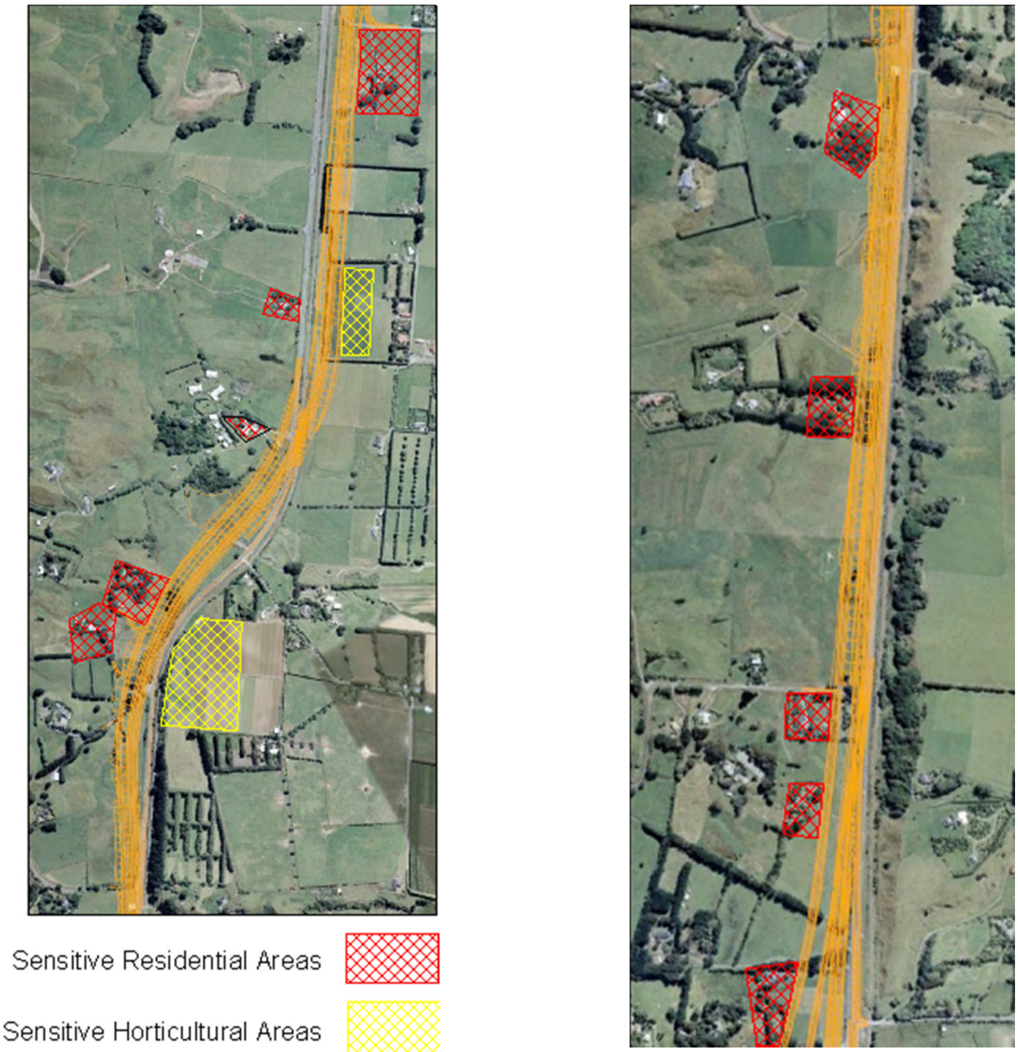
The main sources of dust that could result in nuisance effects in this section, apart from the general construction activities, are likely to come from the significant areas of fill required, primarily around Mary Crest, as well as at Bridge 8, the Te Horo SH 1 underpass.

There are a number of residences around Te Horo, primarily along School Road (see Figure 8-4) that will be relatively close to the construction process for both Expressway and the realigned Gear Road. However, it is considered that the mitigation measures set out in Section 9 will ensure that potential nuisance effects are minimised as far as practical.

There are also a few residences between Mary Crest and Te Hapua Road to the west of the Project (see Figure 8-4) which have the potential to be affected by dust from the construction of the new arterial road, if the mitigation measures described in Section 9 are not appropriately implemented.

However, in general it is considered that it is unlikely that there will be any dust nuisance associated with the construction along this section of the Project.

Figure 8-4 Sensitive Locations in Section 4



8.2 Combustion Emissions from Construction Vehicles

The construction of the Expressway will require a number of vehicles to operate along the length of the scheme for the duration that works occur. Based on the information provided in the Construction Methodology report, construction vehicles will make a contribution equivalent, on average, to between 32 and 131 additional vehicles per day, traveling in the area. Given that the base year traffic volumes are in the order of 16,000 AADT this increase, while resulting in a small increase in the level of combustion emissions in areas adjacent to where the works are occurring, will not give rise to ambient concentrations of pollutants that exceed the NES.

The use of appropriate mitigation measures as described in Section 9 will assist in minimising these emissions.

Mitigation of Construction Effects

This section of the report presents the potential mitigation measures that will be used to control the potential effects of discharges to air during the construction of the Project.

9.1 Construction Activities

9.1.1 General Activities

The construction activity associated with the Project has the potential to generate significant quantities of dust if unmitigated. Therefore, it is necessary to consider the mitigation measures that will be used to control the emissions, and then make an assessment of the potential effects based on the controlled emissions.

The mitigation measures that are contained in the following sections are consistent with the MfE GPG Dust. Ultimately these and other measures will form the basis of the CAQMP, a sub-plan of the Construction Environmental Management Plan (CEMP). A draft CAQMP has been developed as a separate document and will be submitted as part of the application.

The measures that are recommended to assist in the mitigation of air quality effects may include:

- Where practical, defining an area around construction activities where there is the potential to create dust effects and putting in place appropriate mitigation to minimise dust effects within that area;
- Developing location specific speed limits on haul roads in order to minimise dust emissions close to sensitive locations;
- Having a community liaison person who is available to deal with any concerns or complaints;
- Having a comprehensive complaints procedure;
- House cleaning service available for properties that are affected by dust;
- Temporary relocation of the residents of severely affected properties; and,
- Team dedicated to monitoring environmental effects.

It is also recommended that the weather station at Te Horo is utilised to provide wind data which can be used to assist with scheduling activities that have the potential to create significant dust emissions and to assist in the verification of any dust nuisance complaints. Data from this weather station will continue to be available on the internet, and the system can be configured to provide alerts to the construction managers when specific meteorological conditions such as wind speeds greater than 10 m/s occur, to aid in the mitigation process.

9.1.2 Earthworks

There will be considerable quantities of material excavated and placed as fill, as the Expressway, bridges, intersections and related structures are constructed. The following management measures are recommended to minimise dust emissions:

- Develop methods for the removal and stockpiling of topsoil during windy conditions in areas close to sensitive receptors;
- Develop guidelines for the operation of construction vehicles in areas close to sensitive receptors;
- Develop guidelines for the removal of potentially dusty cut or placement of fill material, such as sand and silts at locations close to sensitive receptors;
- Where cut material is to be utilised immediately as fill material, the haul distance should be minimised as far as practical;
- Where potentially dusty cut material is being transported for longer distances, the material should be dampened to avoid dust generation;
- Material that is placed in temporary stockpiles that should not be disturbed for more than three months will be vegetated or covered with hydroseed or mulch as soon as practicable;
- All finished cut batters will be vegetated or covered with hydroseed or mulch as soon as practicable;
- Watercarts should be available to control dust, with water supply available along the length of the construction;
- Wheel washes should be installed to prevent the transportation of material onto sealed surfaces where the material can become a source of dust emissions; and
- As appropriate dust suppression chemicals can be applied to roads using watercarts and work by bonding dust particles together to prevent them from becoming airborne and causing dust nuisance effects. The effectiveness of this type of dust suppression is limited during periods where the haul road is heavily used. Therefore it is more effective to apply the dust suppression during weekends when low numbers of vehicles are using the haul roads. This will help to minimise wind erosion and the associated dust nuisance effects, during periods where the haul road is not used.

9.1.3 Odour Mitigation

Based on the investigations to date no specific odour sources have been identified. However the potential exists that odour sources such as septic tanks or offal pits may be encountered during the construction process. Therefore it is appropriate for the CAQMP to contain mitigation measures to deal with this potential in the event that it is encountered.

The following are the measures that will be in place to deal with such an event:

- Material will be transported from the site to an appropriate facility for disposal as soon as practicable. Trucks used to transport the material will be covered by a tarpaulin or clean soil/fill to reduce the potential odour effects as the material is being disposed of;
- Develop guidelines for the excavation of odorous material in areas close to sensitive receptors;
- Minimising the open areas of excavations as much as practicable at all times, including ensuring that odorous sources are covered or temporarily backfilled when not excavating; and
- Having the ability to use an odour masking agent or deodoriser such as “Power Green”, on to the surface of odorous material as it is encountered. The deodoriser can be applied by a worker using a back-pack pressurised sprayer.

9.1.4 Stockpiled Material

As the Project is constructed, there will be quantities of material excavated and placed as fill. The following management measures are recommended to be used to minimise dust emissions from stockpiles:

- Develop guidelines for the removal and stockpiling of topsoil during windy conditions at locations close to sensitive receptors;
- The size and height of stockpiles should be kept to a minimum;
- Using water to control dust where practicable and appropriate;
- Installation of wind breaks around large stockpiles; and
- Locate stockpiles as far as practical from sensitive receptors.

9.1.5 Construction Yards

There will be a number of construction yards associated with the Project, with the main yard proposed to be located near the Otaki River. These yards will be in the order of a hectare in size, and are likely to be metalled. Depending on the activity being undertaken in them, there may be the need to use water carts on occasions, or place fresh metal to control the potential for dust. If the main construction yard is used for activities such as aggregate processing or construction of precast concrete components, then additional mitigation measures will be required such as:

- Storing fine aggregate in bunkers;
- Use water to control dust on any crushing or screening plant;
- Keeping the size of stockpiles to a minimum;
- Minimising the drop height of material on to the stockpile; and
- Sheltering transfer points and conveyor belts.

9.2 Construction Vehicles

While there are unlikely to be significant emissions associated with the construction vehicles, it is possible through the use of appropriate maintenance to minimise vehicle-related emissions. The measures that would typically be used include, but are not limited to:

- Appropriate and regular engine maintenance;
- Ensuring that tyres are inflated to the correct pressure;
- Ensuring that haulage distances are kept as small as possible;
- Ensuring that the haul roads are appropriately maintained; and
- Ensuring vehicles are not overloaded.

9.3 Construction Monitoring

This section outlines the monitoring that is proposed as part of this project.

9.3.1 Wind Monitoring

A weather station is located at Te Horo which is approximately the middle of the scheme. This site will be configured to collect data automatically and display it on a website. This station will be used to identify when wind speeds exceed specific trigger values that can result in increased dust generation (average wind speeds in excess of 5 m/s or wind gust speeds in excess of 10 m/s). This information will be provided via text or email alerts to key individuals such as the Site Engineers and Environmental Manager so that they can implement appropriate mitigation measures.

9.4 Visual Monitoring

Table 9-1 outlines the dust monitoring programme that is to be implemented during the construction process. The frequency of the monitoring is defined but in the instance of strong winds (gust wind speeds greater than 10 m/s), discharges of dust that cross the site boundary or receipt of a complaint, the monitoring programmes will be undertaken more regularly.

Table 9-1 Dust Monitoring Programme

Monitoring Activities	Frequency
Check weather forecasts for strong winds and rainfall to plan appropriate dust management response (7 day forecasts available on www.metvuw.co.nz)	Daily
Inspect land adjacent to the site, construction exits and adjoining roads for the presence of dust deposits.	Daily
Observe weather conditions, wind via observations and data outputs from weather stations and presence of rain.	Daily and as conditions change
Inspect all unsealed surfaces for dampness and to ensure that surface exposure is minimised.	Daily and as conditions change
Inspect stockpiles to ensure enclosure, covering, stabilisation or dampness. Ensure stockpile height is less than 3 m or appropriately stabilised.	Weekly and at times of expected high winds
Inspect dust generating activities to ensure dust emissions are effectively controlled.	Daily and as new activities are commenced
Inspect watering systems (sprays and water carts) to ensure equipment is maintained and functioning to effectively dampen exposed areas	Weekly
Additional monitoring of dust generating activities and water application rate.	In winds over 5 m/s (11 knots or a Beaufort scale number of 3)
Inspect site access and egress points to ensure effective operation of wheelwash/truckwash systems and/or judder bars (if installed).	Weekly
Ensure site windbreak fences, if used, are intact.	Weekly

Assessment of Effects from the Operation of the Project

10.1 Assessment of Environmental Effects from Vehicle Emissions

This section of the report presents the results of the road traffic pollution dispersion modelling assessment and discusses the potential for effects. As discussed previously, five modelling scenarios were assessed to determine the concentrations of air pollutants in areas near to the existing SH 1 and the Expressway.

The results indicate that the highest concentrations for the future scenarios are expected for the year 2021, with a slight reduction in concentrations expected over the following ten years to 2031. This reduction in concentrations is due to a decrease in vehicle emissions expected as vehicle emission control technologies improve. This decrease in emissions is slightly offset by the small increase in vehicle traffic expected over this period, however overall the reduction is still significant. Therefore the results of modelling for 2031 have not been considered any further, although they have been presented in tables within this section for completeness. The only exception to this is that in 2031 traffic flows during peak holiday periods are predicted to reach a critical level, where flow breakdown is expected on the Expressway and traffic may have to cue. For this reason only the 2031 holiday traffic congestion scenario has been presented.

10.2 Section 1: North Otaki to South Otaki

NO_2, CO and PM_{10} concentrations were predicted for areas within 200 m of the existing SH 1 and the Expressway at the township of Otaki for each of the scenarios, Base Year, 2021 'Without Project' and 'With Project' and 2031 'Without Project' and 'With Project'.

The location of the discrete receptors is shown on figures in the following sections to allow for comparison of predicted concentrations with their relative location.

10.2.1 Nitrogen Dioxide – 99%ile 1-hr Average Concentrations

The results of 1-hr NO_2 modelling are presented in Table 10-1, Figures 10-1, 10-2 and 10-3.

Table 10-1 Predicted 99.9%ile 1-hr NO_2 (Excluding Background) at Otaki

Receptors		Base Year 2010 (µg/m³)	Without Project (µg/m³)		With Project (µg/m³)		Significance of Change (+ve, NC, –ve)[40]	
			2021	2031	2021	2031	2021	2031
1	286 Main Hwy	127	67	65	41	41	–ve	–ve
2	Otaki Motel	81	65	63	32	34	–ve	–ve
3	270A Main Hwy	52	57	53	28	28	–ve	–ve
4	56A Rahui Road	9	13	11	14	11	NC	NC
5	153 Main Hwy	66	52	52	34	34	NC	NC
6	Otaki College	8	6	6	5	5	NC	NC
7	239 Main Hwy	47	31	30	17	19	NC	NC
8	Highway Baptist Church	42	45	43	19	20	NC	NC
9	Former Rahui Milk Treatment Station	23	25	23	24	22	NC	NC

[40] The 'significance of change' criteria is explained in Section 3.4

10 Assessment of Effects from the Operation of the Project

Based on the 2021 traffic data the Project will reduce the number of vehicles using the existing SH 1/Mill Road intersection by a factor of 2.3. This reduction in traffic flow, from the opening of the Expressway, along with improvements in vehicle emission technology, will significantly reduce NO_2 emissions and concentrations around the intersection and at locations adjacent to the existing SH 1. This is evident when looking at Table 10-1 which indicates a reduction in 99%ile 1-hr average NO_2 concentrations at two receptors, 286 Main Hwy and the Otaki Motel, both located within 50 m of the intersection.

A reduction in 99%ile 1-hr average NO_2 concentrations is also predicted at properties located alongside the existing SH 1 to the southwest of the intersection. The reduction in concentration at these locations is caused by a decrease in vehicle traffic volumes and improvements in vehicle fleet emissions.

Concentrations of 99%ile 1-hr average NO_2 at Otaki College are not expected to significantly change from existing levels for either the ‘Without Project’ or ‘With Project’ scenarios. This is because the college is located at a sufficient distance from the existing SH 1 and the Expressway that vehicle emissions from these sources will have little effect on ambient concentrations at this location.

The ‘With Project’ scenario will result in a small increase in 99%ile 1-hr average NO_2 concentration in areas located within 200 m of the Expressway to the east of Otaki. However these increases are considered to be minor.

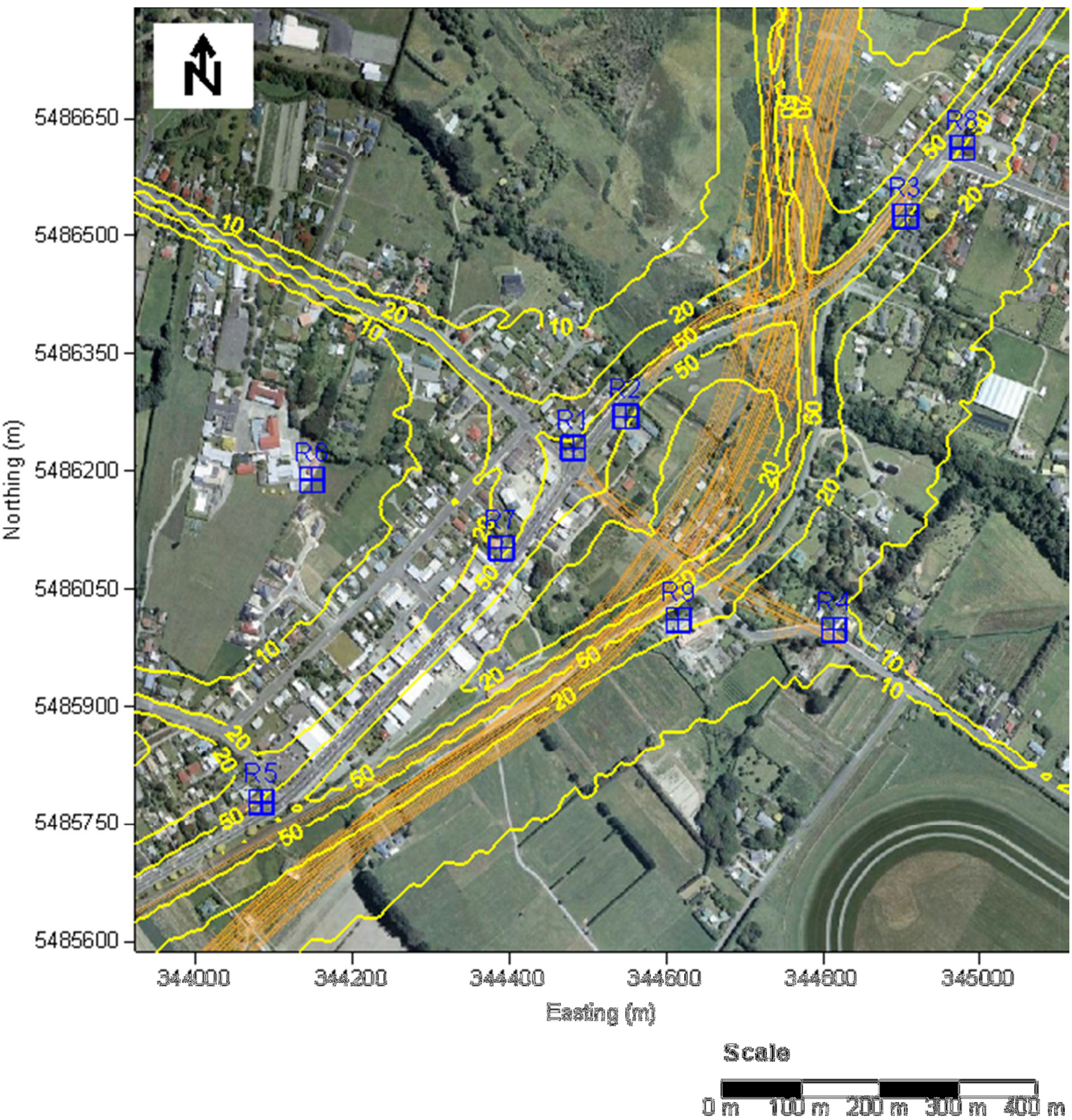
As discussed in Section 5.4.3, the average 1-hr background NO_2 concentration is likely to be approximately 10 µg/m³ with a maximum 1-hr average of 53 µg/m³. Even assuming that worst-case predicted concentrations from vehicle emissions coincide with the maximum background concentration of 53 µg/m³, predicted concentrations at all of the receptor locations for the ‘Without Project’ and ‘With Project’ scenarios are expected to be well below the 1-hr NES of 200 µg/m³.

Figure 10-3 compares the ‘Without Project’ and ‘With Project’ options for the year 2021. The figure presents changes in concentrations, as ‘With Project’ concentrations subtracted from ‘Without Project concentrations’ with values either being either improvements (‘–ve‘ green contour lines, reductions with Project) or degradation (‘+ve’ red contour lines, increases with Project). The figure shows a reduction in concentrations at locations close to the existing SH 1, particularly around the SH 1/Mill Road intersection. An increase in concentrations is predicted at locations close to the Expressway (e.g. within 200 m). However this increase is not significant and is unlikely to result in exceedances of relevant air quality assessment criteria.

URS has also assessed the potential effect for high concentrations of pollutants associated with holiday traffic, particularly congestion events associated with the merging of traffic and consequential flow breakdown at the end of the Expressway, north of Otaki. The results of modelling show that there will be increases in ambient concentrations at locations close to the proposed route, above those predicted for normal worst-case operation. However ambient concentrations are predicted to be below the air quality assessment criteria of 200 µg/m³, with the highest concentration predicted at the Former Rahui Milk Treatment Station of 129 µg/m³ as a 1-hr average including background (76 µg/m³ excluding background).

10 Assessment of Effects from the Operation of the Project

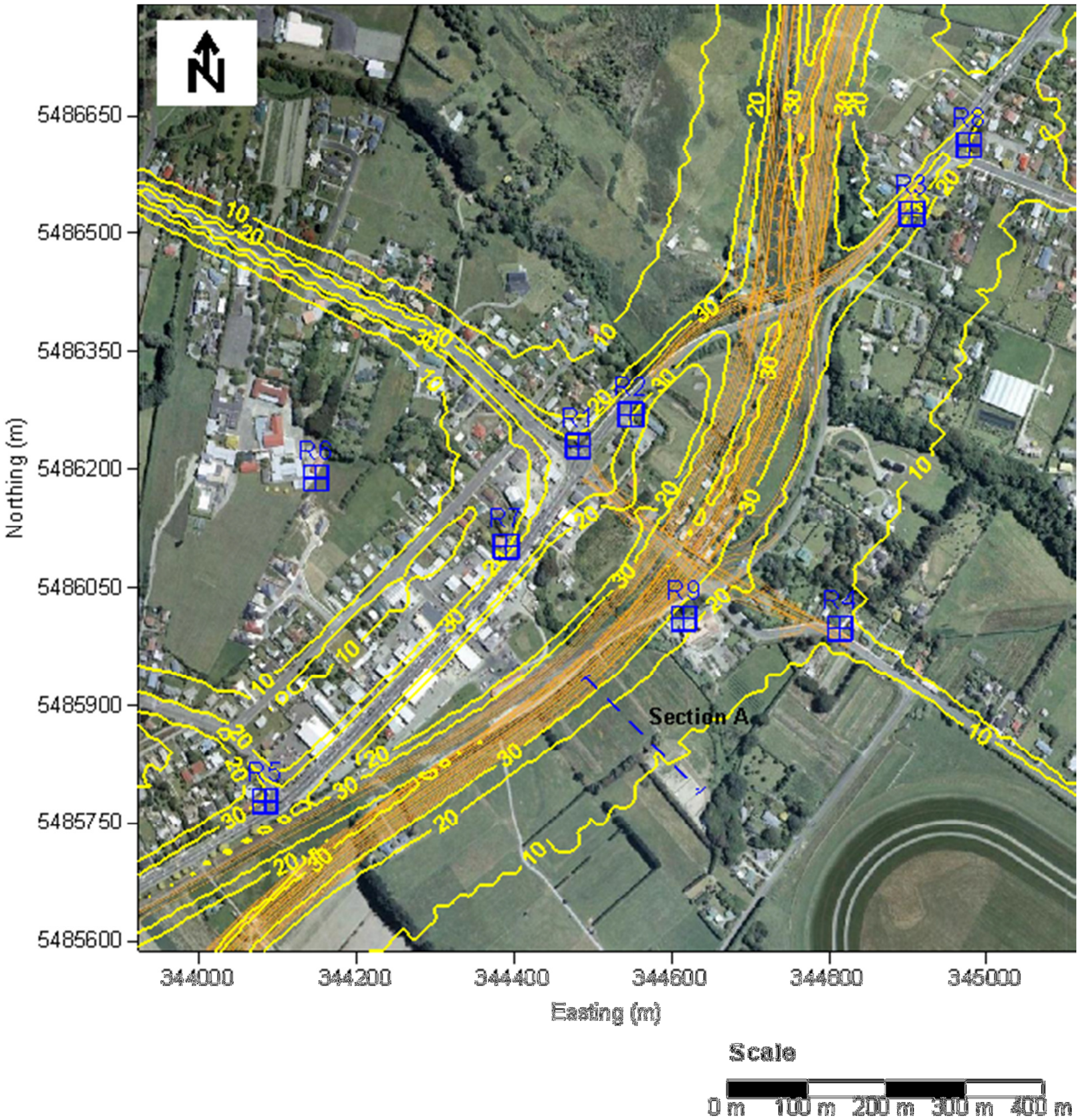
Figure 10-1 Otaki - Predicted 99.9%ile 1-hr NO_2 Concentrations (Excluding Background) - 2021 Without Project



Note: Sensitive receptor locations are shown on figures in this section of the report as blue cross-haired boxes. Section 5.2 provides information on the selection of these receptors.

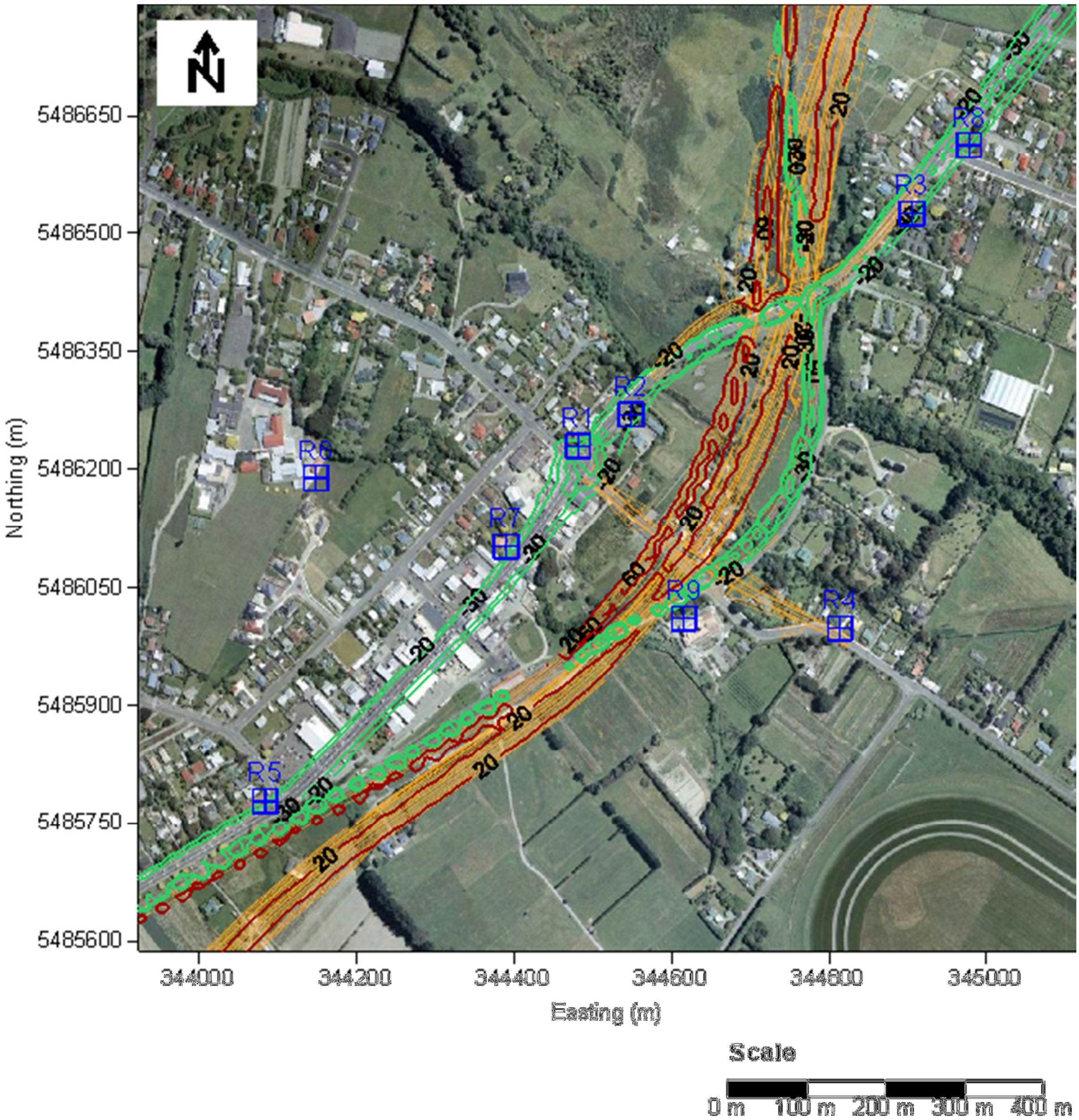
10 Assessment of Effects from the Operation of the Project

Figure 10-2 Otaki - Predicted 99.9%ile 1-hr NO_2 Concentrations (Excluding Background) - 2021 With Project



10 Assessment of Effects from the Operation of the Project

Figure 10-3 Comparison of 'Without Project' and 'With Project' Scenarios for 2021) Predicted 99%ile 1-hr NO_2 Concentrations[41]

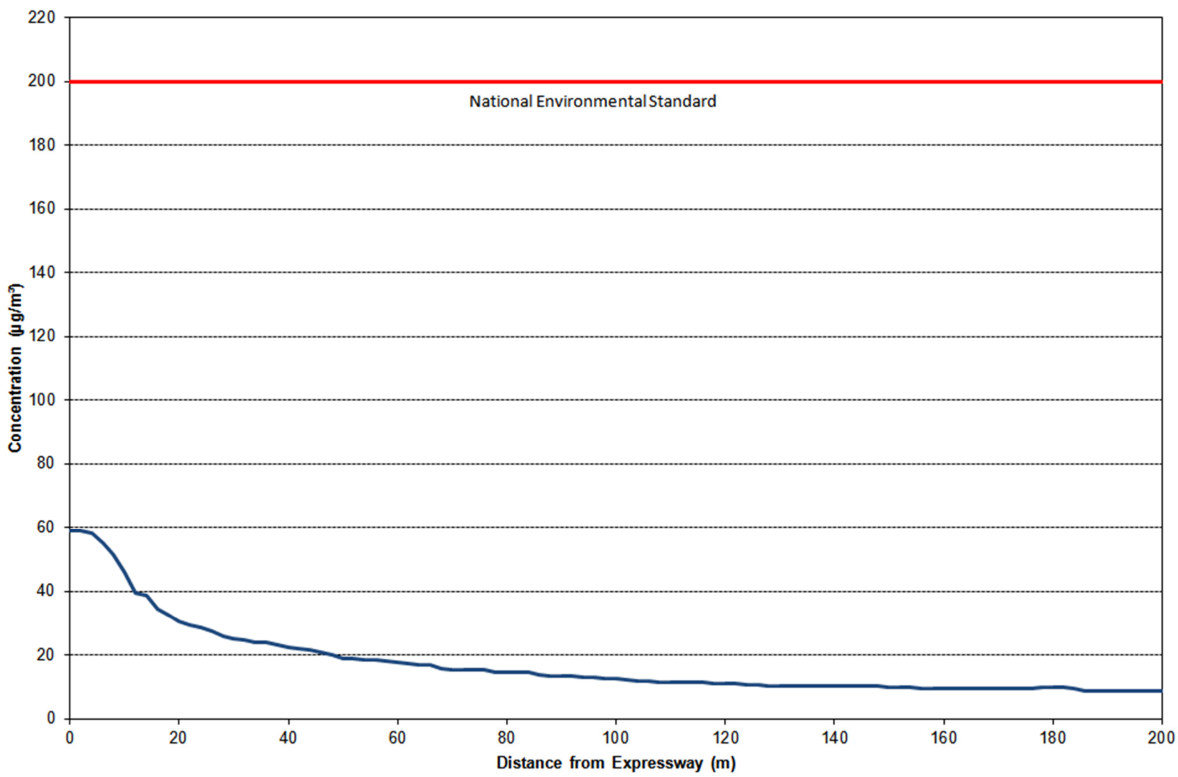


[41] The figure presents changes in concentrations, as 'With Project' concentrations subtracted from 'Without Project concentrations' with values either being either improvements ('–ve' green contour lines, reductions with Project) or degradation ('+ve' red contour lines, increases with Project)

10 Assessment of Effects from the Operation of the Project

The results presented in Table 10-1 indicate that none of the receptors assessed are likely to be adversely affected by 99%ile 1-hr average NO_2 concentrations. However if a receptor is located within approximately 100 m of the Expressway it is likely that there will be a small increase in concentrations. This is shown graphically in Figure 10-4 which presents a typical cross-section taken at Section A on Figure 10-2 of 99%ile 1-hr average NO_2 (Excluding Background) concentrations for the Expressway for the 2021 'With Project scenario' with traffic travelling at highway speeds. The figure shows that 99%ile 1-hr average NO_2 concentrations are approximately 60 µg/m³ at the roadside, well below the assessment criteria of 200 µg/m³. Concentrations then drop to 20 µg/m³ at a distance of approximately 50 m and are near background levels within 200 m.

Figure 10-4 Cross Section 99%ile NO_2 Concentrations for 2021 'With Project'



10.2.2 Nitrogen Dioxide – 24-hr Average Concentrations

Predicted 24-hr NO_2 concentrations (excluding background) at each of the sensitive receptor locations are presented in Table 10-2.

Even when the maximum predicted 24-hr background concentration of 27 µg/m³ is added to the predicted road contribution, cumulative concentrations at all locations are well below the NZAAQG of 100 µg/m³ for all of the future scenarios considered, with the highest cumulative concentrations being 53 µg/m³ for the 'Without Project' scenarios and 43 µg/m³ for the 'With Project' scenarios. Changes in the concentration of 24-hr average NO_2 as a consequence of the implementation of the Project show a reduction in concentrations at locations close to the existing SH 1 with no significant increases at locations close to the Expressway.

Table 10-2 Predicted 24-hr NO_2 (Excluding Background) at Otaki

Receptors		Without Project (µg/m³)		With Project (µg/m³)		Significance of Change (+ve, NC, –ve)	
		2021	2031	2021	2031	2021	2031
1	286 Main Hwy	26	26	15	16	–ve	–ve
2	Otaki Motel	22	21	11	11	–ve	–ve
3	270A Main Hwy	20	19	10	10	–ve	–ve
4	56A Rahui Road	7	6	7	6	NC	NC
5	153 Main Hwy	22	22	14	14	–ve	–ve
6	Otaki College	3	2	2	2	NC	NC
7	239 Main Hwy	12	11	7	8	–ve	NC
8	Highway Baptist Church	17	17	7	8	–ve	–ve
9	Former Rahui Milk Treatment Station	14	13	11	10	NC	NC

In summary, the change in ambient NO_2 concentrations from the operation of the Expressway are either positive or are not considered significant in Otaki, based on the significant criteria for incremental analysis contained in Section 3.4.

10.2.3 Carbon Monoxide – 8-hr Average Concentrations

Table 10-3 presents the predicted 8-hr average CO concentrations, excluding background, for all of the modelled scenarios and also shows the significance of any predicted changes in CO concentrations. For the 'Without Project' scenario the concentrations are predicted to be below relevant air quality guidelines with the highest concentrations predicted around the existing SH 1/Mill Road intersection at receptors 286 Main Hwy and Otaki Motel. For the 'With Project' Scenario the construction of the Expressway is expected to cause a reduction in CO concentrations near the intersection and a small increase in congestion emissions in areas located adjacent to the Expressway. The increase expected in these areas is likely to be relatively small due to the higher Expressway speed (100 km/hr), and consequently lower emissions, when compared to the lower average speed for vehicles at the existing SH 1/Mill Road intersection.

URS has estimated the maximum 8-hr average background concentration of CO within the assessment area to be 1.6 mg/m³. Even when the road contribution is added to worst-case background concentrations predicted concentrations are well below the NES of 10 mg/m³, as an 8-hr average. Given the very low concentrations predicted, it is considered unnecessary to present predicted 1-hr average concentrations of CO.

In summary, the change in ambient CO concentrations from the operation of the Expressway are negligible, well below the assessment criteria and will not result in any health effects.

Table 10-3 Maximum 8-hr CO Concentrations (Excluding Background) at Otaki

Receptors		Base Year 2010 (mg/m³)	Without Project (mg/m³)		With Project (mg/m³)		Significance of Change (+ve, NC, –ve)	
			2021	2031	2021	2031	2021	2031
1	286 Main Hwy	2.7	0.4	0.3	0.2	0.1	NC	NC
2	Otaki Motel	1.2	0.3	0.2	0.1	<0.1	NC	NC
3	270A Main Hwy	0.6	0.2	0.2	0.1	<0.1	NC	NC
4	56A Rahui Road	<0.1	<0.1	<0.1	<0.1	<0.1	NC	NC
5	153 Main Hwy	0.70	0.2	0.1	<0.1	<0.1	NC	NC
6	Otaki College	<0.1	<0.1	<0.1	<0.1	<0.1	NC	NC
7	239 Main Hwy	0.5	0.1	0.1	<0.1	<0.1	NC	NC
8	Highway Baptist Church	0.5	0.2	0.1	<0.1	<0.1	NC	NC
9	Former Rahui Milk Treatment Station	0.1	<0.1	<0.1	<0.1	<0.1	NC	NC

10.2.4 PM_{10} – 24-hr Average Concentrations

The highest predicted 24-hr average and annual PM_{10} concentrations were found to be near the existing SH 1/Mill Road intersection as shown in Table 10-4 for the 'Without Project' Scenario. The construction of the Expressway is predicted to reduce the concentrations on the existing SH 1 and in areas near to the intersection. This is shown in Table 5-4 as a '–ve' change at receptors located at 286 Main Hwy, Otaki Motel and the Highway Baptist Church.

Assuming that the highest predicted PM_{10} concentrations for the either the 'Without Project' Scenario or 'With Project' Scenario are experienced at the same time as maximum background values the concentration of PM_{10} are likely to be well below the NES guideline of 50 µg/m³.

Table 10-4 Maximum 24-hr PM_{10} Concentrations (Excluding Background) at Otaki

Receptors		Base Year 2010 (µg/m³)	Without Project (µg/m³)		With Project (µg/m³)		Significance of Change (+ve, NC, –ve)	
			2021	2031	2021	2031	2021	2031
1	286 Main Hwy	16	8	8	4	3	–ve	–ve
2	Otaki Motel	11	5	6	2	2	–ve	–ve
3	270A Main Hwy	7	4	5	2	2	NC	–ve
4	56A Rahui Road	1	1	1	2	1	NC	NC
5	153 Main Hwy	7	5	6	3	3	NC	–ve
6	Otaki College	1	1	1	1	1	NC	NC
7	239 Main Hwy	6	3	3	1	1	NC	NC
8	Highway Baptist Church	5	4	4	1	1	–ve	–ve
9	Former Rahui Milk Treatment Station	2	3	3	2	2	NC	NC

10.2.5 PM_{10} – Annual Average Concentrations

Table 10-5 presents the annual average PM_{10} concentrations at the selected sensitive receptor locations for the future scenarios. The results show that the contribution of PM_{10} from vehicles is small in comparison with background values. Even when road contribution is added to the existing background concentration of 14 µg/m³ all cumulative concentrations are below the NZAAQG of 20 µg/m³.

In summary, the change in ambient PM_{10} concentrations from the construction of the Expressway are either an improvement or not considered significant, based on the significant criteria for incremental analysis contained in Section 3.4.

Table 10-5 Annual PM_{10} Concentrations (Excluding Background) at Otaki

Receptors		Without Project (µg/m³)		With Project (µg/m³)		Significance of Change (+ve, NC, –ve)	
		2021	2031	2021	2031	2021	2031
1	286 Main Hwy	3	3	3	1	NC	–ve
2	Otaki Motel	2	2	2	1	NC	NC
3	270A Main Hwy	2	2	2	1	NC	NC
4	56A Rahui Road	1	1	1	1	NC	NC
5	153 Main Hwy	2	2	2	1	NC	NC
6	Otaki College	0	0	1	1	NC	NC
7	239 Main Hwy	1	1	1	1	NC	NC
8	Highway Baptist Church	1	1	1	1	NC	NC
9	Former Rahui Milk Treatment Station	1	1	0	1	NC	NC

10.3 Section 2: South Otaki to Te Horo

A modelling assessment of the Expressway at the South Otaki interchange has been undertaken in order to determine whether there was the potential for elevated concentrations of pollutants due to reduced dispersion effects associated with the below grade section.

NO_2 is considered to be a good indicator for assessing worst-case effects from other vehicle related pollutants, such as CO and PM_{10}, as it has the greatest potential to cause exceedances of air quality assessment criteria. Therefore for this section of the Expressway only NO_2 concentrations have been predicted.

10.3.1 Nitrogen Dioxide – 99%ile 1-hr Average Concentrations

The results of 99%ile 1-hr average NO_2 modelling are presented in Table 10-6. Refer to Figure 5-2 for receptor locations.

The results indicate that the implementation of the Project will only result in small changes (less than 10% of the relevant air quality assessment criteria) to 1-hr average NO_2 concentrations at receptor locations.

Even when the maximum predicted background concentration of 53 µg/m³ is added to the predicted road contribution, concentrations at all locations are well below the NES for all of the future scenarios considered, with the highest cumulative concentrations being 124 µg/m³ for the 'Without Project' scenarios and 113 µg/m³ for the 'With Project' scenarios. Both cumulative concentrations are well below the NES of 200 µg/m³.

Table 10-6 Predicted 99.9%ile 1-hr NO_2 (Excluding Background) at South Otaki

Receptors		Without Project (µg/m³)		With Project (µg/m³)		Significance of Change (+ve, NC, –ve)	
		2021	2031	2021	2031	2021	2031
1	53 Otaki Gorge Road	8	7	12	11	NC	NC
2	44 Otaki Gorge Road	7	7	11	9	NC	NC
3	34 Otaki Gorge Road	13	11	19	17	NC	NC
4	69 Otaki Gorge Road	7	7	11	9	NC	NC
5	1277 Addington Road	23	20	22	20	NC	NC
6	10 Addington Road	16	15	19	16	NC	NC
7	1229 Addington Road	71	64	60	52	NC	NC
8	1209 Addington Road	61	55	55	49	NC	NC
9	1199 Addington Road	56	50	51	46	NC	NC
10	36 Otaki Gorge Road	9	8	11	11	NC	NC

10.3.2 Other Pollutants

As the results of modelling indicate that 99%ile 1-hour average NO_2 concentrations will be below the NES it is considered that concentrations of CO and PM_{10} will also be below air quality assessment criteria.

10.4 Section 3: Te Horo

This section of the report discusses and presents the results of road traffic pollution dispersion modelling at Te Horo. NO_2 and PM_{10} were predicted in areas near to the existing SH and the Expressway at the settlement of Te Horo. Predicted CO concentrations were not presented for this assessment area as the contribution from vehicle traffic was found to be insignificant and assessment criteria is between 1 and 2 orders of magnitude higher than worst-case road contributions.

The location of the discrete receptors is shown on figures in the following sections to allow for comparison of predicted concentrations with their relative location.

10.4.1 Nitrogen Dioxide – 99%ile 1-hr Average Concentrations

The results of 99%ile 1-hr average NO_2 modelling are presented in Table 10-7 and graphically in Figures 10-5, 10-6 and 10-7.

Predicted 99%ile 1-hr average NO_2 concentrations for both the 'Without Project' and With Project' scenarios at Te Horo, including background, are well below the NES. The construction of the Expressway is likely to cause a reduction in concentrations on the western side of the main arterial road. This is shown in Table 10-7 as a negative change in NO_2 concentration at receptors Red House Café, 845, 961 and 937 SH 1.

Even when the maximum predicted background concentration of 53 µg/m³ is added to the predicted road contribution, concentrations at all locations are well below the NES for all of the future scenarios considered, with the highest cumulative concentrations being 127 µg/m³ for the 'Without Project' scenarios and 94 µg/m³ for the 'With Project' scenarios. Both cumulative concentrations are well below the NES of 200 µg/m³.

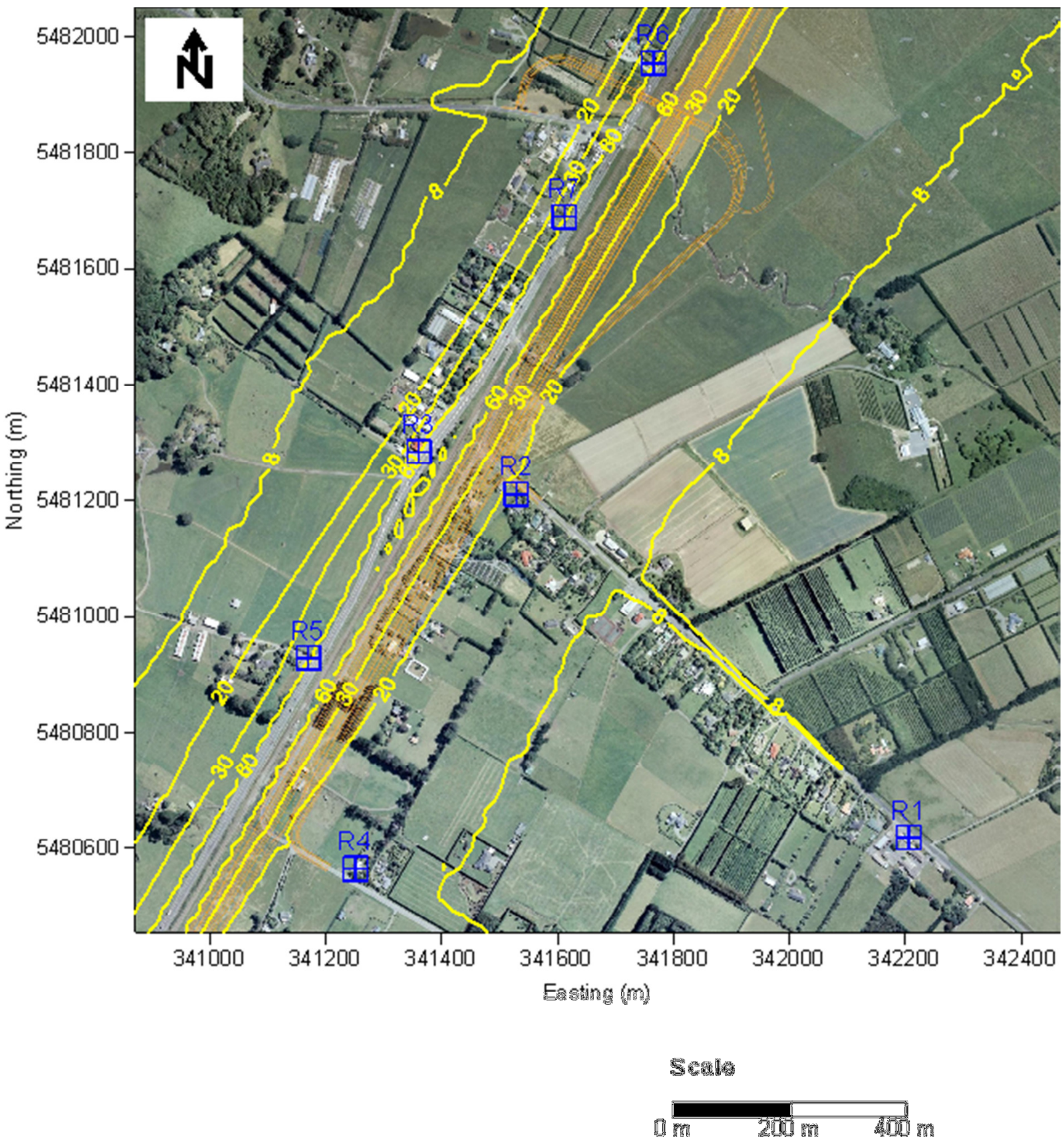
Figure 10-7 compares the 'Without Project' and 'With Project' options for the year 2021. The figure presents changes in concentrations, as 'With Project' concentrations subtracted from 'Without Project concentrations' with values either being either improvements ('–ve' green contour lines, reductions with project) or degradation ('+ve' red contour lines). The figure shows a reduction in concentrations on the western side of the main arterial road. A small increase is predicted in concentrations at locations close (<200 m) to the east of the Expressway, however this increase will not result in exceedances of relevant air quality assessment criteria.

Table 10-7 Predicted 99%ile NO_2 1-hr Concentrations (Excluding Background) at Te Horo

Receptors		Base Year 2010 (µg/m³)	Without Project (µg/m³)		With Project (µg/m³)		Significance of Change (+ve, NC, –ve)	
			2021	2031	2021	2031	2021	2031
1	Te Horo School	10	7	7	9	7	NC	NC
2	26 School Road	29	23	22	31	28	NC	NC
3	Red House Café	115	74	65	35	32	–ve	–ve
4	97 Gear Road	18	18	17	18	17	NC	NC
5	845 SH 1	76	68	62	41	39	–ve	–ve
6	961 SH 1	111	64	56	37	35	–ve	–ve
7	937 SH 1	122	65	55	35	33	–ve	–ve

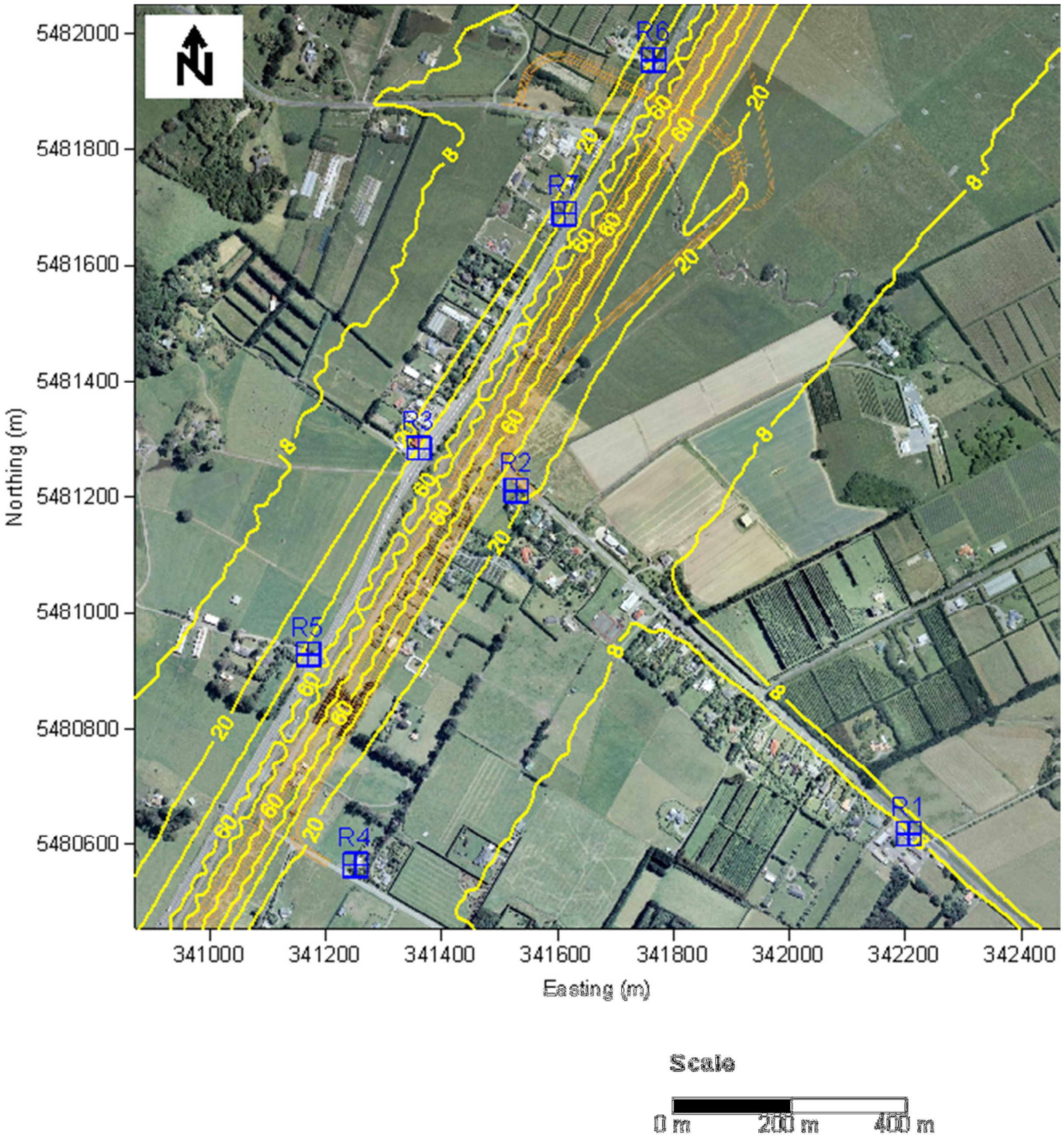
10 Assessment of Effects from the Operation of the Project

Figure 10-5 Te Horo - Predicted 99.9%ile 1-hr NO_2 Concentrations (Excluding Background) - 2021 Without Project



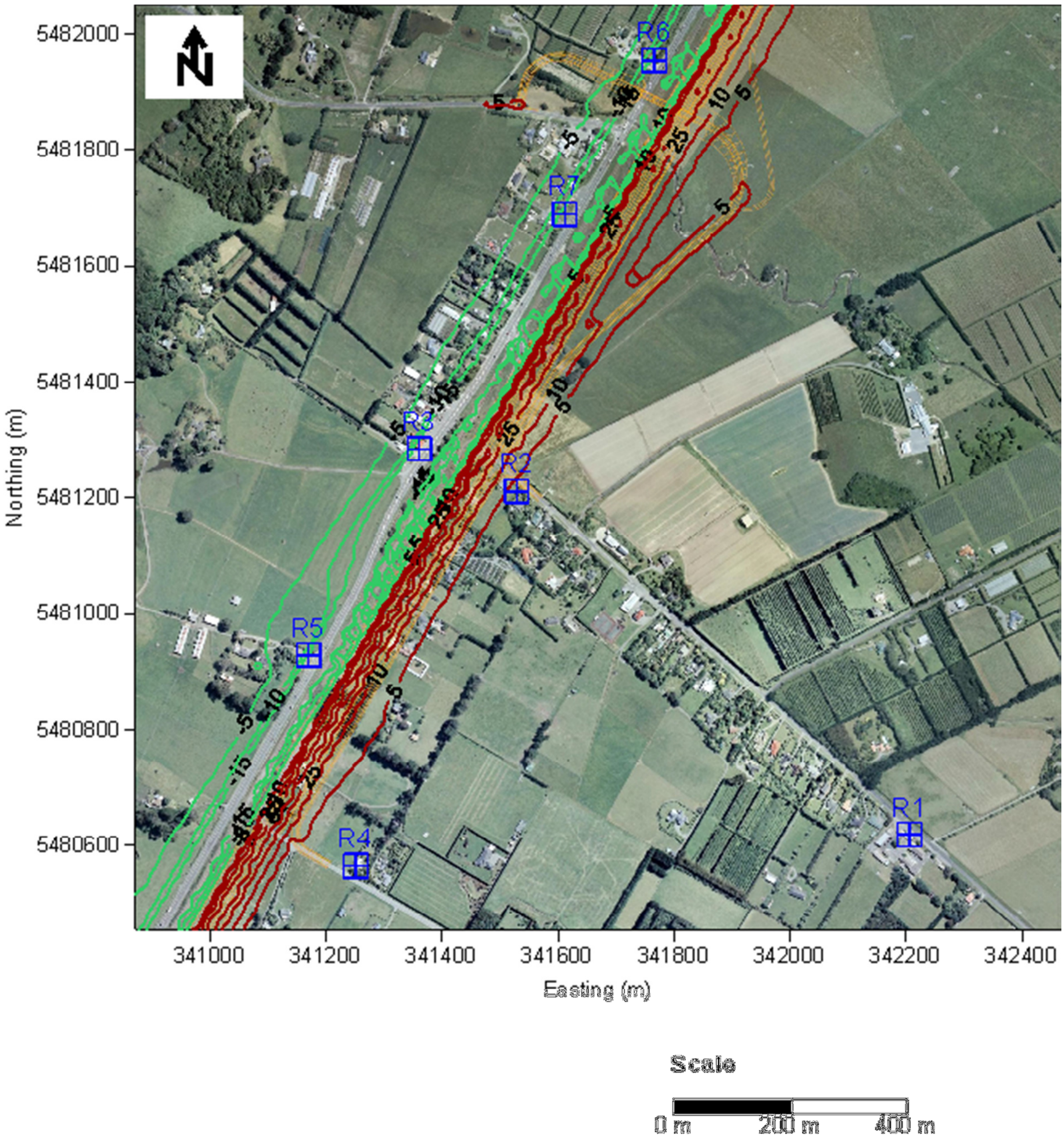
10 Assessment of Effects from the Operation of the Project

Figure 10-6 Te Horo - Predicted 99.9%ile 1-hr NO_2 Concentrations (Excluding Background) - 2021 With Project



10 Assessment of Effects from the Operation of the Project

Figure 10-7 Comparison of 'Without Project' and 'With Project' Scenarios for 2021) Predicted 99%ile 1-hr Concentrations)



10.4.2 Nitrogen Dioxide – 24-hr Average Concentrations

Predicted 24-hr average NO_2 concentrations (excluding background) at each of the selected sensitive receptor locations are presented in Table 10-8.

Even when the maximum predicted 24-hr background concentration of 27 µg/m³ is added to the predicted road contribution, cumulative concentrations at all locations are well below the NZAAQG of 100 µg/m³ for all of the future scenarios considered, with the highest cumulative concentration being 60 µg/m³ for the 'Without Project' scenario and 47 µg/m³ for the 'With Project' scenario. The results of modelling predict that once the Expressway is operational there will be a general improvement in NO_2 concentrations at Te Horo.

Table 10-8 Predicted Maximum NO_2 24-hr Concentrations (Excluding Background) at Te Horo

Receptors		Without Project (µg/m³)		With Project (µg/m³)		Significance of Change (+ve, NC, –ve)	
		2021	2031	2021	2031	2021	2031
1	Te Horo School	4	4	5	4	NC	NC
2	26 School Road	11	10	15	13	NC	NC
3	Red House Café	33	29	17	16	–ve	–ve
4	97 Gear Road	9	9	9	9	NC	NC
5	845 SH 1	31	28	20	19	–ve	–ve
6	961 SH 1	25	21	14	13	–ve	–ve
7	937 SH 1	31	26	17	16	–ve	–ve

10.4.3 PM_{10} – 24-hr Average Concentrations

Table 10-9 presents the 24-hr average PM_{10} concentrations for Te Horo which are predicted to be below the NES for both the 'Without Project' and 'With Project' scenarios, even when background concentrations are included. A significant reduction in concentrations is expected on the western side of the Project once it is completed. This is shown in Table 10-9 as a negative change in PM_{10} concentration at receptors Red House Café, 961 and 937 SH 1.

Concentrations at Te Horo School, for both scenarios, are not expected to significantly change, based on the significant criteria for analysis contained in Section 3.4, with predicted values well below the NES.

In summary the change in ambient 24-hr average PM_{10} concentrations from the construction of the Expressway are either an improvement or not considered significant, based on the significant criteria for analysis contained in Section 3.4.

Table 10-9 Predicted Maximum PM_{10} 24-hr Concentrations (Excluding Background) at Te Horo

Receptors		Base Year 2010 (µg/m³)	Without Project (µg/m³)		With Project (µg/m³)		Significance of Change (+ve, NC, –ve)	
			2021	2031	2021	2031	2021	2031
1	Te Horo School	1	1	1	1	1	NC	NC
2	26 School Road	3	3	2	3	3	NC	NC
3	Red House Café	11	7	7	4	3	–ve	–ve
4	97 Gear Road	2	2	2	2	2	NC	NC
5	845 SH 1	9	7	6	5	4	NC	NC
6	961 SH 1	11	6	4	3	3	–ve	NC
7	937 SH 1	12	7	5	4	4	–ve	NC

10.4.4 PM_{10} – Annual Average Concentrations

Table 10-10 presents the annual average PM_{10} concentrations at the selected sensitive receptor locations for the future scenarios. The results show that the contribution of PM_{10} from vehicles is not significant. Even when road contribution is added to existing background concentration of 14 µg/m³ all cumulative concentrations are well below the NZAAQG of 20 µg/m³.

Table 10-10 Annual PM_{10} Concentrations (Excluding Background) at Te Horo

Receptors		Without Project (µg/m³)		With Project (µg/m³)		Significance of Change (+ve, NC, –ve)	
		2021	2031	2021	2031	2021	2031
1	Te Horo School	0	0	0	0	NC	NC
2	26 School Road	1	1	1	1	NC	NC
3	Red House Café	2	2	1	1	NC	NC
4	97 Gear Road	1	1	1	1	NC	NC
5	845 SH 1	2	2	1	1	NC	NC
6	961 SH 1	2	1	1	1	NC	NC
7	937 SH 1	2	1	1	1	NC	NC

10.5 Section 4: Te Horo to Peka Peka

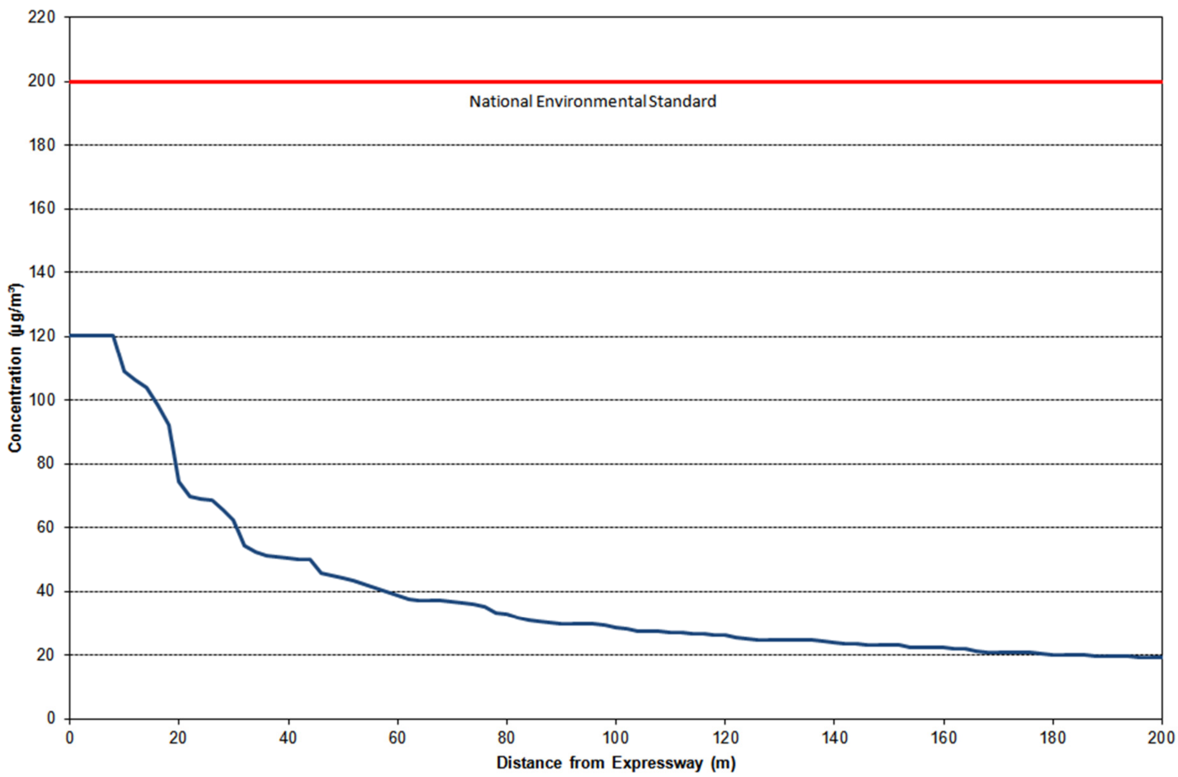
10.5.1 Nitrogen Dioxide – 99%ile 1-hr Average Concentrations

NO_2 concentrations were predicted within 200 m of the Expressway to determine the potential for any effects. CO concentrations were not presented for this assessment area as the contribution from vehicle traffic was found to be insignificant and assessment criteria is between 1 and 2 orders of magnitude higher than worst-case road contributions. PM_{10} concentrations were also not predicted for the assessment area as concentrations are expected to be insignificant given the low PM_{10} emission from vehicles travelling at highway speeds.

Figure 10-8 presents a cross section of predicted $NO_{2,}$ concentrations adjacent to the Expressway which are representative of those predicted between Te Horo and Peka Peka for the year 2021. Figure 10-9 shows the Expressway alignment between Te Horo and Peka Peka.

Figure 10-8 shows that concentrations of NO_2 are less than 125 µg/m³ at the roadside. Concentrations then drop to approximately 30 µg/m³ at 100 m and are close to background levels within 200 m. The concentrations predicted are higher than those presented in the cross-section from Otaki, as shown in Figure 10-4, where the maximum concentration was found to be approximately 60 µg/m³. This difference is due to the higher traffic volume expected on this section of the Expressway. The results indicate that concentrations are below the air quality assessment criteria of 200 µg/m³ and therefore no adverse effects are expected.

Figure 10-8 Cross Section of 99%ile 1-hr Average NO_2 Concentrations for 2021 'With Project'



10 Assessment of Effects from the Operation of the Project

Figure 10-9 Section 4 - Expressway Alignment between Te Horo and Peka Peka

10.5.2 Other Pollutants

As the results of modelling indicate that 99%ile 1-hour average NO_2 concentrations will be below the NES it is considered that concentrations of CO and PM_{10} will also be below air quality assessment criteria.

10.6 Regional Air Quality Effects

Given the small change in emissions associated with the Project, regional scale effects on the Kāpiti Coast airshed are considered to be insignificant and will not result in any further degradation of the airshed or non-compliances. In this regard the Project will not affect Greater Wellington Regional Council's ability to issue resource consents as prescribed by clauses 17(1) and 20 of the NES.

The improvements associated with the Expressway will result in a higher average speed and a reduction in travelling times for vehicles travelling between Peka Peka and Otaki, leading to a reduction in vehicle emissions. In addition, the relocation of vehicle traffic from the existing SH to the Expressway will result in significant reductions in roadside concentrations of air pollutants around the Mill Road / SH1 intersection.

Some of these improvements will be offset by the greater number of vehicles travelling along this section of highway, however increases in vehicle traffic flows are predicted regardless of whether the Project is implemented or not. Overall the Project is predicted to result in lower concentrations of air pollutants and exposure for residents within the project area, particularly at Otaki and Te Horo.

10.7 Summary of Effects from Vehicle Emissions Associated with the Project

Overall, following the opening of the Expressway, it is considered that the proposed alignment will result in an improvement in air quality within the assessment area. This is based on the following:

- The results of road traffic pollution dispersion modelling for the township of Otaki show that reductions in the concentration of vehicle air pollutants can be expected along the existing SH 1 and around the existing SH 1/Mill Road intersection. An increase in concentrations can generally be expected in areas located within 200 m of the Expressway, however this is expected to be minor and only likely to be experienced by a small number of receptors, due to location of the proposed Expressway alignment, which takes vehicle traffic to the east and away from the township of Otaki. Based on the concentrations predicted by the model these increases will not result in exceedances of air quality assessment criteria.
- The results of dispersion modelling of the South Otaki interchange section of Expressway show that the implementation of the Project is unlikely to cause significant increases in NO_2 concentrations or exceedances of relevant air quality assessment criteria in this area and concentrations are predicted to be well below air quality assessment criteria.
- The results of dispersion modelling for the settlement of Te Horo predict improvements in air quality, especially at locations on the western side of the main arterial road. A small increase in concentrations is expected in areas adjacent to the eastern side of the Expressway, however this increase is insignificant when compared to the overall improvements associated with the construction of the Project and will not result in any exceedances of relevant air quality assessment criteria.
- The results of dispersion modelling of the section of Expressway between Te Horo and Peka Peka indicate that NO_2 concentrations in areas close to the Expressway will be well below air quality assessment criteria.

Mitigation of Operational Emissions

11.1 Mitigation Options

No specific mitigation is recommended based on the results of this assessment as the contribution of air pollutants is not expected to cause any effects.

11.2 Post Project Air Quality Monitoring

The predicted contribution of vehicle pollutants associated with the implementation of the Expressway, above those predicted for 'without project' scenarios, is considered to be negligible. It is therefore considered unnecessary to undertake any post-project air quality monitoring.

12 Consultation

Extensive community consultation has been undertaken as part of this project. This is discussed in Volume 2 Part F, Chapter 11, Consultation and Engagement of the AEE.

Summary and Conclusions

13.1 Assessment of Effects from the Construction of the Expressway

The primary potential air discharge from the construction of the Expressway will be dust. Generally, properties located within 100 m of construction activities could be affected and mitigation will be required.

A number of mitigation measures have been recommended to reduce the potential for dust emissions. These measures are contained in the draft CAQMP and include:

- speed restrictions on construction vehicles operating near sensitive receptors;
- where practical, defining an area around construction activities where there is the potential to create dust effects and putting in place appropriate mitigation to minimise dust effects within that area;
- use of water tankers to dampen surfaces that have the potential to create dust: and,
- finished cut batters will be vegetated or covered with hydroseed or mulch as soon as practicable.

There will also be minor emissions (exhaust fumes) from construction vehicles. These are not considered significant due to the relatively small number of vehicles that will be operating during the construction period.

13.2 Assessment of Effects from Vehicle Emissions

The assessment has predicted ambient concentrations of nitrogen dioxide (NO_2), carbon monoxide (CO) and PM_{10} from vehicle emissions within the project area for the opening year (2021) and the design year (2031). The results of the assessment indicate that a reduction in concentration can be expected between 2021 and 2031 for the pollutants assessed. This reduction in concentrations is primarily due to a decrease in vehicle emissions as a result of improvements in vehicle emission technologies.

The results of road traffic pollution dispersion modelling indicate that small reductions in the concentration of vehicle air pollutants can be expected in the township of Otaki along the existing SH 1 and especially around the SH 1/Mill Road intersection. For both of the years assessed, concentrations are generally predicted to increase in areas located within 200 m of the Expressway. However, this increase is minor and likely to only be experienced in a small area due to the location of the proposed Expressway alignment, which takes vehicle traffic to the east and away from the majority of the township of Otaki. Regardless of the scale of any increase, predicted concentrations will remain well below relevant air quality assessment criteria.

An assessment was undertaken to determine whether there was the potential for elevated concentrations of pollutants due to reduced dispersion effects associated with the below grade section. The results of road traffic pollution dispersion modelling showed that the Project is unlikely to cause significant increases in NO_2 concentrations or exceedances of relevant air quality assessment criteria in this area.

The results of dispersion modelling for the settlement of Te Horo predict improvements in air quality, especially at locations on the western side of the main arterial road. A small increase in

13 Summary and Conclusions

concentrations is expected in areas adjacent to the eastern side of the Expressway, however this increase is expected to be minor when compared to the overall improvements associated with the construction of the Project and will not result in exceedances in air quality assessment criteria.

NO_2 concentrations within 200 m of the Expressway between Te Horo and Peka Peka were found to be below air quality assessment criteria.

Overall, the Expressway will improve air quality in the project area as a result of improved traffic flows which corresponds to reduced traffic emissions.

14 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 Opus Consultants Limited and only those third parties who have been authorised in writing by URS to rely on the report.

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 contract dated July 2010.

Where this Report indicates that information has been provided to URS by third parties, URS has made no independent verification of this information except as expressly stated in the Report. URS assumes no liability for any inaccuracies in or omissions to that information.

This report was prepared in August 2012 and February 2013 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.

Glossary

Note: The definitions presented in the Glossary below have been taken from the Draft NZTA Standard to assessing air quality effects for State highway asset improvement projects.

AAQG	MfE Ambient Air Quality Guidelines
AEE	An assessment of environmental effects is a statutory assessment of the social and environmental effects and measures to avoid, remedy and mitigate these as required under the Resource Management Act and other relevant legislation.
NES	National Environmental Standards for Air Quality, which set standards for ambient air quality for key air pollutants to protect health. The AQNES apply to any location outdoors where people are likely to be exposed. The full title is *Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins, and Other Toxics) Regulations 2004*.
Background Air Quality	Background refers to existing air quality 'without project'. It is usually estimated for the current year, the opening year and the design year and may be separated into 'non-road' and 'existing road' to differentiate the contributions of these sources from the contribution of the 'new road'. Some practitioners refer to this as 'baseline' but this Standard recommends the term 'background'. Background should also not be confused with 'natural' sources of air pollution, e.g. sea salt or wind blown dust.
CO	Carbon monoxide, an air pollutant produced from incomplete combustion of fuels, e.g. diesel and petrol used in transport. CO can cause health effects such as asphyxia.
CO_2	Carbon dioxide, a greenhouse gas produced from the combustion of fossil fuels used in transport.
Concentration	The amount of a substance in a mixture. The concentration is usually proportional to the observable intensity of effects. For air pollution, concentration is reported as either a volumetric measure (e.g. parts per million PPM or parts per billion PPB) or as a mass measure (e.g. milligrams per cubic metre mg/m^3 or micrograms per cubic metre $\mu g/m^3$).
Design year	The year in which traffic volumes are anticipated to reach a preselected level, usually taken to be 10 years after the completion of the State highway improvement.
Designation	A provision made in a district plan to give effect to a requirement made by a requiring authority (e.g. NZTA) for a public work, project or work.
Emission	The release of a substance (e.g. an air pollutant) from a source, (e.g. transport, industry or domestic fires). Emissions are often expressed in units per activity (e.g. grams per kilometre driven g/km or grams per kilogram fuel burnt g/kg).
Exceedance	An occasion when the concentration of an air pollutant exceeds a standard or

15 Glossary

	permissible measurement.
Existing	Air quality risk at the date of assessment carried out under this Standard for each link affected by the project.
MfE GPG Dust	MfE Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions
MfE GPG LT	Ministry for the Environment, Good Practice Guide for Assessing Discharges to Air from Land Transport
Link	In a road network, a portion of a road between two intersections, junctions, interchanges or nodes. Its basic characteristics are length, vehicle speeds, travel times and number of lanes.
LTMA	Land Transport Management Act 2003, whose purpose is to contribute to the aim of achieving an affordable, integrated, safe, responsive, and sustainable land transport system
MfE	Ministry for the Environment
MoT	Ministry of Transport
NO_2	Nitrogen dioxide, an air pollutant produced from the combustion of fossil fuels used in transport. NO_2 can cause health effects such as retarded lung development in children and increased susceptibility to lung infections.
Notice of requirement	A notice given by a requiring authority (e.g. NZTA) to a territorial authority (e.g. a city or district council) of the requiring authority's (e.g. NZTA's) requirement for a designation for a public work, project or work. A proposed designation is referred to as a requirement for a designation.
NZTA	The New Zealand Transport Agency is the agency responsible for the building and operation of New Zealand's State highway network, amongst other duties, since July 2008. Previously State highways were managed by Transit New Zealand.
NZTS	The New Zealand Transport Strategy sets the government's direction for transport to 2040. Its overarching vision is that "*people and freight in New Zealand have access to an affordable, integrated, safe, responsive, and sustainable transport system*".
Opening year	The year in which the State highway improvement is completed and opened for use.
PM_{10}	Fine particulate matter less than 10 µm in diameter, an air pollutant produced from the combustion of fossil fuels, primarily diesel, used in transport. PM_{10} can cause serious health effects such as increased cardio-respiratory illness and premature death. Although $PM_{2.5}$ is of increasing concern, because its emissions relate more directly to observed health effects, PM_{10} is commonly used in air quality assessments as it covered by an AQNES and more comprehensive monitoring

15 Glossary

records exist.

Receptor	A location where any person may be exposed to pollution from the road for 1-hr or more, irrespective of whether or not that person is considered to be sensitive to the effects of air pollution e.g. an industrial or commercial building.
RMA	Resource Management Act 1991, whose purpose is to promote the sustainable management of natural and physical resource
SAR	The scheme assessment report assesses the preferred option (and other options under consideration) against NZTA's social and environmental policy and objectives and legal requirements. It is used to determine and justify the option to be put forward to gain funding for design and construction. Included within the SAR is a social and environmental assessment (SEA) for the preferred option, the scale of which is appropriate to the scale of effects of the project.
Sensitive receptor	A location where people or surroundings may be particularly sensitive to the effects of air pollution e.g. retirement villages, aged care facilities, hospitals, schools, early childhood education centres, marae, other cultural facilities, and sensitive ecosystems.
Tier 1	The first stage of an air quality assessment – referred to as a preliminary assessment in this Standard – which is undertaken as part of the SES phase in NZTA's SEM process. A Tier 1 assessment is intended to indicate whether an air quality trigger is exceeded by any option under consideration.
Tier 2	The second stage of an air quality assessment – referred to as a screening assessment in this Standard – which is undertaken as part of the SEA phase in NZTA's SEM process. A Tier 2 assessment is intended to indicate whether an air quality guideline or standard is likely to be exceeded by the preferred option(s) under consideration.
Tier 3	The third and final stage of an air quality assessment – referred to as a detailed assessment in this Standard – which is undertaken as part of the AEE process in NZTA's SEM process. A Tier 3 is intended to provide a detailed assessment of the likely air quality impacts associated with the final design of the project.
TSP	Total suspended particulate, a measure of likely dust nuisance.
VOC	Volatile organic compounds are a group of air pollutants. In transport applications, VOCs are produced by the evaporation or combustion of fossil fuels and include a wide range of compounds. The ones of most concern in relation to State highway projects are benzene and 1,3-butadiene (both known or suspected carcinogens).

15 Glossary

Benzene is often used as an indicator for the other compounds.

With Project	The predicted air quality risk for each link affected by the Project at both the predicted opening year and the design year, with the Project implemented.
Without project	The predicted air quality risk for each link affected by the Project at both the predicted opening year and the design year, assuming no alterations are made to the existing road.